Universidad Continental

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III Congreso Internacional **de Tendencias en Innovación Educativa**

Proceedings



Universidad Continental, Perú
Del 9 al 11 de diciembre del 2020

Klinge Orlando Villalba-Condori | Jari Lavonen
Lung Hsiang Wong | Aman Yadav

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Editors

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Preface

CITIE 2020, focused on Post COVID-19 Digital Education, due to the context of the pandemic has been developed in a virtual way. CITIE promotes spaces for dialogue and reflection among teachers, managers and researchers related to education. This edition of CITIE has allowed the socialization of the trends and innovations that are manifesting themselves in diverse educational contexts. On this occasion there have been 80 manuscripts of which 36 were accepted for presentation, these are framed in the thematic areas of this edition:

- Digital Education.
- Trends in Education.
- Educational Innovation.

We understand that education is the only tool for change in society and these spaces of socialization, such as CITIE, favor this development.

December 2020 The editors.

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A literature review of the YouTube phenomenon and the teaching and learning practices

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Abstract. In the past decade, Internet platforms have undergone a steady and rapid growth. Within this context, their use by young people becomes significative. YouTube is not the exception to this phenomenon, furthermore, it has gained relevance both in quantitative and qualitative terms, that is, in the number of subscribers and visualizations, as well as in the variety of content that it offers. Thus, in order to widen the horizon and understand how young people experience the world, and based on the assumption that platforms are key spaces for this purpose, this work presents a literature review where the most relevant contributions regarding YouTube and its relation to the teaching and learning practices are collected. Finally, based on the vacancies we have identified, we present some considerations that stem from this analysis and offer some possible future lines of investigation.

Keywords: Teaching, Learning, YouTube, Online Audiovisual Content.

1 Introduction

Given the massive popularity of the Internet, the production of knowledge and its modes of circulation and consumption, along with the media in which it is objectified, are showing evidence of transformation [1]. These modes cause tension, not only in the process of production, but also in the modern institutions, which have historically been in charge of (re)producing it. Furthermore, there are many questions and

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tensions surrounding formal education[1], in particular, concerning the strategies associated to the production and transmission of knowledge as well as the actors involved in this process. On the other hand, both informal and nonformal[2] education are gaining ground in these processes of production and transmission and becoming acknowledged spaces for this purpose.

In this scenario, digital technologies in general, and platforms in particular, take the center stage. YouTube seems to be playing a leading role in this context, although this role is surely to expire soon. Nonetheless, given its relevance, it is worth exploring how the students from low-income sectors who attend technical schools access, use and perceive it in order to identify its usage and how they build an interaction between the needs arising from extracurricular concerns and those arising from formal education.

YouTube is an exclusive platform intended to produce, store, share, visualize and assess online audiovisual content (AVC) [2, 3]. Basically, "the site takes user-generated content to fill their catalogue, generate user traffic and attract advertisers") [4]. In addition, the AVC is produced by amateurs and professionals alike with various goals that range from "simply" sharing a production to its monetization [5]. However, quoting one of the most representative studies about this platform [6], this "participatory culture" is not free of tensions.

As for the users of the platform, it is interesting to note the intensive use that young people make of it. They consider YouTube a place where they are able to find any type of content [7] and thus, it is also perceived as a search engine to find educational content, preferring it over other services offered by big companies like Google or Bing [7, 8], In this sense, it would seem that a great percentage of young users are considering YouTube as the search engine by default.

Initially, YouTube was a platform intended to provide entertainment resources, however, the passing of time has seen a rise in the production, storage and circulation of audiovisual resources connected to learning and teaching [5]. Likewise, there has been an increase in the frequency in which this platform offers tutorials, recipes, step-by-step videos, repair and maintenance tips, and tricks to improve gaming. As a result, YouTube has become a reference for informal learning.

For young people, YouTube has become one of the most important learning environments and plays a major role in the media consumption —and sometimes,

[1] Formal education is considered to be "the highly institutionalized, chronologically graded and hierarchically structured, spanning lower primary school and the upper reaches of the university" [9].

[2] Informal education is considered "the lifelong process by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to the environment" and nonformal education is "any organized, systematic, educational activity carried on outside the framework of the formal system to provide selected types of learning to particular subgroups in the population, adults as well as children" [9].

production— of contents. YouTube constitutes the great school of "distance learning" of the new generations [7].

Generally speaking, young people's learning demand can be divided into two categories: a) those related to their every day, nonschool life, that arise from the things that motivate, affect and appeal to them, among others and b) the demand that is born within the system of formal education and from it. The starting point of this study is the assumption that both are subsidiary. Accordingly, we present a literature review where the most relevant contributions concerning YouTube, formal education and learning are collected.

This article is organized in the following sections. The first section constitutes the Introduction. Followed by a second section in which we present a literature review concerning YouTube and its relation to the teaching and learning practices. Finally, based on the vacancies we have identified, we present some considerations that stem from this analysis and offer some possible future lines of investigation.

2 YouTube and learning: an approach from the literature

The bibliography concerning the educational and extracurricular use of YouTube is prolific [10, 11, 12], [8], [13]. For this reason, a first distinction is made between the literature that provides a general description of the use and consumption by young people of the YouTube platform, and those studies that explore a possible connection between YouTube and their learning needs, from the perspective of both formal and informal education.

With reference to the first point, there is a series of investigations from different countries that describe the use and consumption of the platform by young users. In general, the studies suggest that these actors are avid users of the platform. They turn to YouTube to show themselves, share their likes and dislikes, develop socialization experiences, find entertainment and at the same time, learn new things [14, 15, 16], [12], [3].

In relation to the second point, that is, tracing the possible connections between YouTube and learning needs, from the perspective of formal or informal education, we have identified four major groups of studies:

a) those concerning YouTube and learning in general;
b) those considering the uses of YouTube and learning needs and interests;
c) those attempting to identify links between the uses of the platform and the needs and interests that stem from formal education and
d) those studies that describe the practices of the creators of educational content in YouTube (called edutubers).

Before going into this analysis, it's worth mentioning that in the course of this research and bibliographical analysis, we have additionally identified a group of studies concerning the didactic uses of the AVC in the classroom; in particular, investigations that examine and discuss the role that the AVC has in formal education

in general and in classrooms in particular things [10], [17, 18, 19, 20, 21, 22, 23]. Even though this bibliography bears no direct connection with the purpose of this study that is describing and analyzing the possible contributions of the AVC to the learning that takes place outside school hours and the school environment, we consider it relevant to measure the YouTube phenomenon and education in general.

As for the four major corpus, we identify a first group of studies that provides generic and quantitative information on the prevalent position of YouTube and learning. First, it is worth mentioning a report from Fundación Telefónica that suggests that eight out of ten young Spanish people turn to video for educational purposes, "a number that constitutes 96% and 94,6% of young adults between the ages of 14 and 19, and 20 and 24 years old respectively" [24]. A more recent study indicates that 97% of YouTube users in Argentina and Mexico consider these videos to be instructive because their content allows them to learn new things or solve problems. 40% of these users list YouTube as a source of inspiration [25]. According to a study carried out in Argentina in August of 2017, 59% of participating adults indicated that YouTube videos had helped them figure out how to do things or how to acquire new skills [26]. A study on education methodology, conducted with people ages 14 to 40 years old in Northamerica [27] suggests that these subjects are changing their preferences regarding their learning methods. In particular, young people between the ages of 14 and 23 claim that online YouTube videos are their preferred learning tool, followed by group activities, learning applications, interactive games and, in last place, textbooks.

The second corpus of literature describes the use of YouTube by young people in relation to their learning needs and interests. In higher education, it is worth mentioning the study of Moghavvemi and others [11], who confirms that entertainment, the search for information and academic learning are the most important motivators when it comes to using this platform. In particular, students consider that the AVC helps them answer questions and solve problems, thus, the resources are identified as a complementary learning tool.

In the secondary level, there is the work of Pires and others [8] that reveals, on one hand, that, in YouTube, young people learn based on a series of practices (learn by doing, problem solving, learning new things and answering questions) and, on the other hand, it identifies metaphors (MOOC, informal learning environment, search engines and tutorial repositories) that are used to describe the representations that young people make in connection to the educational uses and practices of the platform.[3]

Lastly, we identify a recent study conducted with Argentinian students attending the first year of technical school about the relation they have with digital technologies [28]. Regarding the AVC, it is noteworthy that the YouTube platform is heavily used

[3] The research has found five uses of YouTube: radio, tv, social, productive and educational. The study found that the majority of the uses are connected to the teenager's daily routines, in particular, the way in which they acquire the knowledge and develop their skills. In addition, a series of analogies were identified from analyzing certain elements of their discourse.

by students for different purposes, including studying and learning through tutorials about the things that motivate or affect them.

The third group of studies attempts to describe the uses that young people make of the AVC in the YouTube platform and, at the same time, describe its relationship with the needs and interests that arise from formal education. In the context of higher education, Nagumo and others [13] analyze the students' habits, how they use of these contents to complement their formal studies, and suggest four categories (content learning, content review, test preparation and audiovisual resources). Along these lines, Usaini and others [29] observe that YouTube is used for informal learning, as students say they learn a large number of topics not acquired in the process of formal education. More specifically, there is a study conducted with Indian students that examines the use of YouTube for educational purposes [30]. This study shows that the AVC not only helped the students in preparing assignments, presentation and seminars, but it also helped them to achieve a better educational outcome.

Regarding secondary education, Masanet and others [31] suggest that teenagers develop a close relationship with the media, including YouTube, and that they consider themselves to be "digital learners". Therefore, their practices are characterized by a "show, don't tell" logic, based on learning through imitation. Meanwhile, taking a closer look at the motivations that students have regarding the use of YouTube, a study conducted on students attending the 3º and 4º year of ESO in Spain [32] noted that "teenagers acknowledge the extensive didactic use of tutorial videos. Many conceive these recordings as a valuable aid to reinforce the curricular content developed in class, and even use it to pass their courses".

Finally, Bardakci [33] examines high school students' educational use of YouTube. He suggests that performance expectancy and social influence are the significant predictors of behavioral intention to use YouTube. In particular, "behavioral intention is the significant predictor of actual usage. The results suggest that students intend to use YouTube for improving their academic performance".

The last corpus of literature focuses on the practices of the educational content creators in YouTube (edutubers). These practices, along with their production and demand, have increased significatively, and fit within the frame of informal education, a concept described in other studies. In this case, we include this fourth corpus because we understand that students of different levels might resort to this content looking for "quality" AVC and find some of the learning methods mentioned earlier. First, we will identify a group of studies that investigates the producers of educational content and focuses on tutorial videos. Then, we will present a second group of studies whose main purpose is to examine edutubers and their channels.

Regarding the first group, the book "YouTubers and other Species" by Berzosa [34] examines the world of content creators addressing issues like the application of YouTube to formal and informal education through tutorial videos. Other authors describe edutubers as scientific [35].

In addition, Romero-Tena, Ríos-Vázquez and Román-Graván [36] discuss the practices of YouTubers, as well as Aguilar [37], who defines edutubers as:

"a type of YouTuber who makes videos to share knowledge of the disciplines found in the curriculum of the institutions of formal education, as well as that knowledge whose purpose is to provide orientation or solve a problem" [37].

Based on our research, we observe that the studies about this topic are unilateral and incipient.

The second group of studies focuses on the practices of edutubers. In fact, there are studies that analyze two of the most popular Spanish-speaking edutubers: the teachers David Calle and Julio Alberto Ríos Gallego [38, 39, 40]. Their educational practices are systematized based on interviews and the analysis of their videos. Particularly noteworthy is their style of discourse and performance in front of the camera, they foster values of accessibility, familiarity, conciseness and understanding. To this end, they employ a combination of traditional resources (for instance, a board) and digital resources (infographies or animation). As for the edutubers' communicative and pedagogical skills, we can mention vocalization, plain language, the use of questions to guide the content, the use of examples and analogies, the use of audiovisual resources, dynamism and humor. However, not necessarily all edutubers make use of these resources, in other words, different styles can be identified.

Beyond these groups of studies, there is an emerging field of study in connection to the needs that arise from formal education and that are "solved" searching and using YouTube's AVC. An example of this is the study of Gil-Quintana and others [41]; they examine Mathematics learning and the contents of the platform. This research was based on a survey conducted to 4.845 Italian teenagers, and it includes an analysis of the Italian edutuber Elia Bombardelli's videos, their content and his YouTube channel.

On the whole, based on this analysis, there are three matters to be considered. The first one is the significant role that YouTube plays as a learning source and a learning environment. While this is true for users from a wide range of age groups, in the case of young users, it becomes a fundamental role.

The second matter is that these actors acknowledge that, in this environment, they learn differently and are also exposed to an array of different topics, allowing them to answer questions and solve problems that originate in the spaces of formal education and that also stem from it. These contributions have been extremely valuable as they allow us, on one hand, to measure the importance of YouTube in connection to informal education, and on the other hand, to understand the students' representations, seen as a space for the resolution of school difficulties.

Finally, the third matter is about the relationship between the actors in formal education, in particular, active teachers, whose purpose is to colonize informal learning spaces (such as YouTube) by developing their own audiovisual content. These actors, generally called edutubers, have gained significance as a result of their productions' high demand and mainly because of the dialogue they engage in with young people through their comments.

3 Final considerations

In this paper, we present a literature review of the YouTube phenomenon, and the teaching and learning practices. In particular, from our research, we have identified four corpus of knowledge related to this topic. It is important to highlight the consolidation of this platform of audiovisual content as a hegemonic space for entertainment and informal learning.

Based on this review, we have identified at least two possible lines of investigation that need more exploration. The first one consists of analyzing the learning needs that originate —to express it in simple terms— in formal education and are then "redirected" by young people's motivations towards the search and visualization of the AVC in Youtube. In order to widen the horizon, especially considering the disparity between the teaching practices and the learning practices, this redirection might bring these practices closer, considering that their interaction is only partial at the moment.

The second line of investigation, in a first attempt to address this phenomenon, is a description of the practices of edutubers (albeit we recognize the existence of some preliminary studies on this topic); this research might prove helpful to outline pedagogies that compensate for what young people seem to need. Moreover, we consider that young people's comments about the AVC of edutubers is vital and rich in content because it would enable us to record the elements that they seem to be lacking in formal education and that, in turn, redirects them to the platform. At the same time, it would enable a better understanding of the teaching practices that they value: the use of examples and explanations, among others, found in the AVC in general, and in connection to the edutubers in particular.

In conclusion, we consider that the study of the YouTube platform and its relation with the teaching and learning practices is a type of "thermometer" that will allow us to understand at first hand some of the factors undergoing tension in the educational system and that are also affecting young people's trajectories.

All in all, we consider that this research might provide the knowledge to build bridges connecting the inside and outside of the classroom in a dialogue to improve those educational trajectories.

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Collaborative construction of a wiki to promote self-learning of Discrete Mathematics: a university experience

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Abstract Discrete Mathematics teaching-learning processes are an area where significant learning is most difficult, then the use of novel methodological strategies is necessary. This work relates the process of collaborative creation of a wiki for a specific topic of Discrete Mathematics, process developed by students and monitored by the teacher. The main purpose was to evaluate the use of wiki as an educational resource to promote learning and the development of generic competencies. Students were evaluated before and a survey was administered to collect their perception of it. The results show that the development of the wiki had positive results: increase in qualifications, development of teamwork competency and other generic competencies, it was also possible to modify the role of the teacher and the interactions between students. In addition, it is concluded that both the activity and the methodology used can be an input for processes to improve educational quality.

Keywords: Wiki, cooperative learning, discrete mathematics, university teaching, active methodologies

1 Introduction

The current trend in educational processes is the creation of shared work environments in which teachers and students work together, either in person or remotely, in knowledge building processes. This trend is leading to the cooperative learning model being enhanced by the integration of technological tools such as virtual educational platforms and web 2.0 tools, so that the student is placed at the center of the learning process, a process that is built in collaboration with their peers, teachers and the context around them [1].

Mathematical education, like education in other areas of knowledge, is characterized by an ongoing process of transformation, some of the aspects involved in this transformation are the incorporation of new teaching-learning strategies and the integration of Information and Communication Technologies (ICT). Integration that is based on the very nature of mathematical reasoning that is not linear that resembles a network structure. On the other hand, understanding mathematical objects is not only reflected in verbal language, but also requires multiple representations.

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In x it is further noted that, thanks to the interactivity of these tools, the student assumes a more active role that results in greater motivation towards study and the achievement of significant learnings [2].

There are many experiences of integrating ICT into learning teaching processes, however, in the field of Discrete Mathematics the experiences revolve around the implementation of virtual teaching-learning spaces [3, 4].

In [5] a didactic strategy for teaching discrete mathematics is used, in particular Boolean algebra, using Derive for Windows 6.0 and Multisim through virtual learning environments in order to obtain better use. In [6] a mixed model is implemented that includes the use of active methodologies and virtual classroom in the development of the subject Discrete Structures, the perception of students about the new model versus the traditional class model is collected.

In [7-10], a wiki is used in other specialties such as language, biology, psychology and accounting sciences, as a support instrument and reflections on the implications of its use for the teaching-learning processes carried out.

In this context, it is decided to propose an educational intervention consisting of students, supported by the teacher, building a wiki that will serve as a resource to support the teaching and learning processes.

While Web 2.0 offers different resources to make the student an active agent in the learning process, in light of the experiences carried out in other fields of knowledge, it seems that the wiki responds to the current demand for skills development generic skills that go beyond the specific knowledge of a subject and are necessary for the comprehensive training of the student.

Then, the main objective of this work is to evaluate if the digital educational resource “wiki” favors the evolution of learning and the motivation of students in the subject “Discrete Mathematics”, in particular in the topic “Coding Theory”.

2 Theoretical Foundation

2.1 Virtual Environment for Teaching-Learning

“Computer application designed to facilitate pedagogical communication between participants in an educational process, whether it is completely remote, face-to-face, or of a mixed nature that combines both modalities in different proportions… it serves to distribute educational materials in digital format (texts, images, audio, games, etc.) and to access them, to conduct debates and online discussions on aspects of the subject's program, to integrate relevant content from the network or to enable the participation of experts or external professionals in discussions or talks" [11].

From the different definitions in the literature, it is concluded that a virtual teaching-learning environment is a set of synchronous and asynchronous interaction environments, where, based on a curriculum program, the teaching-learning process is carried out, through a learning management system.

2.2 Teaching Mathematics with Technology Support

The teaching of mathematics, in addition to the rejection of apprentices, faces new challenges and new problems that place it in a phase of imbalance generated by the phenomenon of teaching massification, the evolution of social relations between students and teachers and the mathematical culture necessary to function in today's society.

The need of a citizen today goes far beyond knowing how to "count", because the current social context requires him to reason in situations of risk and uncertainty, decipher and know how to critically analyze the avalanche of codified information he receives [12].

On the other hand, learning technologies are changing the way we teach in the field of higher education, particularly in the field of mathematics. Teachers have been forced to test new teaching strategies, take advantage of online support, multidisciplinary and collaborative learning, and the integration of both mathematical and teaching supporting software.

Regardless of the resources used, the objective is to develop training processes that generate significant learning, for this, they must be based on the individual and social construction of knowledge always taking into account a critical and constructive position of the applications and limitations that digital technologies and mathematical knowledge have to solve problems [6].

2.3 Wiki

The term WikiWiki is of Hawaiian origin and means: fast. It is commonly abbreviated as Wiki. A wiki is a website that can be edited by multiple users asynchronously and through a web browser. The first wiki system is created under the premise of ease of use, that is, anyone can contribute to the content without having knowledge of programming languages or content management tools [13]. Wikis are an appropriate and efficient tool for students to develop meaningful learning; because its construction involves factors such as motivation, feedback, collaborative and active learning. For its part, [14] emphasizes the fact that if learners are content creators then their motivation is increased.

In the educational field, the use of a Wiki makes it possible for both students and teachers to collectively gather content in order to develop glossaries, build repositories, create textbooks, etc., so that they share responsibility for the project in which they work. For [15], transferring this responsibility to students can instill in them a sense of responsibility and belonging.

3 Context

The research is carried out at the Professional School of Systems Engineering of the National University of San Agustin (Arequipa, Peru), in which Discrete Mathematics is one of the axes on which specialty subjects are supported. This discipline begins

with Discrete Structures I which is a prerequisite for studying Discrete Structures II, subjects that are located in the first and second academic semesters respectively. For [6], these subjects are considered as critical subjects, within the mathematical component of the curriculum, since the failure rate is high; consequently, they are a bottleneck for student advancement.

The topic covered on the Wiki is "Coding Theory" and corresponds to Discrete Structures II. The Coding Theory is the study of techniques that enable efficient and accurate transmission of information from a source to a destination.

The teaching-learning processes of this topic are a challenge for teachers and students, this is due to the use of abstract algebra concepts: number theory, groups, rings and fields for understanding cryptography and coding theory.

4 Methodology

In the methodological framework, a quasi-experimental design was used in which mixed methods were used as they allow to generate more information regarding the phenomenon under study. This approach was able to achieve a broader view of the variables and benefits of the wiki in the cooperative work done by students for learning the topic "Theory of Coding".

In the qualitative phase, a non-participating observation sheet was used to assess the interaction between students and with the Moodle wiki tool; four categories were considered: the interaction of students with the wiki, the development of cooperative work, familiarity with the topic developed on the wiki and availability of resources.

In the qualitative phase, to study the evolution of academic results, a pretest and post-test on "Theory of Coding" was used, the results obtained were applied to the t-Student test. To collect student perception, a survey was conducted, implemented on the Moodle platform.

The population consisted of 40 students enrolled in group A of the subject "Discrete Structures II" of the Professional School of Systems Engineering of the National University of San Agustin in the academic semester 2019-II. Of these students towards the end of semester four left the course so the experience was carried out with 36 students.

4.1 Description of the Experience

Roles of teacher and students

The experience described is developed under the mixed modality (b-learning), in which the virtual classroom is used as a support system for face-to-face attendance, so the teacher had to fulfill the functions: technical, academic, organizational and guiding contemplated in [16]. In addition, the teacher performs a monitoring function, so that he intervenes if the information is not correct, complete or doubts remain.

For their part, the students had an active participation in which they showed responsibility for achieve the goals, interacted with the contents and applied work techniques in groups.

Performed activities

Before starting the construction of the wiki, a master class was given on the subject under study and a pretest was carried out to evaluate the learning.

The first activity in the construction of the wiki was to ensure that there were equal opportunities to contribute to the wiki, for this purpose the basic instructions on its operation were given in a face-to-face session and subsequently published in the virtual classroom. In the same session, the subtopics were identified and distributed to the student teams.

To give feedback to students' contributions and ensure the quality of the wiki content, a draft of the contents was worked on a shared folder on Google-Drive.

For a support system to the construction of the wiki, a specific forum was opened in the virtual classroom.

Rubrics were used to evaluate both the cooperative work carried out by each of the teams and the wiki as a product of the cooperative activity.

The last action was to design a post-test to evaluate the learning again and be able to assess the wiki's influence on them.

Activity design

It was determined that the wiki construction activity would last three weeks, for this the scope of each of the subtopics was taken into account and that the wiki was the final activity planned in the subject.

Since a wiki is worked collaboratively, the key elements for developing a true cooperative learning enunciated by Johnson and Johnson [17] were taken into account: positive interdependence, individual and group responsibility, stimulating interaction, personal and group attitudes and skills, and group evaluation.

For the design of the activity, the proposed steps for the design of cooperative activities were adapted and implemented, steps that are formalized in [18].

For the formation of the groups and for the management of cooperative work, the characteristics worked in [19, 20]. Thus, the groups were made up of 6 students and three main roles were defined: academic manager, creativity manager and writing manager.

To follow up on the Wiki construction activity, students were asked to work on a draft of the contents in a shared folder on Google-Drive that would be accessed by the team members and the teacher; n this way, individual contributions could be identified and feedback on progress and proposals could be given. Likewise, they were told that they had to write a set of commitments (as objectives and tasks) that they would have to fulfill individually and as a team, this document would also be placed in this shared folder.

To assess the wiki, a rubric was developed in which three dimensions were scored: a) content organization, b) information quality and diversity of formats and c) evidence of information analysis (comparison, contrast, examples and/or conclusions). This rubric was published in the virtual classroom

5 Results and Discussion

5.1 Qualitative phase

The observation sheet recorded the situations that were observed during the development of the wiki and that were relevant to assess their influence on students' learning outcomes. Table 1 summarizes the findings of the qualitative phase.

Table 1. Situations observed in the qualitative phase.

Category	Situations observed
Student interaction with the wiki	At the beginning of the activity the participation of the students was not very fluid; however, towards the second week of work, student participation increased notably. The forum activity created for this purpose encouraged participation and cleared doubts.
Development of cooperative work	The teams worked appropriately according to the principles of cooperative learning, were active, role performance led to positive interdependence and the stated commitments were fulfilled. Students gradually demonstrated confidence in the partner's work and skills to work cooperatively.
Familiarity with the topic developed in the wiki	Students took responsibility for the fact that they had to contribute creatively to the construction of the wiki, in that way they sought multichannel information that led them to a better appropriation of the contents worked.
Resources	One of the limitations was the time, because of the three weeks proposed, in practice they only worked hard in two. Other problems the space limitations and availability of computer equipment and internet service that the students had, which made it difficult for them to coordinate and perform the tasks that had been assigned.

These results lead to affirm that the construction of a wiki allows to present content and learning support materials in different ways. At this point it coincides with [21] who also concludes that sharing, commenting and discussing them enables learning in any area of knowledge.

5.2 Quantitative phase

This phase includes the two moments of learning evaluation through written tests: pre-test and post-test on the topic " Coding Theory". Table 2 shows the descriptive statistics of the scores obtained in both tests and the t-test results for means of paired samples. The test was performed with the Excel data analysis-t-test for means of two paired samples.

Table 2. T-test for means of two paired samples

	Pre-test	*Post-test*
Mean	12.94	14.63
Variance	3.17	3.71
Observations	36	36
Pearson's correlation coefficient	0.76	
Hypothetical difference of means	0	
Degrees of freedom	35	
Statistical t	-7.66	
P(T<=t) one tail	< 0.001	
Critical value of t (one tail)	1.69	
P(T<=t) two tails	< 0.001	
Critical value of t (two tails)	2.03	

Observing Table 2, it can be seen that there was an improvement in learning outcomes, the average in post-test increased by 1.68 points in relation to the pre-test average. To verify that this difference in the averages was not due to situations unrelated to the phenomenon under study, it was considered that the ratings came from the same study subjects at two different times, so the Student's t-test was applied for means of two paired samples. With a 95% confidence level, the following hypotheses were raised:

H_0: There is no significant difference between the averages of the grades obtained in the pretest and the posttest

H_1: There is a significant difference between the averages of the grades obtained in the pretest and the post-test

When analyzing the information in Table 2, it is found that the p-value for two tails is much less than 0.025, therefore the null hypothesis is rejected, this is confirmed by noting that the obtained t-value is in the reject zone marked by the critical value of t.

To gather student perception, a survey was carried out, implemented on the Moodle platform, which included 14 questions: an open question and the others of Likert scale.

The open question was **"What suggestions would you make to improve the activity?"** Some of the responses collected are listed below.

- *More freedom could be given in terms of content.*
- *Greater collaboration from my colleagues.*
- *I didn't like the wiki, it was very complicated to use, I don't think it's a very developed technology, one has many things to improve.*
- *Get to know the team members a little more.*
- *It would be interesting if each team can choose the editing format that best dominates, it is true that uniformity maintains order and this, but taking this suggestion into account could further exploit the creative potential of the students.*
- *It's very good.*

- *That there was a greater diversity of topics and that we could choose.*

To collect students' assessment in relation to the construction of the wiki, a Likert scale with scores 1 to 5 was used, from the "Totally disagree" option to "Totally Agree", being "Neither disagree nor agree" the middle position.

The coding of the answers was: 1: Totally disagree, 2: Disagree, 3: Neither disagree nor agree, 4: Agree and 5: Totally agree.

Table 3 shows the averages of the ratings expressed by students.

Table 3. Averages of activity valuations

	Question	Means
1	It facilitated my learning about the subject	3.82
2	It helped me develop other skills: writing, spelling, etc.	3.97
3	Provided positive motivation for learning	3.67
4	It motivated the search for information.	4.15
5	Made learning the topic interesting.	3.91
6	The development of the activity was complicated for me.	2.91
7	I have actively participated in the activity.	4.36
8	It would have been convenient to spend more time developing the activity.	3.61
9	I had a clear idea of what I wanted to achieve as the final product of the activity.	3.7
10	Enhanced my commitment to studying and my sense of creative achievement	3.88
11	I would have preferred to create a website.	3.64
12	It would be preferable to work the WIKI on a topic explained more widely in class.	3.82
13	The scores obtained in the activity have seemed fair to me.	3.36

As seen in Table 3, with the exception of question 6, satisfactory mean scores close to 4 points were obtained, so it can be inferred that students perceive the construction of the wiki as a productive activity that had an impact on their learning. It is important to note that in none of these cases does the level of indifference be reached.

6 Conclusions

The proposed objective has been achieved as there has been an increase in motivation towards learning discrete mathematics (in particular the topic "Theory of Coding") subject. There has also been an increase in academic results; therefore, the use of the wiki as a resource to support the teaching-learning of this subject has been beneficial.

The proper integration of digital technologies into teaching and learning processes can positively promote the appropriation of mathematical knowledge; to do this it is necessary to use methodological strategies focused on the student and the interactions that they establish in their formative process.

Cooperative work supported in ICT makes individual and team contribution possible without the need to physically come together to carry out the task, each participant can contribute their own from wherever they are, can also propose modifications, so that the final version of the task is a consensual version by all the members of the team.

The wiki turns out to be an efficient resource for teaching and learning processes, because presenting the contents in various ways creates an important attraction towards learning.

In addition, the cooperative nature of its elaboration contributes to the development of generic competencies such as teamwork, leadership and communication. It also helps to develop information search skills and encourages the exchange of information and knowledge between students and with the teacher.

Particularly in the field of mathematics, students often believe that listening to the teacher's explanations is enough to understand what is being done, however, at the time of evaluation they realize that they had not internalized the concepts. On the other hand, with the elaboration of a wiki, a continuous process of content review is facilitated, content that can be presented in different formats (text, graphic, video, audio, etc.) facilitating its understanding.

The construction of the wiki also helps to bridge knowledge gaps and teacher's work, because in the construction process, it is possible to assess whether it is necessary to delve into a topic.

Finally, it is concluded that both the activity and the methodology used can be an input for processes to improve educational quality.

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Theoretical Approach to the Problem of Macro-Micro Relationships in Secondary Chemistry Teaching: A Proposal Based on Observation and Inference

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Abstract. The aim of the present study, of elucidative and argumentative nature, is to propose a first draft for a theoretical approach towards establishing well-founded explanatory relationships between the micro and macro levels of chemical knowledge. The establishment of such an aim is done taking into account that "levels" in chemistry are usually regarded as the cause of many misconceptions among secondary students. We first examine the recent literature of chemistry education addressing the "macro-micro problem". We then redefine that problem, using the aid of the philosophy of science and the specific philosophy of chemistry, in terms of observations and inferences. We draw attention to the theoretical-empirical, explanatory-descriptive, abstract-concrete, general-factual nature of chemical concepts in science education. Finally, we derive some instructional guidelines that intend to be coherent with currently established knowledge in chemistry education research. We indicate some clues for the design of instructional sequences, laboratory practices, and technology-mediated teaching activities that follow the spirit of our theoretical approach.

Keywords: Secondary Chemistry Education, Macro and Micro Levels, Observation and Inference, Theoretical Approach, Philosophy of Science.

1 Introduction

The theories of Piaget, Bruner, Gagne and Ausubel on how individual experience influences learning emerged more than half a century ago as a new paradigm in education, and they are still widely used to support science teaching. Constructivist learning theories emphasize the importance of experiences, and one of the most crucial aspects of those experiences is observation [1]. For instance, the model of learning

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through discovery, as proposed by Jerome Bruner [2], describes an approach that requires students to draw conclusions from their observations. Observation, which is an indispensable element of the scientific research process, is also a basic skill that is effective in traditional and in technology-mediated science classrooms [3].

Although there are many different teaching methodologies that require students to observe, in terms of science education, the first thing that comes to mind are laboratory-based methods. Such methods are effective in achieving learning outcomes through observations, management of prior knowledge, conceptual understanding, critical thinking, developing ideas and skills, and eventually using digital technologies. Perhaps the most established purpose of experiments in science classes in compulsory education is explaining facts using theoretical knowledge [4]. In other words, making accurate inferences by using the available theoretical knowledge to interpret the observations made through experiments. Therefore, school experiments allowing observation and inference –with or without the aid of new technologies– should have an important role in science teaching. The skills of experimenting, observing, drawing conclusions and establishing hypotheses are "exemplar" scientific processing skills, and therefore significant objectives of contemporary science education. On the other hand, the difference between observation and inference within the scope of the so-called "nature of science" should also be taught [5].

In accordance with the previous considerations, the aims of this article are:

1. To draw attention towards the hybrid theoretical-empirical, explanatory-descriptive, abstract-concrete, general-factual nature of chemical propositions.
2. To make some philosophical considerations on the ontological and epistemological characteristics of the levels in which chemistry functions (macro and micro).
3. To sketch the outline of a theoretical approach towards secondary chemistry teaching based on the process of making inferences from observation.
4. To derive instructional guidelines, coherent with current proposals in chemistry education research, in order to design laboratory experience with or without the mediation of digital technologies.

2 Theory and Antecedents

2.1 The Problem of the Macro-Micro Relationship when Making Inferences from Observation in the Chemistry School Lab

Laboratory and experiments play a significant role in chemistry, which seeks to understand the transformation of substances. In this regard, chemistry may be the first field of science that comes to mind when it comes to experiments. As stated earlier, the main purpose of experiments in science education is to enable students to "reach" scientific facts about observed events reconstructed with reasonable inferences based on already learned, structured knowledge. However, empirical and theoretical knowledge on concrete phenomena re-read through experiments is correlated *through processes of observation and inference*. This supposes an additional difficulty for chemistry education.

Relationships between theoretical and empirical knowledge in the chemistry education literature are described in terms of "levels" of understanding –macro, micro and symbolic [6]. Establishing appropriate relations between macro and micro, two *ontologically separate* aspects of the chemical world, is a competence expected from learners. Chemistry develops scientific models that try to explain with micro "phenomena" how the macro phenomena take place. But when these two levels are considered separately in teaching, students face problems in explaining and modelling [7]. It is usually emphasized that misconceptions in chemistry are caused by confusion between levels [8]: the micro-related knowledge students use in explaining their observations *is incorrectly inferred*, i.e. its transport from one level to another is flawed. Solutions to this learning problem depend on the development of a robust understanding of the micro and a correct structuring of the macro (and this of course can be aided by a consistent and well-founded use of digital technologies).

The specialized literature focusses on the importance of concretizing micro models for chemical problem solving [6-9]. There are diagnostic studies that determine the conceptual structures, reasoning patterns and extended misconceptions that individuals use at the micro level. Additionally, when school lab experiments aimed at interpreting the micro structure are examined, it is seen that some typified materials, analogies, images and simulations predominate [10, 11]. Current diagnoses portray the problem of the conceptual association of micro and macro in terms of both observing the macro and inferring from the micro.

2.2 Current Approach: Heavy Focus on the Micro

The literature suggests that most research and innovation in chemistry teaching has a micro-oriented approach. Accordingly, different means (scale models, drawings, animations, etc.) are used in order to concretize the theoretical knowledge about micro. However, there are limits to represent the micro through models prepared with concrete materials, analogies with experienced phenomena, images, and digital recreations. Indeed, one of the drawbacks of these representations is the emerging assumption that models are a "replica" of reality [5]. The formation of this epistemologically feeble understanding in the teaching process can lead to new obstacles, instead of eliminating misconceptions. Therefore, it is not surprising that students explain macro behaviors (such as melting or solving) with flawed analogies; students tend to explain the micro level with concepts related to the macro level, instead of the other way round [1, 7, 12]. So, lack of awareness of the use of such tools in activities in the teaching environment may lead to grave conceptual problems. The problem about the micro is basically related to the models used when teaching and the approaches including modelling to reveal the characteristics of central chemical concepts [8, 11]. The process of using concrete models of the micro as proxies of the macro level experience should be supported, and at the same time support, the set of accepted theoretical propositions and inferences based on other formal, symbolic and linguistic representations (formulas, equations, symbols, etc.). Such a complex process requires awareness of the theoretical knowledge and its representations, *and digital mediation, used without care and control, can severely amplify the aforementioned problems*.

On the other hand, available studies show that teachers often prefer to provide "accurate" explanations of the micro, limiting their teaching to "horizontal" relationships at the micro level, and not accompanying their students in the establishment of "vertical" relationships with the macro. Therefore, what is done is the "transmutation" of micro-sized phenomena that do not allow observation to a macro form with concrete (model, drawing, etc.) or digital (animation, simulation) representations. But understanding laboratory experiments is not "enlarging" or "scaling up" the micro pieces involved. Chemical models and their tools are "fictional" descriptions or explanations of the pieces, therefore, the following question is key in chemistry education: what are the "experiences" of students of the nature of the entities modelled, drawn, simulated –broadly, represented? We argue that an experimental approach (which can be made more robust through the use of digital technologies) is indispensable in school chemistry in order to associate the theoretical knowledge about the micro with empirical knowledge about the macro.

3 Discussion: Elucidation and Argumentation

3.1 Analysis of the Problem with the Help of the Philosophy of Science

In order to attack the problem of macro-micro relations, a strategy is to first describe it in some detail with the aid of the philosophy of science [8]. The idea is to identify key aspects of the nature of chemical knowledge to be taught and to establish consistent teaching methods at the secondary level. The philosophy of science has delved into the epistemology of knowledge production and the mechanics of scientific representation (models, analogies, simulations, etc.); these are valuable inputs for chemistry education.

As stated above, chemistry teaching tends to be micro-based and adopts a micro-to-macro orientation. This tendency results in students' conceptual understanding to shift from abstract to concrete. In terms of content knowledge, from theory to observation. The acceptability of using *only* that way is epistemologically and pedagogically controversial: it clashes with what we know of the nature of chemistry. The main reason for this is the epistemological qualities of chemistry. From the philosophical point of view, the problem is related to issues such as emergence, supervenience, holism, part-whole relations, asymmetry, causality, among others [13]. In the discussion in terms of chemical properties, the properties of the part will not be sufficient to understand the properties of the whole, the explanation cannot assume a linear causality between part and whole. In an approach more consistent with the nature of chemistry, we need to take into account the emergence of properties caused by the interaction of the parts, assume a non-reductionist approach to understand the asymmetric relations between whole and part, critically examine the notion of causality, and understand a dynamic and contextual relationship between substances, structures and properties. From this general framework drawn from the philosophy of chemistry, the problem of macro-micro relationship in chemistry is mainly about how to relate observations through inferences. It is the process of inference that reveals new perspectives on the nature of the macro, micro and symbolic dimensions in chemistry education.

3.2 Observation and Inference

Understanding the relations between observation and inference from a scientific point of view requires epistemological distinctions between descriptive/empirical/concrete/ factual and explanatory/theoretical/abstract/general knowledge [14]. The existence of abstract, theoretical knowledge in chemistry depends on a process of *institutionalization of ideas* through the use of technical language. Knowledge is expressed in propositions roughly divided into descriptive and explanatory, respectively aiming at defining the status of phenomena and responding to questions on how and why. Explanatory knowledge, constituted by general propositions about abstract states of affairs involving the identification of causes and consequences, is often simplistically coalesced with theoretical knowledge. If knowledge produced in these processes is obtained directly from the observed characteristics of phenomena, it is usually called empirical knowledge. Indirectly obtained knowledge requires the use of concepts to "reconcile" representations, which point at the unobservable.

Descriptive knowledge can thus be theoretically supported, and explanatory knowledge can refer to empirical sources. However, we usually state, for teaching purposes, that explanations are "general" and description are "factual". For instance, "litmus paper turns red in HCl solution" expresses an empirical conclusion in the form of a description, whereas "litmus paper turns red due to an interaction with the HCl solution" expresses an empirical conclusion in a form that contains explanations produced from observable features. To sum up, the theoretical or empirical nature of the propositions expressing scientific knowledge is more related to the sources of knowledge, while its descriptive or explanatory nature is more related to the aim and intention of the text composed of those propositions [15].

Theoretical knowledge includes terms to describe and explain, produced by the creators of the theory and accepted through consensus. These terms ("theoretical concepts") constitute the "apparatus" of the models of phenomena that appear when using the theory on an empirical domain. For example, when thinking about the boiling point of a liquid, terms such as "van der Waals forces", "induction" or "polarity" are the theoretical concepts that "model" the phenomenon. In the school chemistry lab, empirical knowledge is not sufficient to make sense of a phenomenon observed, theoretical knowledge is also needed. What is observed *is a sign of something else that cannot be observed* (e.g. temperature is a sign of kinetic energy or molecular movement). Further knowledge is needed to understand and explain this "signing", and this includes the list of theoretical concepts. Following the classical ideas by the French physicist and philosopher Pierre Duhem [16], an experiment is accompanied by an *interpretation* relating concrete data obtained by observing to theoretical entities accepted by observers; such an interpretation yields some abstract and symbolic descriptions and explanations. Therefore, each empirical concept is meaningful in a theoretical framework; there are *theoretical structures* to make sense of what is actually happening in a school experiment.

3.3 Moving from Concrete to Abstract

Abstract chemical concepts describe the behavior of substances through resorting to an unobservable particle level. This epistemic move is at the center of the literature of chemistry education. Such a characterization of the knowledge of chemistry can hide the experiential and experimental nature of chemical intervention, and this turns to be an obstacle to understanding the knowledge structure of the discipline. Therefore, although chemistry relies on "unobservable" chemical processes, these are not completely abstract, they are "anchored" in the concrete of chemical interventions to change materials and control such changes. Chemical knowledge consists of *explanations* made by experiencing the phenomenon through scientifically accepted representations, and this is why we talk about moving from concrete to abstract.

As frequently stated in the literature of chemistry education, the three-level (macro, micro and symbolic) understanding of chemical processes [6] requires accepting that the nature of the three levels is not the same. Macro and micro appear to be ontologically separate dimensions, and the symbolic level is *semiotic* (i.e. it deals with the signs). Phenomena occurring at the macro and micro levels are expressed linguistically and non-linguistically through elaborate representations. The macro will be the target of school chemistry lab practices, the micro will be grasped through some theoretical mediators (concepts, representations, scale models, images, spectra, symbols, mechanisms, equations, formulas, etc.). Knowledge of this micro dimension is possible with those epistemological tools produced by science, each element constituting that dimension acts a *semiotic indicator*, having meaning because it refers to macro events. Just because a student writes down a reaction with formulas and symbols, this does not mean that s/he has actually understood the macro change or the micro reaction. The symbolic dimension which of course can be enhanced by digital technologies, should act as a means of establishing satisfactory explanatory relations.

4 A Teaching Proposal

In the light of the conceptual framework given above, some instructional implications can be drawn. Secondary chemistry teaching should act in an integrated fashion at the macro and the micro levels through relating whole and part and expressing the knowledge about these two dimensions with different semiotic tools, including digital technologies in all their potential. Coherent chemical descriptions and explanations should be attempted when conceptualizing the school labs. In this respect, it is possible to divide our instructional proposal into two sub-dimensions: one that is more *ontological*, the relations that we needed to establish between the macro and the micro, and another one that is more *epistemological*, the appropriate theoretical knowledge and representations that we can use to efficiently model those relations.

The history of science has shown that chemical phenomena have been interpreted in quite different ways: it is now commonplace to contrast the explanations for combustion given by supporters of phlogiston and of oxygen. "Making sense of" a phenomenon is done according to the principles of good reasoning and the constraints of theoretical categories. The macro ontological dimension of chemical events is the

first step of theoretical reconstruction, which culminates at the micro level with entities that can vary considerably between different theoretical schools. In current chemistry, this sense-making is made by giving properties to the whole through inferring properties of parts, and this requires a whole network of relations. In the philosophy of chemistry, the top-down causality adopted by the holistic approach is more plausible from the epistemological point of view, as opposed to the bottom-up causality adopted by the ontological reduction of the whole (ontological reductionism) approach. Accordingly, in order to explain a chemical phenomenon, the configurational "forces" that determine the relations that are present should be mentioned [13, 17]. Otherwise, stating a chemical causality "piling up" from the micro linearly without emergence can cause misconceptions about properties that cannot be explained.

A perceptible property of a substance, such as odor, is a property depending upon the properties of the particles but it is not explained by an isolated examination of the particles; therefore, it is more appropriate for chemistry to establish an asymmetric relationship between macro and micro with a causality derived from macro properties. In other words, if we seriously consider ideas from the philosophy of science, the starting point in the teaching process should be observable changes of the whole. It can be said that a chemical explanation of a "whole" from this point of departure of "parts" can be put forward more clearly. In this context, instead of giving exaggerate priority to micro representations (models, symbols, technological representations, etc.), the teaching of chemical content should be based on theoretically-reconstructed experiences. It then seems more appropriate to establish an *interactive* relationship by bringing the representations under use closer to the observed phenomenon.

"Projecting" theoretical knowledge onto phenomena requires making *inferences*, i.e. transferences or extractions from models to phenomena. There are different types of reasoning that scientists use when making these inferences to "overstand" (i.e. dominate) facts. In the literature of philosophy of science, a number of theoretical frameworks have been put forward; authors talk about hypothetical deduction, induction, retrodiction, abduction, which are defined as combined, non-formal and therefore non-demonstrative methods [14]. It is often stated that induction and deduction, which are the classical "scientific methods", are not enough in today's understanding of science [18].

Hypothetical thinking is the type of thinking that is essential in science education and forms the basis of a sound method in relation to scientific inference. According to Anton Lawson [14], the process of scientific knowledge formation in the minds of students is essentially neither inductive nor purely deductive. Students reason according to patterns expressed as hypothetical arguments in the form of conditional structures "if… and/but…, then…, therefore…". When effective use of existing theoretical knowledge is required, a hypothetical-deductive form becomes important. Theoretical knowledge and observations related to the phenomenon are linked through an "inference about the case": a fact is observed, a theoretical corpus is deemed appropriate, then an abduced hypothesis provides a reasonable answer. In such a conclusion, two different factual situations can arise. 1. the hypothesis is supported by empirical data, and we have yet another reason for the adoption of our theoretical knowledge, or 2. the hypothesis is not supported empirically, and our theoretical

knowledge is deemed insufficient to explain the case: we need to revise. In this "method", as it can be seen, the theoretical knowledge proposed by the teacher is effectively applied and at the same time tested: "ampliative" reasoning is consistent with the notion that scientific knowledge is open to change.

In our proposal for chemistry teaching, a crucial point of the hypothetical method is providing meaning for empirical knowledge. When interpreting a lab experience, there is *production* of testable hypothetical propositions within the framework of theoretical knowledge institutionalized in class. In this context of school chemistry, relationships between the macro and the micro are established through an interactive process that "comes and goes" between observation and theory with the intervention of inferences. Here, of course, technological mediations can give new dimensions to the process. An overview of that interactive process that we envisage is presented in Table 1.

Table 1. Proposal of an interactive process between the macro and the micro for secondary chemistry teaching through lab experiences.

Dimensions and stages	
A. Working in the macro dimension	A1. Observation of an experience in the school lab, with or without technologies A2. Transition from observation to inference
B. Working in the micro dimension	B1. Theoretical representation of the experience, with or without technologies B2. "Making sense" of the phenomenon
C. Working in the macro and micro dimensions	C.1. Comparing and "editing" inferences C.2. "Abduction" of hypotheses C.3. Test of hypotheses, with or without technologies C.4. Extraction of conclusions

5 Final Remarks

An initial evaluation of our teaching proposals in terms of the corpus of science education research can be done under some general "headings". Instructional activities generated with our framework are in accordance with the "inventive route" strategy of proposing and testing hypotheses. Current well-known "active" teaching methods, and adequate supporting new technologies, can be inserted at the different stages of our proposal (see Table 1). For example, when students face the macro experience in the lab, teachers could use *computer-assisted* labs, *remote* labs, *virtual/simulated* labs or *animation-based* labs. On the other hand, when a dimension of "prediction" is incorporated as a preliminary stage, prior to the transition from macro observations towards micro explanations, the whole lab experience can become a prediction-observation-explanation cycle, a method favored in the specialized literature.

In the stages where the micro is being examined, a wide variety of digital technologies (animations, mobile apps, augmented reality, *and even search engines and*

social media) can be profitably used to enrich teaching and assist learning. The stage where students are required to infer can be organized as the construction of *school scientific argumentations*, and further argumentative texts can be elaborated to connect the different stages of our proposal. Argumentation leads the students to justify their own conclusions with the use of multiple representations such as pictures, graphs, scale models, multimodal and hypermedia texts and even gestures [19].

The fact that our teaching proposal is adjusted to methodological approaches currently favored in innovative chemistry education and at the same time to epistemologically valid views on the nature of scientific processes is salient. The use of Lawson's proposal [20] of hypothetical prediction and argumentation warrants that our suggestions for secondary chemistry classrooms are aligned with conceptions of the nature of science shared within our research community [21]. Activities designed under the guidelines that we have discussed can potentially support scientific thinking and reasoning skills in students. *Affordances* and *constraints* introduced by the mediation of digital technologies at this point of our cycle need to be further investigated in chemistry education.

The conceptual approach proposed in this work focusses on establishing epistemological articulations between observation and inference; it is thus inscribed, as it was said before, in the line of research and innovation around the nature of science, or NOS [21]. Further NOS ideas that can be explored with our proposal are the differences between law and theory, the nature of models in chemistry, the logical structure of chemical knowledge, the nature of idealization or the role of representations. The spirit of our proposal intends to create awareness among students of the empirical, theoretical, descriptive, explanatory, factual, general, concrete, abstract nature of chemical propositions.

In terms of innovative chemistry education, a proposal structured around inferences may contribute to the "eradication" of misconceptions. Many misconceptions on the particulate structure of matter have been related to a lack of understanding of the use of the micro dimension to "account for" the macro dimension. Reconciliation of the pieces of theoretical knowledge that in principle can explain results obtained in the school lab is the keystone of our proposal and a way of "working with" students' conceptions in a more comprehensive way, looking for possible integrations and re-significations.

Finally, we think our approach should be tested in actual technology-mediated implementations in secondary chemistry classrooms with the aid of analytical constructs from philosophy of science and science education. In its state presented in this article, it should be considered a set of recommendations or guidelines derived from currently accepted knowledge in the discipline of chemistry education.

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Students' Experience of a Short-Term Study Abroad Program in the US

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Abstract. Around the globe, nations have become more interconnected and increasingly intercultural and individuals must be able to efficiently deal with cultural differences at universities or colleges, at work or in their private lives. The aim of this study is to analyze how students experience the process of intercultural adjustment in this short-term study abroad program. A qualitative case study design was conducted to understand the adjustment of students from Global Village 2018 edition. Fifteen semi-structured interviews with 19 open-ended questions were carried out. The students' cross-cultural adjustment experiences started with a sense of enthusiasm and overwhelm for diversity, followed by a frustration period where they were supported to adjust and progressively adapted to the Global Village environment. Three main phases were found: (a) Excitement and Disorientation; (b) Frustration and Adaptation; and, (c) Integration. The students' process of adjustment was mostly symmetrical but found differences regarding the emotion predominance depending on the nationality as related to cross-national cultural dimensions.

Keywords: Intercultural Adjustment, Intercultural Communication, Study Abroad, Higher Education

1 Introduction

Around the globe, nations have become more interconnected and increasingly intercultural, presenting challenges for countries, academia, and the corporate world leading to an age of cultural dynamism [1–3]. Individuals must be able to efficiently deal with cultural differences at universities or colleges, at work or in their private lives [3–5]. Intercultural, or cross-cultural, competence is a crucial skill-set in the academic and professional arena [6]. Increasing globalization and demands from well-prepared graduates have had a significant impact and influence on higher education and have catalyzed study abroad programs [7, 8]. In recent years, these programs, rather than pursuing a degree in another country, have become a more common practice among international students from all across the globe, targeting applicants who have had no previous international travel or lack funds for extended study abroad experience [9–12]. Study abroad is an important component of the U.S. College Curriculum Internationalization

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Movement and is a powerful resource for cultivating global, international and intercultural skills [13].

In higher education, research centered on student achievement and program effectiveness are still in early stages; a lack of uniformity in their structure difficult to find a one-size-fits-all assessment [8, 14, 15]. Even though this is a relatively new trend, previous findings in the discipline have shown that (a) the power of studying abroad comes from its unique ability to provide students with challenges in the emotional and intellectual sphere [16, 17]; and, (b) it is not enough to send students to study abroad without pedagogical strategies focused on intercultural effectiveness [10, 15, 18].

Since empirical research on short-term study abroad and their adjustment experience does not confirm their effect on student intercultural development, the current study seeks to provide more insight from a qualitative view of the participant's experience of the Iacocca Global Village for Future Leaders, an innovative immersive five-week intercultural learning program at Lehigh University (Pennsylvania, United States). For more than 30 years, Iacocca Institute programs have hosted participants from more than 150 countries. The Institute is part of the Office of International Affairs at Lehigh University [19], recognized among the U.S.'s premier research universities and located in Bethlehem, Pennsylvania [K. Mendez, personal communication, October 8, 2020]. The Global Village brings university students and professionals from around the world, from a variety of backgrounds (cultural, social, economic, generational and professional) to empower the next generation of global leaders. In this program, a group of highly diverse students go through a 5-week immersion experience where there is no "host culture", but rather a learning environment where they are "hosts", as well as "guests". This study therefore addresses the following research question: How did students experience the process of intercultural adjustment in this short-term study abroad program?

2 Methodology

An interpretative framework of social constructivism that emphasizes on developing subjective meanings of human experiences is adopted [20]. It was used to develop a pattern of meaning of the students' experience in the program since the case under study is a very complex and multifaceted experience [20–22]. Qualitative approach has been adopted to have a detailed understanding of participants' personal experiences during the five-week immersion experience [20, 21]. A case study design was conducted [23, 24] to understand the adjustment of students in the short-term study abroad program: The Global Village for Future Leaders.

The study was conducted among students from Global Village 2018 edition [19] which had 61 enrolled participants -who call themselves "Villagers"- from 36 countries and 4 continents aged from 18 to 45 years old [K. Mendez, personal communication, September 29, 2020]. A purposeful sampling size of 15 students was used [20, 24] until the researcher reached data saturation [25]. The sample included one respondent per country -Azerbaijan, China, France, Greece, Hong Kong, Israel, Italy, Kazakhstan, Mo-

rocco, Pakistan, Peru, Puerto Rico, Dominican Republic, Sierra Leone, and South Africa- and varied across attributes of gender (Female: 9; Male: 6), age (21 to 32 yrs.), and the students´ majors ranged from engineering to communications, medicine, accounting, political science, culinary arts and management.

The main qualitative data collection approach was semi-structured interviews with 19 open-ended questions focusing on (a) the student's perception of their experiences during the program, and (b) how the program design elements influenced the process. The interview guide was validated in the field to identify unclear or ambiguous statements [20, 24]. The interviews were carried in English and took from 30 to 60 minutes. Synchronous online in-depth interviews were conducted via computer-mediated communication through a secure online application. All students received an explanation of the procedures followed and the purposes of the study as well as the measures taken to preserve the confidentiality of their responses. The rights of individual participants to self-determination, privacy and dignity was always respected [26]. An alphanumeric code was used to identify participants as follows: Participant Number, Sex, Age, City, Country (P01, Male, 21, Wenzhou, China). Thematic analysis was used to define categories and themes in line with the research question across the data [27, 28].

3 Results and Discussion

The students' cross-cultural adjustment experiences started with a sense of enthusiasm and overwhelm for diversity, followed by a frustration period where they were supported to adjust and progressively adapted to the Global Village environment. Three main phases were found as experienced by the students:

3.1 Excitement and Disorientation Phase

When participants received an acceptance notification that they would attend the program, they experienced feelings of nervousness and excitement until their arrival in the US. The first phase of students' experience is characterized by the enthusiasm and uneasiness generated upon program start. It begins before arriving at the campus, provides a peak of excitement, and persists until the challenges of living and/or working are intense and move students to the next phase. Similarities can be found with the first phase of the W-Curve model, the tourist phase, as people entering this new country (in this case, educational environment) believe that (a) attending was a very good decision; and, (b) it is an exciting adventure despite they might feel anxious on how to interact with others [29–31]. The W-curve model is an emotional pattern that occurs when a person experiences culture shock.

> I didn't know what to expect, like how it would be. It was very scared of what was going to happen but at the same time excited to know. (P07, Female, 25, Athens, Greece)

However, the emotions predominance varies in the interviewees depending on the nationality. A tendency for anxiety as a predominant feeling was identified towards European and Asian participants whereas the Latin American and African tend to have excitement as a predominant emotion. This result is in line with the Hofstede's culture

dimensions, since American and African countries with weaker uncertainty avoidance tend to feel tolerance and curiosity for diversity whereas Central and Eastern European Countries with strong uncertainty avoidance tend to suffer from higher stress and anxiety when faced with ambiguity [32–34].

> I was hype… very excited. Even though I never saw people from all these countries or didn´t know where in the map they were, I knew I was going to be all right. (P05, Male, 23, Bayamon, Puerto Rico)

The feeling of confusion and disorientation before arrival was higher in the students who had no prior travel experience and lower in the ones who had visited the USA before for tourism or other academic program. Students highlighted that in this specific program, they felt that they were left on their own to figure things out until they got to campus and a faculty picked them up from the bus station. No pick-ups at main airport or no mediation amongst their initial encounters, made students felt overwhelmed, confused and excited, which according to Engle and Engle [16] is "the heart of a successful sojourn". Upon arrival, the initial impression for most students was the tremendous diversity found in residential common areas (lounges, kitchens, bathrooms, hallways, etc.). All students, regardless of nationality, reported feeling surprised and overwhelmed. Language was identified as a big stressor before and during the first encounters. This result was in line with previous studies [30, 35].

> When I first arrived, I was confused, too many things going on... I´ve never been part of such a thing and I knew I was going to meet people from all over the world and share experiences with all of them. I was excited but also nervous… a little anxious about the first time when I would have to speak English. (P01, Male, 21, Wenzhou, China)
>
> I was so stressed [about getting to campus] … I was at the airport and needed cash to buy the bus ticket but didn´t know the name for an ATM [automated teller machine] (…) Finally, a kind guy who worked at the airport took me to an ATM (P02, Male, 24, Paris, France)

The start of the daily coexistence – academic and social life - offers students a valuable opportunity to test the ideas learned in their cultural context about other nationalities. This has a relevance at the cognitive and relational level and at the same time reduce the tension to interact with classmates regardless of their nationality. Almost all respondents admitted being surprised when contrasted preconceived notions of certain nationalities and highlighted how media shapes the reality you believe in and how they took this opportunity to contrast those ideas with real people. Three major groups of students were evidenced: (a) a majority who recognized they arrived with many stereotypes and how their perception changed; a minimum proportion (b) who thought they did not have stereotypes but then realizing they had many – in this group, all have had previous multicultural exposure –; and (c) who did not have any strong stereotypes about others due to previous cultural experiences.

> I thought Chinese people were very cold and they just work and study (…) I learned to make a difference between Koreans, Chinese, Japanese, Central Asians like Tajikistan… Country cultures have influence, but personality traits

> are so important… We think culture defines the people, but I think it´s something ourselves do to become less nervous you know? (P12, Female, 22, Lima, Peru)

Almost all the responses involved the recognition of wider range of people rather than those they had before for world regions as they interacted with people in diverse scenarios and held media responsible in shaping public perceptions and opinions. For the growth of any stereotype, the long-term media exposure, especially television, "cultivates" a conception of social reality in viewers that reflects the content they see on television [36, 37]. In line with participants' responses, several studies confirm that African, Latino and middle eastern representations don´t portray their realities [38–42].

> I think a lot of people had ideas about me or about my country because of some things that had media exposure… Oh is Ebola still in your country? … A lot of people have many stereotypes about us and how we live… because of how media portrays us… it was difficult sometimes to hear how much misinformation there is. (P09, Female, 25, Freetown, Sierra Leone)

3.2 Frustration and Adaptation Phase

This phase starts when the cultural differences affect the student's daily life and there is pressure from the program to adapt personally and professionally. It holds two key moments: the frustration peak and the start of adaptation. Students mentioned that their mentoring groups and project guide were key elements to achieve project objectives.

Regarding the personal challenges' students manifested difficulties getting used to the dorms, living facilities, bathroom sharing, alcohol and religion and reported some incidents with physical contact. One villager did report a difficult situation due to an ongoing controversial cross-national conflict and other students commented about it and how it got solved by the end of the program. Data show that students solved their conflicts. The Culture-Based Social Ecological Conflict Model [43] refers how people use what they know about a conflict to act competently and produce an effective resolution. In line with previous studies [43–45], the students were able to (a) respect the cultural differences, (b) bring conflict-sensitive responses and manage stress.

> During my country presentation, I had a tough situation and I felt bad because some students judged me only from the country I´m coming from… step by step I showed them that I´m not what they were told... There was a night were conflicted nations and I sat down and shared our history and we understood how people are the victims… they were my classmates and in the end, we all knew there is good people everywhere. (P11, Female, 29, Tel-Aviv, Israel)

Since the beginning of the program, students are assigned to a support group with an appointed mentor (GV Alumni) for personal goals and experience a positive bonding with peers. During the difficult moments, all students manifested that mentoring – from their project advisor and their group guide – were crucial for developing problem-solving skills for life. Besides, students mentioned that the willingness of the participants to listen and be guided was a determinant of coaching effectiveness.

> Global Village wouldn´t be the same without the guides. It´s probably the most important to have the guides and lead you through the experience … It taught

> me to be responsive to my group needs… I am a more thoughtful person after it … it wasn´t until I got my issues that I got to see the value of the guides and how their support makes you grow. (P15, Female, 22, Rabat, Morocco)

3.3 Integration Phase

When students reach the peak of integration, they have – without noticing – established well-developed friendships and the time to return home is close. This phase could be compared to the adaptation phase of the W-curve model [29, 31]. When being asked about their friendships in the program, some students recognize to have searched at the beginning for friends with similar cultural characteristics. Interviewees were able to connect with each other and mentioned that the student-led bonding activities like cooking classes, parties and late-night talks were critical to building strong and worthwhile bonds. When international students feel included, they may go beyond their comfort zones and explore relationships with culturally dissimilar others. Without friends to support them, they would resist their own intercultural adjustment process. Previous research on intercultural friendship [45–47] have found that friendship numbers and satisfaction were significantly related to communicative adaptability and loneliness reduction.

> I think my closest friends were not just for cultural affinity but more like personality… no matter where you're from you could be friends and I think that I discovered through them that I had no fear to expose myself like the real me (…) I will never forget a night when we were all outside the dorms… the program was ending, and I saw them all just laughing and soon realized that the problems I thought were only mine (P3, Male, 31, Foggia, Italy)

When asked about their perceived personal growth, all students said they had a personal improvement in their life, and referred themselves to being flexible and open to new experiences. Some of them also mentioned they felt capable and willing to communicate with people from diverse backgrounds. According to the Intercultural Willingness to Communicate scale from Kassing [48], there is a willingness to talk to someone: (a) the subject perceived as different; (b) from a culture the subject knows little about; and (c) who speaks English as a second language. In line with the intercultural competence that is the ability to understand members of other cultures as if they (a) have a sense of belonging to a group of people based on relationship (i.e., family, friends) rather than cultural identity (i.e., people from my culture, people from other cultures); (b) notice similarities in personality between people who belong to totally different cultures; and (c) feel that people from other cultures have valuable things to teach them [49, 50].

> I definitely feel I changed like a lot … you're open minded and you never will look at the world at the same way… I feel like I traveled the whole world in just a summer… through people and it's just inspiring because now the map has a face… Part of your heart is like attached… you walk out of GV and I feel like I can open up and talk to somebody from any part of the world and I know have the capacity to do that. (P10, Female, 24, Santiago, Dominican Republic)

All interviewees affirmed that Global Village meant to them a life-changing opportunity that made them come out as a completely different person. This was an unforgettable and rich experience that they will always remember. The most frequently used words used to describe were unforgettable, family and friends around the world, and personal growth process.

> I´ve changed a lot … I can´t even explain…I came with some expectations for professional growth and left with I got more than I expected... When I came back to my country, I fought everyone because I knew I had a world supporting me… it was until then I got the shock from being here again and I said: wow, I changed. It´s incredible how in just a month you can change drastically and when you come back it´s hard to stay within that new yourself. (P14, Female, 32, Astana, Kazakhstan)

4 Conclusions

According to the aim of this study, findings show that the students experienced the process of intercultural adjustment in three main phases: (a) Excitement and Disorientation; (b) Frustration and Adaptation; and, (c) Integration. It is of concern that the majority of students perceived the difference in terms of adjustment between those who have had previous exposure to cultural diversity - functioned as a stress reducer in most cases - and those who did not. The students' process of adjustment was mostly symmetrical but found differences regarding the emotion predominance depending on the nationality as related to cross-national cultural dimensions. The biggest stressors identified throughout the experience were: language, real work accountability, and daily life. Overall, participants perceived that the experience was positive, and findings reinforce the importance of developing intercultural competence.

Even though this is a relatively new trend, the power of education abroad comes from its unique ability to provide students with challenges in the emotional and intellectual sphere. For future studies it is relevant point out how the design and structure of the programs play key role in the different impacts of educational experience on students. It is important to study cross-cultural adjustment experiences of specific groups of international students and their coping strategies within their context to enrich the possibilities of improving the programs. Practitioners such as university counselors and community workers should first be able to recognize specific adjustment experiences of different groups of international students and then apply different effective strategies to help these different groups solve their problems.

The study is not without limitations. The results apply to The Global Village for Future Leaders, a short-term study abroad program. Therefore, more studies in others study abroad programs in US as well as in other countries will transfer these findings into larger host contexts.

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A Content Analysis of Teachers Reaction Towards the Aggressors: Some Preliminary Results

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Abstract. Bullying have been characterized by asymmetry of power, persistence and repetition towards the victim. Despite that this phenomenon is considered a public health issue, it is still a major problem in Peruvian schools. Additional factors such as poverty, lack of professional competence and programs that are not based on evidence, bullying seems to impact more in developing countries. A recent report from the Peruvian government indicated that 39 315 cases of bullying incidents have been reported between 2013 and 2020. In addition to this, 89% of public schools do not have psychologists in their staff. As a result, this situation make teacher intervention in bullying cases more complex and challenging. Previous studies have found that teachers use a variety of strategies in relation to bullying incidents and that these have positive or negative impact in aggressors' behavior. Therefore, the present research aimed to describe and analyze how elementary Peruvian teachers react towards the aggressor in bullying incidents. To reach this goal, teachers completed a questionnaire of hypothetical physical bullying situations as well as sociodemographic and open ended questions. Results showed that teachers used different strategies to handle physical bullying and that they had limited knowledge in how to approach these situations. Results are discussed in terms of research, possible practical applications for teachers and schools.

Keywords: Bullying, Teacher Strategies, Elementary School

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1 Introduction

The higher rates of violence in public Peruvian schools has called the attention from teachers, students and families. Bullying has characteristics of power imbalance and it has been defined as a repetitive physical, psychological or sexual aggression in school settings in a way that causes harm, fear and/or sadness to victims [1]. This situation has a major impact in developing countries where economic barriers and risky schools interact with students relationships. For instance, a recent report [2] showed that 39,315 cases of bullying have been reported in Peru and 75.7% of children reported that they were victims of bullying [3]. However, these number may be biased as it is still unknown the number of non-reported cases, which may hide the real extent of bullying penetration in Peruvian public schools. In addition to this, the majority of reported cases came from public schools where conditions are precarious and risk factors coexist.

Clearly, bullying has many types of manifestations and it is well-established that each type has different short and long term consequences. For instance, Beggotti [4] stated that physical and verbal bullying are explicit manifestations of aggression while psychological or social attacks are implicit. Overall, some of these types of aggression have negative repercussions in academic performance, school climate, antisocial behavior, mental health issues and chronic health problems [3], [5-7]. These amount of evidence show that bullying has several implications among student's wellbeing and their social relationships in school settings. Moreover, these repercussions may increase the persistence of violent behaviors from aggressors and the possibility to develop antisocial personality traits in the future.

In spite that bullying has been considered a mental health issue [6], efforts to tackle this phenomenon in Peru are not sufficient. For instance, according to SISEVE physical bullying is the most frequent type (e.g. 51% of 39, 315 cases reported) and the number of reported cases tends to increase every year [2]. Apart from this, a government report showed that 89% of Peruvian public schools do not have psychologists in staff and 70% of bullying incidents are not reported or corrected [8]. This is particularly critical in rural zones of Peru such as the highlands or the jungle where public schools may not have internet access to use SISEVE platform. In the same way, lack of financial, human resources (e.g. psychologists) and knowledge in how to handle bullying makes the phenomenon more challenging and difficult to reduce aggressor's behavior.

The literature on bullies has highlighted several short and long term behavioral issues. Research in bullies profile has shown that they exhibit different types of aggression [6], show antisocial behavior [2, 10], use aggressive strategies for conflict resolution [9] and have poor relationship with their teachers [7]. Likewise, there are risk factors that contribute to initiation and maintenance of bully's behavior. For example, a recent review found that low monitoring, lack of connection with school, conflicting families, negative attitudes towards the victim [10] and lack of teacher support contribute to aggressor's behavior [11]. These behaviors has profound negative consequences at a psychological, academic and physical level on victims. For instance, recent work by researchers has established that bullying influence confidence, self-esteem, chromosomal abnormalities, psychosomatic problems, depression, social problems, stomach pain and sleep difficulties in victims [7, 12]. Considering all of these evidence, aggressors have a protagonist role in these behaviors that result in negative consequences for

victims. Moreover, these behaviors may be maintained and reinforced because their actions may not be addressed by staff (e.g. teachers). Therefore, it seems reasonable to address teachers as they are in the front line and spent most of the time with students.

Despite that teachers have a critical role in bullying prevention, intervention and maintenance [4], their capacity to handle bullying situations is diminished by several factors. Recent evidence suggest that 34% of Peruvian teachers did not intervene in bullying situations [13]. In addition to this, previous studies have found that teachers may feel less confident to intervene aggressors [14], feel less prepared [7], deny bullying incidents [15] and may have biased conceptualizations about bullying [16]. This controversy has generated distrust among victims and parents about how prepared is the staff to handle these situations and to what extent they are responsible to do so by considering contextual factors mentioned before. Moreover, this lack of training may affect student's mental health as well as maintain, increase and ignore bullying incidents. Therefore, there is a necessity to explore bullying in Peruvian public schools, those implicated (e.g. teachers, aggressors) and the type of approach that teachers use.

In general, much of the literature have mentioned that teachers use a variety of strategies to handle bullying. For instance, previous research indicated that they use punitive [7, 17, 18], dysfunctional (e.g. ignore, displacement of responsibility, naturalization) [7, 16, 19], psychological (e.g. role play, conflict resolution, assertiveness, psychoeducation) [4, 16, 20], classroom (e.g. peer resolution, school assembly, school climate) [7, 18, 21], external (e.g. parents, school principal, psychology staff, community) [20, 22, 23] or communication strategies (e.g. talking to victims, aggressors and staff) [14, 18] to handle bullying. These observations occur when teachers normalize violent behaviors, do not have the competence to intervene or seek support from psychologists or tutorial committees. However, these strategies may be influenced by additional factors such as the lack of implementation in anti-bullying policies [24], absence of mental health professionals in public schools [8] and misconceptions about mental health [25]. Together, these studies indicate that teachers may use inadequate or effective strategies to handle bullying incidents and that the latter may not have the adequate support because of the lack of knowledge and importance towards students mental health.

In addition to this, there is also evidence that reflect teachers' reluctance to intervene and lack of competence in bullying management. One study found that teachers considered bullying as a "regular familiarization process" while others ignore bullying incidents [26]. What is more, an investigation with teachers showed that they lack of training programs in this topic [27], 25% of them did nothing on bullying incidents [28] and others approach aggressors without a structured strategy [14]. In contrast, recent reports have found that teachers are more likely to intervene with a holistic approach by calling the victim, bystanders, bullies and parents [7]. These inconsistencies has called attention among scholars on the psychological and social factors that may influence these approaches among teachers. Nevertheless, a lack of empirical studies on elementary teacher's reactions towards the aggressor(s) is scarce in the Peruvian context. What is more, much less is known about studies that address on these strategies by using qualitative approaches. Therefore, this paper attempts to a) identify elementary Peruvian teacher's reaction in relation to physical bullying; b) describe the type of strategy in bullying management. This study provides new insights into teacher-students relationship on bullying situations. It also make important contribution to the field of bullying incidents in public schools in Peru and it also provides a baseline for possible intervention programs and further research in students-teacher interaction.

2 Methods

The participants in this study were recruited from Lima, Peru. A total of 804 elementary teachers were invited to participate. These teachers were attending a one-week training program dictated by the Peruvian Ministry of Education. All of the participants were working in public elementary schools located in the suburban area of North of Lima. A convenience sample was chosen because of the easy access to researchers, save time and resources [29]. Prior to data collection, staff of the Ministry of Education received an explanation of the research project. After teachers training, participants were told about the objectives of the study, informed consent, their right to withdrawal and anonymity protection procedures. A major advantage of using teachers is that they share large amounts of hours with students and are witnesses of bullying situations. In addition to this, teachers have been useful in bullying research [30].

Participants were asked to respond to sociodemographic questions such as sex, if they received specialized training on bullying, existence of bullying program in their schools, among others. The Bullying Attitudes Questionnaire was used to show the hypothetical physical bullying scenario [31]. Once the sample saw the vignette, open-ended questions [32] were asked about how teachers would react to the bully, victim and bystanders. The Bullying Attitudes Questionnaire has shown adequate internal consistency [33] and vignettes are in line with official bullying criteria [34]. In addition to this, opened-ended questions have shown to be useful on showing teacher strategies towards the bully [32].

The use of qualitative research is commonly used in bullying research [30]. For this study, we used content analysis [35]. A major advantage of content analysis is that it allows to establish the presence of concepts, quantify and analyze them. In addition to this, it helps to analyze large amounts of written messages, open-ended responses, identify patterns and make inferences for practical action [36, 37]. Prior to manually coding the data, transcripts from open-ended questions were checked and read for data familiarization purposes. After training two coders of the research team, we decided to use an inductive-existence approach as well as distinguish concepts when similar phrases appeared [35, 36]. Once analysis decisions were taken, three coders of the research team met three times a week to code teacher phrases and resolve any discrepancy. After coding the data, we decided to remove irrelevant codes because they were not related to the research question or were irrelevant [36]. Once the coding was finished, we started to develop emergent sub-categories and categories. In particular, one emergent category called “mixed strategy” was problematic because it included more than one strategy, it was not consistent (e.g. each of the responses contained different reactions in one sentence) and did not make sense in comparison to other categories. As suggested by previous authors [35], we used this category to re-examined responses, codes and the remaining categories. After that, the list of sub-categories and categories were revised in order to make clusters and definitions.

3 Results

The purpose of this study was to explore and describe elementary teacher reactions to physical bullying situations. Overall, teachers showed a variety of strategies to cope with the aggressor in bullying incidents. Fig. 1 shows an overview of main categories, categories and sub-categories. In relation to descriptive statistics, the mean score for age was 48 years old and respondents reported they had 21.5 years on average teaching in elementary public schools. Overall, 20.9% and 79.1% were males and females respectively. From both genders, 80.8% did not received training on how to handle bullying situations and 85.1% stated that it did not exist an anti-bullying program in their schools. For those who said that there was a bullying program in their schools, some teachers indicated that it was "written on paper" but it was rarely applied.

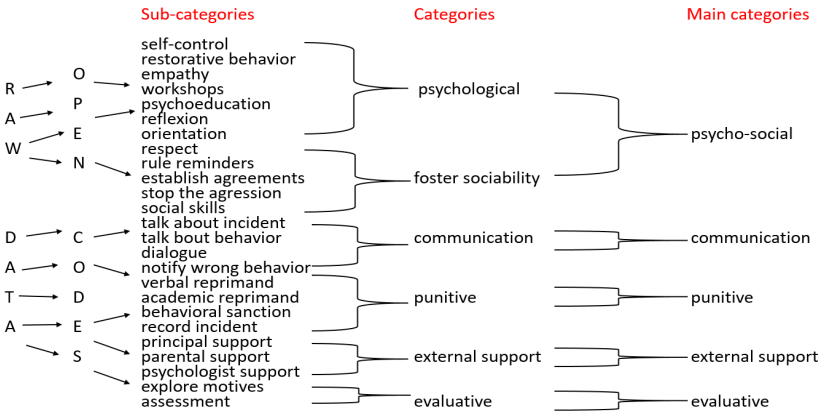


Fig 1. Teacher Strategies Towards Aggressors

3.1 First Category: Communication

The major strategy towards the aggressor among teachers was the use of "communication strategies". Communication strategies encompassed talks with the aggressor about the incident, their behavior in relation to the victim and the notification of the incorrectness of such acts. For instance, talking about their behavior included talks with the aggressor's attitudes and their violent actions towards the victim. This can be exemplified when one teacher indicated: *"I would probably talk to him about his negative attitudes toward the victim because this kind of response is not appropriate"; "I would talk to him about his attitudes because the way he is behaving is not right".*

3.2 Second Category: Psychological

Another recurrent strategy was the "psychological" approach. In this category teachers were more likely to encourage self-control, empathy, restorative behaviors, psychoeducation, self-reflection, guidance and workshops. For instance, "psychoeducation"

included showing video-tutorials about bullying, small talks about violence and its consequences. Examples of this can be taken from participants responses: *"I would try to instill on him that violence may affect his behavior, personality and that it may bring him consequences"; "I would show them video-tutorials about violence and possibly make a plan for parent-teacher group meetings and talk about the topic".*

3.3 Third Category: External Support

In this category, teachers considered that seeking support from principals, parents and mental health professionals would be an effective strategy to cope with bullies. In relation to parents support, teachers mentioned that they would communicate with parents, make phone calls or talk with them in front of the bully. This was exemplified in the following extracts: *"I would probably register that incident in bully's log book and then make an appointment with his parents"; "I would call his parents and advise them to seek support with a mental health professional".*

3.4 Fourth Category: Punitive

Another group of teachers stated that they would use punitive strategies such as academic reprimands, verbal reprimands, behavioral sanctions and registration of the incident. For example, verbal reprimands included talks with the bully in a severe way, reprehend and criticize his behavior. An example of this is found in teacher responses: *"I would let him know that his behavior is unacceptable and I would ask him if he would accept the same kind of behavior towards him"; "I would talk to him in a severe way."*

3.5 Fifth Category: Evaluative

Teachers also indicated that they would try to use evaluative strategies such as finding specific motives of bullies or make specific assessments about bullies family or problems. In relation to bullies' motives, these included asking questions, find the cause, request explanations about his attitudes and behaviors and/or find their specific intention through parents. This is evident in the following extracts: *"I would talk to him and ask what kind of problems he has and why is he behaving like that"; "I would try to find out why does he not respect other people´s things?".*

3.6 Sixth Category: Foster Sociability

In relation to the sixth category, teachers indicated that they would try to promote respect, set reminders for rules of coexistence, establish agreements between the aggressor and victim, stop the aggressive behavior and propose social skills. For example, the "social skills" sub-category comprised teacher's intention to promote assertiveness as well as find with them alternatives ways to communicate. This can be seen in the following citations: *"I would try to convince him to stop the aggressive behavior and show him alternative ways to borrow the eraser"; "I would tell him that if he wants something he can say it in other ways".*

4 Discussion and Conclusions

The present study was designed to determine elementary Peruvian teachers reaction towards the aggressor in physical bullying. In general, results suggest that teachers used a diverse range of strategies and that some of these are not appropriate approaches.One interesting finding is the category of "communication" where teachers talk with the aggressor about their behavior, the incident and attitudes towards the victim. This kind of response comprised the majority of participants' responses. A possible explanation for this might be that teachers use these strategies because they lack of knowledge on how to address bullying situations or feel less confident in how to address bullying situations. This finding was also reported by previous investigations that indicate that the most frequent type of intervention was talking to students who were involved in the incident [33, 38]. These findings are concerning, because it reflects isolated and subjective approaches to handle bullying situations. These kind of approaches may not minimize bullies behaviors and may create long term consequences to victims.

On the other side, other teachers indicated that they will address the situation with punitive strategies such as verbal reprimand or sanctions It maybe that this group considered physical bullying as a more serious issue. These results further support the idea that teachers believe that punitive strategies are effective to reduce physical bullying [17, 18, 39] and that Peruvian education system has a punishment education policy [40]. However, Ansary [6] indicated that punitive strategies lack of self-reflection and are ineffective. As a result, draconian approaches may exacerbate tensions and conflict between teachers, aggressors and victims.

Similarly, another group specified the preference for evaluative strategies in order to investigate bullies behaviors. In other words, these teachers are more likely to consider specific motives from bullies to perform dysfunctional behaviors in class. A possible explanation is that teachers may want to intervene in those motives to minimize violent incidents. These results are consistent with previous studies that indicate that teachers are effective in assessing bullying behaviors [41]. However, Peruvian teachers may need to be trained, consider robust psychometric questionnaires and complement their assessment with victims, bystanders and parents. Further studies are needed to determine the type of assessment teachers use to identify bullying cases in Peru.

Furthermore, another group of participants indicated that they would use psychological approaches towards the aggressors such as workshops, orientation, reflection and psychoeducation. A possible explanation for this might be that this group of teachers are more informed about bullying effects or may have received psychological training. This finding seem to be consistent with other research which found that teachers use psychological techniques to approach bullying such as such training in social skills, conflict resolution, psychoeducation and boost self-esteem [4, 9, 16]. These findings are encouraging, as it shows that despite the lack of psychologists in schools, a group of teachers still want to change specific behaviors and educate students about bullying effects. However, more research and support is needed in order to implement and assess which programs and techniques are more effective by considering students age and context.

Another important finding was the category "external support". In this category, teachers considered to call parents, get support from the school psychologist and the principal. This finding could be attributed to the fact that Peruvian teachers have workload and/or other jobs so they try to reduce aggressive behaviors in bullies by

getting external support. These results reflect previous research findings that indicated that teachers may consider parents to tackle bullying and send aggressors to counselling departments or principals [7, 22, 23, 28]. In spite of this, alternative supports and follow-up cases should be given to teachers due the lack of psychologists in public schools [8].

With respect to the category "foster sociability", teachers reported a variety of strategies such as rule reminders, provide training in social skills and encouragement agreements between aggressors and victims. A possible explanation is that this group of teachers give importance to students relationships and school climate. These results support the idea of Bauman [18] and Berkowitz [20] who indicated that teachers make efforts to improve social relationships among students. This type of strategy can be accompanied with family members and community in general in order to strengthen student's relationships.

In general, we observed that elementary Peruvian teachers lack competence in how to manage bullies behaviors. These results show the lack of professional capacity and the necessity to include holistic programs that involve bystanders, victims, aggressors, principal, community and school staff in general. These findings will be of interest for government educational institutions, educators and mental health professionals. A limitation of this study is that we did not explore gender differences or used in-depth interviews. In addition to this, the sample came from North of Lima, so findings cannot be generalized to the whole population. Notwithstanding these limitations, this study has provided insights into bullying phenomenon, teacher approaches and possible practical interventions. This study should be repeated using relational content analysis, focus groups or compare teacher strategies in different behavioral problems (e.g. ADHD, homophobic bullying, and sexual harassment). There is, therefore, a definite need for evidence-based interventions for teachers as well as finding strategic alliances to counter the lack of psychologists and help to those affected.

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Developing Technical Writing for Engineering Students under a paper conference format

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Abstract. This paper's objective was to share our experience in developing technical writing for Engineering students based on the cognitive process theory of writing and based on the sociocultural perspective that affirm that writing is social practices that vary depending on the contexts in which it is carried out. Since 2014 we included a new course called "Writing Technical Articles" were students have to write a six-page paper in a conference format. We believe that the conference format shows students in an active learning approach how to communicate specific ideas according to the requirements of their field of study. We have structured the technical contents based on technical writing recommendations suggested by the Institute of Electrical and Electronic Engineers (IEEE), a professional association that produces over 30% of the world's literature in the engineering and computer science fields, publishing approximately 200 peer-reviewed journals and magazines. Students develop skills for organizing sections and subsections, relationships among parts of an argument, and combining paragraphs with diagrams, formulas and codes very common in Engineering. Until now 630 Ingeniería de Sistemas students from Universidad de San Agustin de Arequipa has been part of the course. Our experience showed that this format gives students the scope to start the process of technical writing. As initial results, we have surveyed students about their perception of usefulness of technical writing under the conference format. The initial results showed us that more than 90% of the students are Agree and Strongly Agree about the usefulness of developing technical writing.

Keywords: Technical writing, cognitive process theory, conference paper

1 Introduction

In recent decades the Engineering field has recognized the need for graduates to develop strong communication skills. Institutions such as the National Academy of Engineering (NAE) in its report "The Engineer of 2020: Adapting Engineering Education for the New Century" [1] describes a set of attributes that are necessary in a world directed by rapid technological and environmental changes, one of these

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attributes refers to communication. International accreditation institution for Engineering programs like ABET (Accreditation Board for Engineering and Technology) requires that programs must include for student outcomes the ability to communicate effectively: orally and written [2]. Engineering discipline has generated theoretical and empirical studies presenting suggestions for curriculum design, interdisciplinary courses, integrated programs, and a variety of support systems, including writing and communication centers and online resources to emphasize communication instruction in engineering [3-6]. Donnell, Aller & Kedrowicz [7] focused an important study on identifying why the industry considers these skills to be weak. They found that part of the disparity arises because the communication tasks that engineering students perform at university differ significantly from the writing situations (audiences, purposes, and occasions) that engineering graduates encounter in the industry.

From the literature review Solé et al. [8] affirms that students are used to responding to simple writing demands that primarily require writing for a single recipient - the professor - and with the objective of demonstrating what they learned. Also Catelló [9] presented as the main difficulties faced by university students regardless of the type of text and the disciplinary area: (a) lack of knowledge of the nature of the written composition process (b) lack of knowledge of structural characteristics of academic texts and the useful strategies to produce them. Students do not know the differences between a report, a personal comment or between a bibliographic review and a synthesis or a technical paper for a conference. Also Rienecker and Jörgensen [10] stressed that writing to meet the expectations of university education contexts requires having a set of competencies that go beyond the basic learning acquired in primary or secondary education. They have shown that the skills necessary to master the writing of higher studies are not acquired spontaneously. Authors affirm that writing requires an instructional process. Under these context our work seeks to answer the research question: Is it possible to develop technical writing skills in Engineering under the conference paper format?.

The course “Writing Technical Articles” was implemented since 2014 at the Escuela Profesional de Ingeniería de Sistemas at Universidad Nacional de San Agustin de Arequipa [11]. The activities of the course were designed based under the cognitive process theory of writing [12] and taking as foundation technical writing standards for Engineering. Technical writing recommendations are long stablished by the Institute of Electrical and Electronic Engineers (IEEE) [13] that produces over 30% of the world's literature in the electrical and electronics engineering and computer science fields, publishing approximately 200 peer-reviewed journals and magazines..

2 Background

Hayes and Flower [10] developed the cognitive theory process of writing where they identified three main activities in the writing processes: planning, translating and reviewing. Planning takes the writing assignment and produces a conceptual plan for

the document as output. Planning includes sub-activities of generating ideas, organizing those ideas logically, and determining what effects one wants to achieve. Translating takes the conceptual plan for the document and produces text expressing the planned content. In reviewing, the text produced so far is read, with modifications to improve it (revise) or correct errors. Hayes and Flower [12] presented evidence that these processes are frequently interleaved in actual writing, authors may be planning for the next section even as they produce already-planned text; they may read what they have written and detect errors and change their goals and plans for the next section. Hayes and Flowers affirm that writing involves complex problem solving. From the social cultural perspective knowledge is conceived as a cultural and discursive fact, a social construction that the human community has made, with the rational instrument of language [14]. Education must be understood by the activity of production and communication of knowledge in different disciplinary fields. This assumption implies for our work the need to teach the particularities of the production of the texts that circulate in the disciplinary field of Engineering.

The Institute of Electrical and Electronic Engineers (IEEE) [13] is a professional association for Electronic Engineering and Electrical Engineering . It is the world's largest association of technical professionals with more than 423,000 members in over 160 countries. Its objectives are the educational and technical advancement. IEEE produces 200 peer-reviewed journals and magazines. IEEE publishes more than 1,200 leading-edge conference proceedings every year. IEEE has standards and recommendations for technical writing [15]. It identifies three main blocks: macro level, micro-level, and paragraph [15] ***Macro-level:*** determine a document's purpose. IEEE highlights: (a) Organization of sections and subsections, (b)Relationships among parts of an argument, (c) Formatting and (d)Navigational aids. Sectioning a document involves identifying argumentative units of similar scope or size that have some logical relationship. In research reports, for example, sections are often named using scientific argument terms that research communities tend to recognize such as: "Abstract", "Introduction", "Related Work", "Background", "Method," "Analysis," and "Result." **Micro-level**: is related to carrying out the document's purpose. IEEE highlights (a) Choosing words and phrases in sentences, (b) Recognizing the function of words and expressions (c) Writing in regular sentence patterns, and (d) Including linguistic cues to indicate the structure of an argument. Writing at the micro-level is about identifying the immediate purpose of a sentence related to the sentences around it. The reader should feel an argumentative "flow" as they read a document that moves along unambiguously from point to point. There are five parameters to consider in the micro-level: unity, coherence, emphasis, clarity, and concision [15]. ***The paragraph*** between the macro and micro-level in a document, there is an intermediate level: the paragraph. paragraph is a block of text that functions to group statements that have some logical relationship so that they can be understood together. Less textually dense alternatives to paragraphs at this level are lists, tables, pictures, illustrations, charts, graphs, diagrams, formulas and codes. Each of these can be used effectively to make argumentative points, and each requires specialized literacy to access.

3 Methodology

3.1 Description

The course of Writing Technical Articles was added to the curriculum of the Escuela Profesional de Ingeniería de Sistemas [11] at the Universidad Nacional de San Agustin de Arequipa in 2014. The course has 17 weeks duration. It is taught in the 3rd semester. It has two lecture hours per week. The design of the course has been developed based on the cognitive process of writing [12] and following IEEE technical writing recommendation [15] since the authors agree that writing is social practices that vary depending on the contexts in which it is carried out. The topics taught in the course are listed in Table 1. From the 17 weeks of classes only six are dedicated to developing the topics shown in Table 1. the rest of the time is devoted mostly to a dynamic and iterative process of translating and reviewing. Students are asked to deliver incremental drafts and they receive continue feedback.

Table 1. Topics of the Course

IEEE Main Blocks	Course Topic – IEEE
Macro Level	Unit 1: Overview
	1.1 Why is Technical writing important
	1.2 What is a Call for papers
	1.3 IEEE conference paper format – navigational aids
	1.4 Parts of the article
Micro Level	Unit 2: Planning
	2.1 Keywords, synonyms and related terms
	2.2 Implementing the search strategy and search parameters
	2.3 Searching information: Scopus, Web of Science, IEEE Xplore
	2.4 Credibility and reliability of sources of data
	2.4 Critical Reading
	2.5 The writing plan
Paragraph	Unit 3: Technical Writing
	3.1. Writing sentences and paragraphs
	3.2. Tables, images, diagrams, formulas and codes
	3.3. References and citation in IEEE format with Mendeley
	3.4. Developing unity, coherence, emphasis and clarity
	3.5. Writing Related Works
	3.6. Writing the Proposal
	3.7. Writing Abstract, Introduction and Conclusion

3.2 The conference paper format

Throughout the semester, each student writes a technical paper. Each student is assigned the topic and also the title in the first week. Each topic has been formulated in order to give students knowledge about the scope of the software engineering field and its impact on a global and social context and to motivate them. The final paper only will have six pages, with a minimum of 20 references. There are five reviews throughout the semester. Students deliver incremental drafts of the paper. The description of the deliverables are shown in Table 2.

As we have set in the background section writing academic texts is a complex cognitive process that requires intense cognitive activity. In a specific field like Engineering, writing a conference paper to show a new design, a prototype or a new software is an important professional skill. The process of writing requires described in our experience requires students to search for information, select the one that they consider most relevant after a critical reading, organize this information for propose a writing plan, to write according to the writing plan and rehearse various formulations on the paper. The process that we have just described involves planning, writing (translating) and review activities that, in general, do not occur in a linear way (Fig. 1).

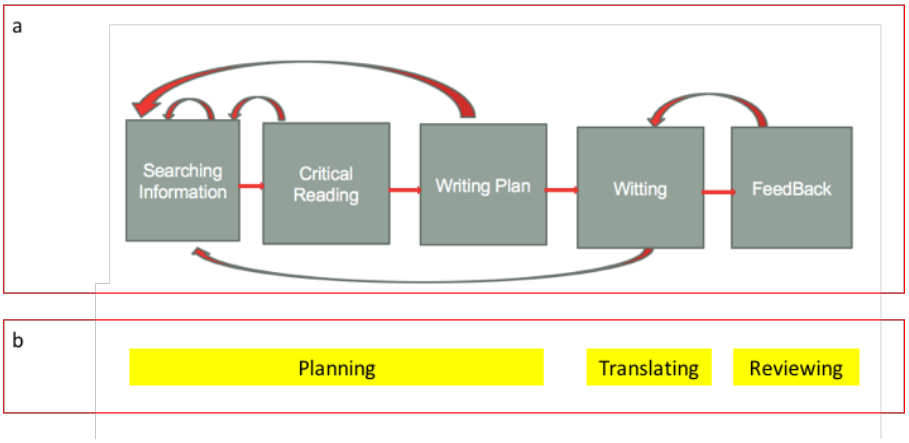
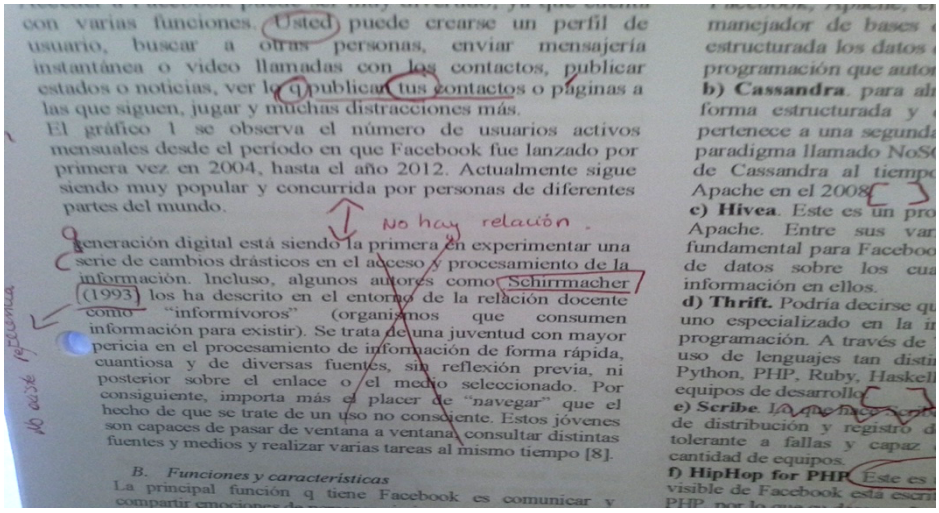


Fig. 1. (a) The main activities of developed in the course for writing the paper are iterative and dynamic. (b) There is relation with the cognitive process theory of writing

Table 2. Deliverables of the Paper

Deliverables description	Week
Basic Information	2
a. Present the keywords and synonymous related to the topic assigned	
b. Present the Search Strategy used and the refined search strategy	
c. Share in the course drive at least five related articles of the topics (justify why they were selected)	
d. Complete the Paul-Elder template for critical reading for the five articles you selected	
Writing Plan	3
a. Based on the previous activity develop your writing plan; consider IEEE section format	
b. Use Title, subtitles and sub-subtitles.	
c. Describe from general concepts to detailed concepts	
d. Consider at least 5 references from IEEEXplore, ACM Digital Library, SCOPUS, WOS, SJR.	
Draft 1	5
a. IEEE paper format	
b. 1 page and 10 references.	
c. No abstract, no introduction and no related works	
Draft 2	7
a. Make up observations in Draft 1	
b. Write 2 pages and 10 references	
c. No abstract , introduction and related work	
Draft 3	10
a. Make up observations in Draft 2	
b. Write 4 pages including Related Works and your Technical Proposal.	
c. No abstract and introduction	
d. At least 15 references	
Draft 4	15
a. Make up observations in Draft 3	
b. Write 6 pages with Abstract, Introduction and Conclusions	
c. At least 20 references	
Final paper	17
Make up observations in Draft 4	

Fig. 2 shows a papers that correspond to the Draft 1 version, we can observe grammatical errors and also the use of citation that do not coincide with the IEEE standard. There is also a reference to Graphic 1 that was not found on the text. Students receive personal feedback after each presentation. Also we summarize common mistakes and prepare a special class to explain again the topics we have found still confuse or difficult for students.



con varias funciones. Usted puede crearse un perfil de usuario, buscar a otras personas, enviar mensajería instantánea o video llamadas con los contactos, publicar estados o noticias, ver lo q publican tus contactos o páginas a las que siguen, jugar y muchas distracciones más.

El gráfico 1 se observa el número de usuarios activos mensuales desde el período en que Facebook fue lanzado por primera vez en 2004, hasta el año 2012. Actualmente sigue siendo muy popular y concurrida por personas de diferentes partes del mundo.

No hay relación.

generación digital está siendo la primera en experimentar una serie de cambios drásticos en el acceso y procesamiento de la información. Incluso, algunos autores como Schirmacher (1993) los ha descrito en el entorno de la relación docente como "informívoros" (organismos que consumen información para existir). Se trata de una juventud con mayor pericia en el procesamiento de información de forma rápida, cuantiosa y de diversas fuentes, sin reflexión previa, ni posterior sobre el enlace o el medio seleccionado. Por consiguiente, importa más el placer de "navegar" que el hecho de que se trate de un uso no consciente. Estos jóvenes son capaces de pasar de ventana a ventana, consultar distintas fuentes y medios y realizar varias tareas al mismo tiempo [8].

B. Funciones y características

La principal función q tiene Facebook es comunicar y

manejador de bases
estructurada los datos
programación que auto
b) Cassandra. para al
forma estructurada y
pertenece a una segund
paradigma llamado NoS
de Cassandra al tiempo
Apache en el 2008[ ]
c) Hivea. Este es un pro
Apache. Entre sus var
fundamental para Faceboo
de datos sobre los cua
información en ellos.
d) Thrift. Podría decirse qu
uno especializado en la i
programación. A través de
uso de lenguajes tan disti
Python, PHP, Ruby, Haskel
equipos de desarrollo[ ]
e) Scribe. La
de distribución y registro d
tolerante a fallas y capaz
cantidad de equipos.
f) HipHop for PHP. Este es
visible de Facebook está escri
PHP

Fig. 2 Paper in Draft 1 version

4 Material and Methods

This experience was implemented in the Escuela Profesional de Ingeniería de Sistemas at Universidad Nacional de San Agustin de Arequipa. To answer our research question "Is it possible to develop technical writing skills in Engineering under the conference paper format?, we conducted an exploratory study. The study population were 90 students from the second year of studies. The sample was stablished though a non-probabilistic convenience sampling with 50 students that were part of the course in semester 2020-A. Students have an age range between 18 and 20 years with no previous experience in writing technical article and no experience in reading technical conference article eater[16-17]. The objective was to verify the perception of the students about the developing technical writing skills under the conference paper format. The instrument was prepared based on the MUSIC Model [9] that consists of five components (1) empowerment, (2) usefulness, (3) success, (4) interest, and (5) caring. For measuring students' perceptions we focus only on Usefulness component. The instrument consists of eleven statements that students responded to on a 6-point Likert scale (ranging from "Strongly Disagree" to "Strongly Agree"). Questions are Q1: In general, writing a paper was useful to me, Q2: The writing paper process was beneficial to me Q3: I found the coursework to be relevant to my future. Q4: I will be able to use the knowledge I gained in this course, Q5: The knowledge I gained in this course is essential for my future.

4. Results and Discussion

Table 3. Results

Question	Answer					
	Strongly Disagree	In Disagreement	Somehow disagree	Somehow agree	In Agreement	Strongly Agree
Q1	0	0	0	4%	34%	62%
Q2	0	0	0	10%	14%	76%
Q3	0	0	0	8%	38%	54%
Q4	0	0	0	4%	44%	52%
Q5	0	0	0	6%	28%	66%

Results in Table 3 shows values over de 50% in all the question in the Strongly Agree answer. Q2: "The writing paper process was beneficial to me" have scored higher with 76%. Considering only "In Agreement" and "Strongly Agree" results shows us that students consider Useful developing technical writing skills in more than 90%. We consider that the results allow us to affirm that we have a positive approach to answer our research question: it possible to develop technical writing skills in Engineering under the conference paper format.

From 2014 to 2020, the course has been taught for seven years. Each year we have had a range from 90 to 100 students. From the beginning, the course has been improved each year. We have emphasized the permanent feedback and incremented the lecture hours devoted to teach how to write the abstract, introduction, and related work. Supported in the experience of the first two years, we suggest reducing the number of students per group, by increasing the number of class sections. This reduced the student/faculty ratio to have more time for feedback sessions and include spaces for discussion. We have found it very useful to compile common mistakes and review the papers in special lectures asking students to suggest improvements to the papers we have shown as samples. In the writing process, the most common mistakes are made in the correct use of citations. Fig. 2 is a sample of it, many times students make a copy/paste from the original paper bringing a different kind of citation like APA (American Psychological Association). A second challenge is given by making a good argumentation when it comes to explaining related works and the similarities and differences with the work that students write. The incremental deliverables allow students to overcame common mistakes. We believe that teaching technical writing at the beginning is essential for students since we give them standards for writing, and they have other courses to apply what they have learned. It is also crucial to motivate them to keep on writing papers and to send them to conferences.

The closed work to ours is the presented by Popescu and Jovanovic [3] who introducing a writing assignments in an Electrical Circuits course, for electrical engineering technology students. Students were required to write a three-pages IEEE format paper. The topics for the assignment were selected from among the concepts studied in the course. The final paper was expected to contain the main results related to the selected topic, which, depending on the topic, could have been theorems,

formulas, examples with commentaries, relationships with other concepts, discussions on related applications, or other relevant information for the chosen topic. The main coincidence we found with our work are: both are IEEE conference paper-oriented, we consider the same important activities like: paper is well written, IEEE format is followed, no grammar or spelling errors, information is well organized in sections, relevant references are included and the proper format is used. One main different is that our work is a specific course in the curriculum that is devoted to teach technical writing while [3] presented and specific assignment as part of the course. Another difference is that we have show the detailed contents of the course that could be reproduced, we have also share the structure of the deliverables of the paper. The proposal has been structured under the cognitive theory process of writing.

5. Conclusions

Our work presents the experience of the development of technical writing skills in Engineering students based on a conference paper format. This experience teaches students the process of writing (planning, translating and reviewing) based on the theory of Flower and Hayes [12] and under the particularities of the production of technical paper in the disciplinary field of Engineering. The writing process is a complex process even more so if it is oriented to a Engineering conference. From a practical point of view students experience during seventeen weeks the dynamic and iterative writing process that includes activities such as information search (in reliable sources), critical reading, organization of the writing work, the writing itself and the reviewing . The results obtained describe in the previous section show us that there is a high acceptance of the importance of incorporating the practice of writing an article in conference format and that student consider it useful for their future professional live. Although the experience has been proven in students of Ingeniería de Sistemas we consider that the experience presented can be adapted to other specific Engineering field, making use of topics appropriate to each discipline. Likewise, starting in the early stages of study allows students to train in information literacy, critical reading and writing practices that are valuable not only for writing articles but for their lifelong learning.

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Effects of a voice training program through Anchor App on Public Speaking Anxiety in college students

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Abstract. Social anxiety (SA) could be around college students in the form of public speaking anxiety (PSA). In this study a voice inflections training program supported with an App (Anchor) is tested to see its effects on this variable. A quasi-experimental design was stablished with 340 students that were part of the research. 161 were assigned to experimental group and 177 to control group. They were tested on SA and PSA. Participants in the experimental group received ten 45-minute sessions (to train diaphragmatic breathing and public speaking) and constant feedback trough Anchor App. Results showed significant differences between both groups in terms of post-treatment measures (t= 2,147 Sig=,033) Cohen's d shows that this effect is small (d=,25) No statistical evidence on moderation (of the program in the relation of public speaking anxiety and social anxiety) is showed (p=, 1465; LLCI=-, 1633 ULCI=,1,0641). Even some aspects have to be reviewed, the program had effects and voice training seems an option for intervene public speaking anxiety

Keywords: Public speaking Anxiety, Social Anxiety, College education, Educational Apps

1 Introduction

Social anxiety could be considered as a form of anxiety disorder that, in its severe form, its characterized by disabling, pervasive fear and avoidance of social interactions which leads to an impact of many life areas and activities of people [1]. In the mildest form it begins with the anticipation of common social-evaluative situations in which the person don't fell capable enough to give a good public image. Ironically, the somatic reactions of this anguish produces a circle of reactions that finish on avoidance of social situations as a dysfunctional cope strategy [2].

This disorder usually begins on adolescence and its prevalence on population is considerable, leading many young patients to leave school and high school due to anxiety and many other students struggle with it every day on academic activities mostly in which social performance is involved [3]. Now, is important that this disorder could be perceived and prevented trough covering some apparently common social avoidance behaviors in classroom as public speaking. An important correlation between fear of public speaking and social anxiety has been found and could function as a predictor variable [4]. Sometimes the fear of public speaking could be associated with lack of

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preparation or nonverbal skills [5], but it also could be associated with hyper arousal as a reaction of this social evaluative situation [6]. In both cases learning skills to overcome this fear is important and preventive.

There are many programs to learn how to speak on public [20,21]. Its focus should aim on increasing the self-awareness of body performance as regulator of the emotional arousal. Voice training could be an excellent option because increase diaphragmatic breathing which has a positive effect on regulate stress-related physiological responses and also because teach how to control voice inflections which transmits dominance and leadership that enhances social performance during interactions. This would probably take the student to an embodied speech experience solving the incongruence of emotions during exposure to public.

1.1. Diaphragmatic breathing and Stress self-regulation

Voice training needs a previous training on diaphragmatic breathing because voice inflections are combined trough air pressure that activates vocal cords and body resonators [7]. This training basically consists on slow the number of breathings per minute and increase the voluntary movement of diaphragm [8].

There are many physiological effects of slow breathing: On respiratory system it reduces the chemoreflex response to hypercapnia and hypoxia (alveolar dead space) improving oxygen saturation [9]. On cardiovascular system it increases efficiency of venous return that are related with blood pressure trough cardiorespiratory coupling [10]. However, the present research emphasizes most of all its relationship with autonomic nervous system through vagal activity that has a much faster influence on the heart in order to modulate it. This is the cardiac parasympathetic efferents that involves acetylcholine release and also GABA pathways from cortex and insula, to inhibit amygdala overactivity [11]. This has been sustained with neuroimaging evidence that shows that slow breathing is related with prefrontal cortex activity to supervise activity from the limbic system and modulate the activity of autonomic nervous system [12].

All this evidence shows that a voice training program on a first moment would have benefits on anxious people through the effects of diaphragmatic breathing. Students will be able to self-regulate its autonomic nervous reaction (arousal) with this training that could be performed before a public speaking presentation and during it while voice is managed.

1.2 Voice inflections from evolutionary perspective and embodied speech

It's been demonstrated that a person's voice affects how others perceive that person. Specifically voice pitch. In order to achieve it researchers had isolated voice pitch as a variable, using voice recording of the same people changing only voice pitch. The results showed that males with lower pitched voices tend to be perceived more dominant

[13], the same with women but also they emphasize that higher pitched voices of women are tend to be considered more attractive [14]. The explanation could rest on evolutionary perspective. Bryan and Haselton [15] pointed that changes on voice pitch are associated with hormonal changes that are signals for coupling both for women and men.

This premise lead researchers to explore if people would perceive leadership trough voice pitch, it's been showed in many experiments that this is accurate [24,25], only existing a genre bias in which male voters could not preferred a female with a deeper voice as a leader.

When students train his or her voice inflections is mandatory to emphasize text to create a nonverbal narrative, this will be done with pitch and volume but also with body expressions that spontaneously links with voice inflections. This is an evidence of the articulation of speaking through thought, movement and feeling, what is called the embodied approach [16]. When the voice begins to give movement to verbal communication, emotions emerges in the perception of the audience. This could be an explanation why people who manage vocal inflections could empathize with audience and have better social interactions.

This articulation could be interrupted by a strong emotion as anxiety [17]. To give the student the awareness to an element (voice inflections) that could re-articulate his or her embodied speech could have an important effect on reducing anxiety experience and improve social performance

1.3 Training voice inflections by Anchor App feedback

Feedback is an important concept in order to achieve this awareness (of voice inflections) because in social anxiety exists a false feedback, patients direct their attention to their internal cues of arousal and use this information to erroneously infer how they appear to others [6]. Is important to search different cues of social performance as breathing, body movement and voice dynamics. The role of a voice trainer is fundamental because when the student begins its training is not conscious of muscle movements from its diaphragm linked with the variation of his voice, Hearing oneself while speaking could be difficult and feedback is essential, because even if the student records the voice, he or she will have problems to understand the body changes that have to be done in order to get a change. Luckily technology has given many tools in order to facilitate feedback for education purposes [18].

Anchor App was founded in 2015 and is a free platform for podcast creation. It allows users the recording, publishing, managing and broadcasting of the episodes. It works as a social media giving the chance to follow the podcast and interacting with the authors. Because is a platform that emphasize voice, allows to save episodes and, most important, interaction and feedback of those episodes by the audience. It appeared as a good option to support a vocal training program on high schools students and review its effects on public speaking anxiety and its relation with social anxiety symptoms.

2 Materials and Method

2.1 Participants

Participants included 340 students of different faculties at Continental University in Huancayo city, Perú. A quasi-experimental, single-blind design was applied with pre- and post-treatment measures. A group of different classes were evaluated in order to pair their ages and scores before assignation. Participants ranged in age from 18 to 33 years old, being 20, 57 (SD=1, 56) the average age in the experimental group and 19, 53 (SD=2, 69) in the control group. 54, 7% of the experimental group was male and 44, 1% was female, on the control group 56, 5% was male and 43,5% was female. Participants were asked about perception of their academic performance, both groups got approximately the same average score (Control group M=3, 16 / Experimental group M=3, 26) t test revealed no significant differences (t=-, 861 Sig=, 390). Finally, test for homogeneity revealed no significant differences between groups at pre-treatment on both dimensions of social anxiety (Fear and avoidance) (t=-, 035 Sig=, 972) (t=-, 084 Sig=, 972). Finally, 161 students were assigned to experimental group and 177 students to control group.

2.2 Instruments

Two scales were administered. The Leibowitz scale of social anxiety in order to take a pre-intervention measure of all participants in order to pair groups and the Personal Report of public speaking anxiety for prove the effects of the program and the main hypothesis of the present research. Also both measures will be correlated in order to prove if the program could moderate that statistical relation

The LSAS (Leibowitz social anxiety scale) comprises 24 social situations that are rated both for level of avoidance (0=none to 3=usually) or fear (0=none to 3=severe) during the past week. Its psychometric properties are good and were explored in Peruvian university students The PRPSA (Personal report of public speaking anxiety) is a scale of 34 items that are rated on a 5 item Likert scale (1=strongly disagree) to (5= strongly agree) 22 items are negative formulated. Its psychometric properties are good, in the present research we used the 18 items version [19] because it's a recently version that has good internal consistency ($\alpha = 0.97$). In order to adapt this short version on the Peruvian context the scale was translated and reviewed by five expert judges for relevance and validity (Aikens V > 70) and a pilot test was run ($\alpha = 0.79$)

2.3 Procedure

The program was established on three stages. The first one consisted on the recruitment of the participants, for this purpose an entire group of undergraduates that belong to a course study named "Methodology of research" was tested with the two scales. With those results, some groups that had similar scores and age were chosen to take the program as a training for their final exam that was an oral presentation. In a second

moment, in order to stablish a platform of training voice we created a podcast on Anchor App named "Psiconline" in which students could find tutorials of voice training that could be review at any time, also they could create their own podcasts in which they would post their vocal exercises. Because we could follow their episodes, we could give them constant feedback. In a third moment and supported by Anchor App feedback they took ten 45-minute sessions (A session per week) in which they can train diaphragmatic breathing and public speaking. This 10 week-program was scheduled as its seen in table 1. Da tuner App use was also required in the first unit of the program in order to recognize their pitch.

Table 1. Contents and goals of each session of the program

Unit	Number of Sessions	Goal	Tasks	Homework
Introduction at diaphragmatic breathing and phonation	1 – 3	Increase the awareness of slow breathing and how managing air could produce changes on the voice pitch and volume.	Attention to breathing 10 min Body relaxation trough meditation 10 min Vocal warmups -10 min Playing with Short quotes-10 min	Practice the exercise of breathing and relaxation at home and upload their first exercises on their podcasts
Analyze the text and give it movement	4 – 7	Public speaking by playing with the dimension of voice inflections and following with body movements	Text emotional Analysis 10 min Plan of vocal inflections 10 min Practice of oral presentation 20 min	Upload pieces of text with movement trough voice inflections
Try an entire piece	8-10	Public speaking with an evident action or intention on the audience	Text Action and strategies Analysis 10 min Practice of oral presentation 30 min	Upload an entire piece of text

2.4 Data analysis

T test were performed in order to determine whether or not groups were homogeneous prior to treatment. Levene homocedasticity test was performed. In order to analyze the effect size of the intervention Cohen's d were performed and repeated measures analysis of variance was conducted, Correlation between public speaking anxiety and social anxiety was performed trough Pearson's r and finally a moderation test (of the program on this relation) was conducted. The level of statistical significance employed was p<, 05. The analyses were carried out using SPSS 22 statistical package, Process V 3.2 and the R Stats effects size calculator for t test.

3 Results

On levels of Public speaking anxiety (PSA), T test indicated no significant differences between control group and experimental group in terms of pre-treatment measures. (t=,862 sig=,390). As is showed on Fig. 1, significant differences were observed between both groups in terms of post-treatment measures (t= 2,147 Sig=,033) Experimental group had lower scores (M=3,96) than control group (M=34,09) Cohen's d shows that this effect is small (d=,25) which is repeated by analysis of variance (F=4,608 p=,033 n^2 =,016) . Significant differences between pre and post treatment on the experimental group are showed (F=11,070 p=,001 n^2 =,034) and the Cohen's d shows that the effect is small (d=, 36). No Significant differences between pre and post treatment on the control group are showed (F=, 324 p=,570 n^2 =,001).

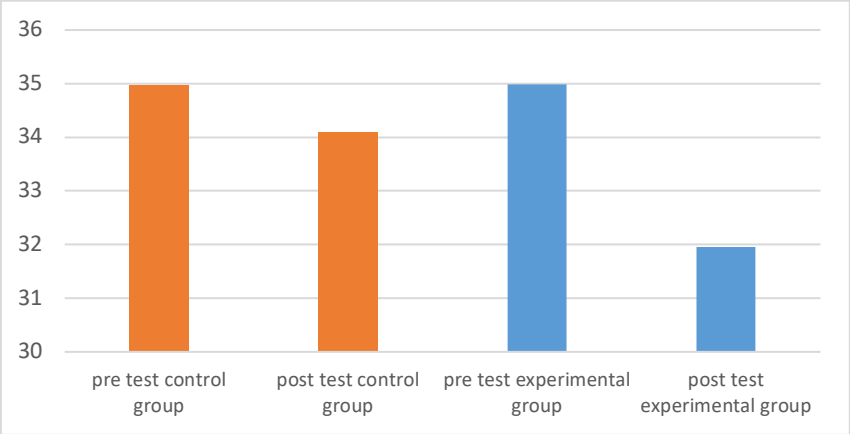


Fig. 1. Significant differences on PSA are seen between means of experimental group: Pre-test (M=34,99) Post-test (M=31,96) and between control and experimental groups: post-test control (M=34,09) Post-test experimental (M=31,96)

Specific effects of the program are showed on Table 2. As it could be seen, eight items (of the eighteen that are part of the short version of the PRPSA) showed statistically significant differences between pre-test and post-test measures. Being three items direct-scored and five items reverse-scored which could be interpreted as presence of anxiety or absence of it. The item number five showed the biggest difference (t=9,422; sig.=,000) being followed by items four (t=-5,885; sig.=,000) and twenty-four (t=-5,662; sig.=,000)

Social anxiety Sub scales didn't show statistically significant differences: Liebowitz Anxiety Scale (t=1,256; sig.=,211) Liebowitz Avoidance Scale (t=,880; sig.=,380)

Table 2. Specific program effects on PSA items and SA sub-scales

Item	Mean		t	Sig.
1- Mientras me preparo para hablar en público, me siento tenso y nervioso	Pre Test Post Test	2,490 2,144	3,349	,001
2. Me siento tenso o inseguro cuando el profesor dice que durante el curso tendremos que hablar en público	Pre Test Post Test	2,226 1,886	3,131	,002
5. Me siento ansioso (a) cuando siento que se acerca mi turno para hablar en público	Pre Test Post Test	2,481 1,462	9,442	,000
6. No tengo miedo al hablar en público	Pre Test Post Test	1,829 2,227	-3,490	,001
4. Justo después de hablar en público usualmente siento que viví una experiencia placentera.	Pre Test Post Test	1,660 2,276	-5,885	,000
16. Siento que estoy en completo control de mí mismo al hablar en público	Pre Test Post Test	1,713 2,165	-4,762	,000
17.Al hablar en público tengo las ideas muy claras	Pre Test Post Test	1,835 2,120	-3,155	,002
24.Mientras hablo en público, sé que puedo controlar mis sentimientos de estrés.	Pre Test Post Test	1,685 2,251	-5,662	,000
Liebowitz Anxiety Scale	Pre Test Post Test	20,360 18,779	1,256	,211
Liebowitz Avoidance Scale	Pre Test Post Test	22,575 21,257	,880	,380

Analysis of correlation between public speaking anxiety and social anxiety shows significance association between both scales (r=, 457**). An important force of association is showed (r=, 504**) between PRPSA total scale and anxiety dimension of

LSAS scale, and less force of association (r=, 354**) with avoidance dimension of LSAS scale. As is showed on Fig. 2, On moderation test applied on students with high scores of anxiety that took the program, r^2 decreases in the post test evaluation (r^2=0,007) in comparison of pretest (r^2=0,302). However, no statistical evidence on moderation is showed trough PROCESS Macro (p=, 1465; LLCI= -, 1633 ULCI=,1,0641).

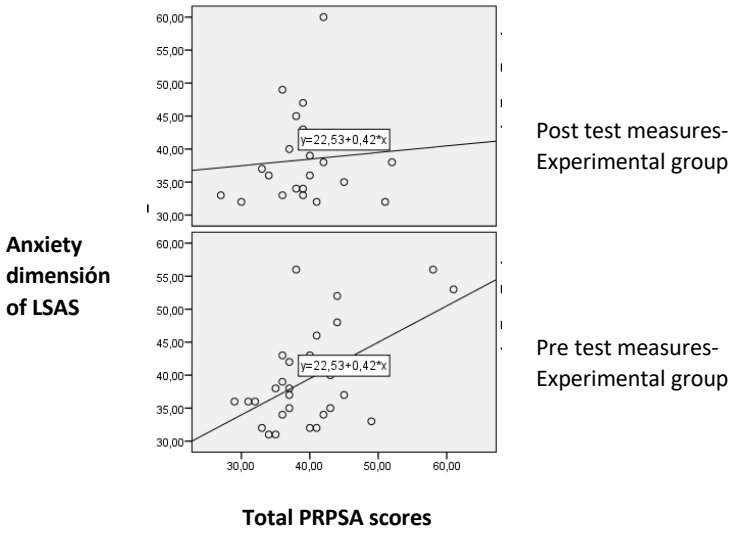


Fig. 2. The association between Total PRPSA scores and anxiety dimension scores of LSAS in participants with higher scores of anxiety changes according the pre test (r^2=0,302) and the post test (r^2=0,007)

4. Discussion

In order to decrease Public speaking anxiety, different kind of programs have been tested as social skills based [20] and virtual reality based [21]. There are few research on voice training based [22] even if there are trustable analysis of how anxiety is related with Social Phobic Speech [23] showing how the treatment of anxiety is related with specifics nonverbal aspects of speech as mean and maximum voice pitch, high-frequency, components in the energy spectrum, and proportion of silent pauses. Giving to the researchers the possibility to explore if voice training could have effects on anxiety

In the present research voice inflections training was supported by tools of relaxation as diaphragmatic breathing, social skills as nonverbal body communication, behavior cognitive fundamentals as exposure and response prevention, and technology through the reception of feedback by Anchor App. Results showed that, even are statistical significant differences, the effect of the program is small when its compared with a control group. One possible explanation could rest on the number of participants and the limits of treatment during classes on university.

Effects of the program could have improved if researchers would had an exclusive space of training, many of the participants of experimental group didn't show interest on using the resources because they focus on other activities. Classroom time was used for training and that probably reduced motivation on students. For ethical reasons those students couldn't be invited to leave classroom or not take evaluations. The program was partially aligned with the interest of the course study, as it was mentioned students had to prepare for their final oral presentation. It could be important for future replication of this study to totally aligne the interest of the course study with the program, for example in a Language or communication course.

Another limitation could rest on that problem (PSA) was partially addressed. The program cover techniques for anxiety management (Diaphragmatic breathing and meditation), practical strategies for non-verbal language (Voice training and body movements) and structure of the message (Different levels of text analysis), however didn't cover communication styles and, most important, personal strengths of each student from their particular personality traits. It would be important to increase time and professional resources to include these elements on future replications.

With all these limitations is important to know that a program based on voice inflections training could have some effects, if all the limitations are improved the effect could be significantly higher.

The relation between public speech anxiety and social anxiety was explored replying previous results of significant association [4], even if correlation decreased on participants with high scores of anxiety (previous and after the program), no statistical evidence of moderation of the program was showed. This could response to the small effect of the program but also because program didn't focus on social anxiety trough public speech as a psychotherapy treatment. It would be important to apply the program exclusively on clinical subjects and see its effects.

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Developing Problem-Solving skills in Engineering through a Programming Methodology: a team-work visual approach

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Abstract. Engineers are problem solvers whether they are involved in software, electronic, analytical, civil, experimental, or design work. International accreditation institutions were strong in the student outcome programs that engineering graduates must have an ability to identify, formulate, and solve engineering problems. Our work describes the experience of developing problem-solving skills in the first year of Engineering using a Programming Methodology that makes a strong emphasis on visual components and team-work: R&G Methodology. The R&G Methodology is a methodological proposal that guides the analysis and solution of problems in a systematic way. Canvas templates allow students to write ideas while solving a problem. Students define, explore, analyze the problem, and graphically design solutions. R&G seeks the development of cognitive skills in the student, instead of mastering the syntax of a specific programming language, promoting logical-computational thinking, the decomposition of processes, the modeling of solutions, the identification and use of patterns, among others. We have to drive quasi-experimental with a sample of 70 students from Ingeniería de Sistemas and Ingeniería Electrónica. The p-value obtained in the experimental group shows that there is an improvement regarding to problem-solving skills when students work in team for solving-problems under a structured methodology. Since programming courses are part of most of the Engineering Curriculum we consider our experience could be valuable for other Engineering.

Keywords: Problem-solving., Team-work., Programming Methodology., Visual-Methodology.

1 Introduction

In the Engineering field, teaching programming is a way of teaching problem-solving. Future graduates must realize that there are multiple solutions to a given problem and that selecting among them is not a purely technical activity. Many students have

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difficulty analyzing problems, formulating a solution, and converting it into a solution written in a programming language. Researchers have long been interested in problem-solving [1-3] and the relationship between problem-solving skills and programming skills [4-5]. Lishinski et al. [6] use a theory-based approach to measure problem-solving as a means of predicting performance in an introductory undergraduate programming course. Ambrosio et al. [4] found that differences in problem-solving skills are due to cognitive processes and mental organizations and that some characteristics shared by good problem solvers are: reasoning, critical thinking, perception, memory, creative thinking, and reading comprehension. On the other hand, Kirschner et al. [6], ensures that learning requires mental representations and schemes that are subject to the amount of information provided. To address this problem, it seems reasonable to think that the use of appropriate systematic methodologies for teaching programming, which explicitly considers the construction of mental representations and schemes that allow focusing first on analyzing the problems, and then, through a guided process, students can get the solution.

Based on Kirschner et al. [7] foundations we have used the programming methodology "Rapid and Global" (R&G) that proposed problem-solving defined in four main phases: define, solve, convert, and coding. This methodology allows early inclusion of teamwork and is based on the use of canvas for strength visual representation of the problem and the proposed solution. The proposed research question is: *¿Does the use of a Programming Methodology based on team-work allows the development of problem-solving skills?*

2 Background

2.1 Problem Solving

Problem-solving skills for introductory programming courses refer to understanding how to apply knowledge to solve real problems, not just writing code and moving bits. Students must realize that there are multiple solutions to a given problem. Students should also be able to communicate their solution to others, including why and how a solution solves the problem and what assumptions were made [8]. Woods et al [9] state that students who solve problems exhibit specific attributes such as: (a) they are willing to spend time reading, gathering information, and defining the problem (b) they emphasize precision over speed (c) they write down ideas and create boxes/figures while solving the problem (d) they are organized and systematic (e) they are flexible (keep options open, you can see a situation from different perspectives/point of view) (f) they are willing to risk and deal with ambiguity, welcoming change and managing stress.

2.2 Rapid and Global (R&G) Methodology

Rapid and Global (R&G) methodology [10] was developed by the third author and has been tested in Chile and Peru. This methodology is problem-solving oriented and also allows promoting the early inclusion of teamwork. The methodology, as illustrated in Fig. 1, defines four main phases: define, solve, convert, and encode. Each stage uses canvas templates that guide students in identifying, describing, and specifying items that make up an algorithm. R&G has specific templates for each phase. The configuration of the templates allows solving problems as part of a team where students have to set goals (identify the problem), plan tasks (propose a high-level algorithm) and meet objectives (solve the problem) The first to phases are related to the solving problem and the third and four are related to translating the solution to code. We describe the first and second phase since they are the focus of our study.

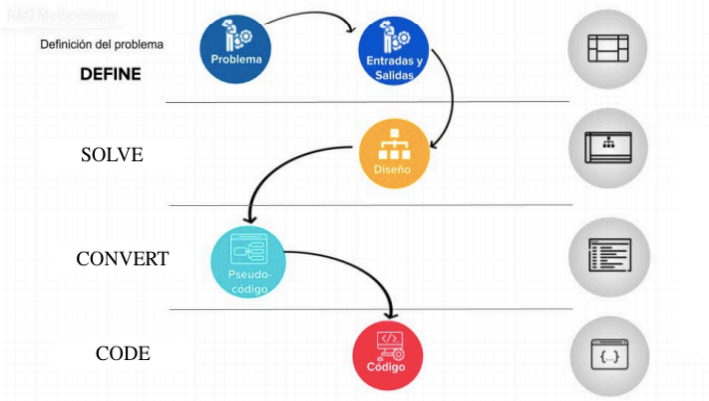


Fig. 1 R&G Methodology phases: Define, Solve, Convert and Coding. Define and Solve is related to problem-solving.

Define: The first step of the methodology is the identification and description of the problem. To make this identification, we must see what the problem is, what data we need to solve it (inputs) and what data will be obtained as a response after solving it (outputs). We must also have identified the considerations that the problem requires. This stage is important as misidentification of the problem can lead us to "solve" non-existent or incorrect problems. This is why this stage is extremely important. Once the problem has been identified, the main conditions or requirements that must be met for its solution must also be identified and in this way structure a solution, which will have a series of activities (reads, loops, storage and reuse of the information generated) In the case of programming, it is quite useful to use functions, procedures, subprograms or methods that have been created and tested before, as it facilitates a certain part of the solution process. Finally, a preliminary outline is made of how this solution process will be carried out, both in the conceptual part and in the interface. To carry out this scheme, we use the R&G Canvas template (Fig 2) in which we can identify and indicate the inputs, outputs and processes at the level of sentences, activities and modules.

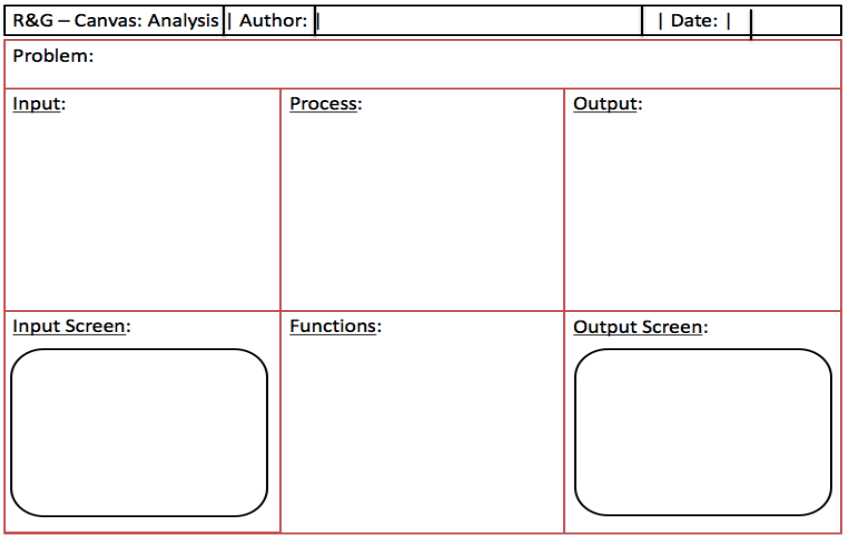


Fig. 2 R&G Canvas Analysis. It helps to define the problem; the first step is to identify and describe the problem. Answer the questions (i) What is the problem?, (ii) What are the inputs?, (iii) What are the outputs? (iv) How is the process? (v) Are there predefined functions that we can reuse? This step helps students understand and describe what problem they need to solve.

Solve: It corresponds to conceptual refinement where students use principles of abstraction, successive refinement, and modularity. Its purpose is to identify the sequence of individual actions, called activities. The basis for this step is based on the premise that "nothing is particularly difficult when divided into small tasks." The problem (main activity) is divided into 3 sub-activities (Input, Development, and Output). Fig 3 illustrates the Design Canvas, called R&G-Canvas-Design, used to represent the solution graphically.

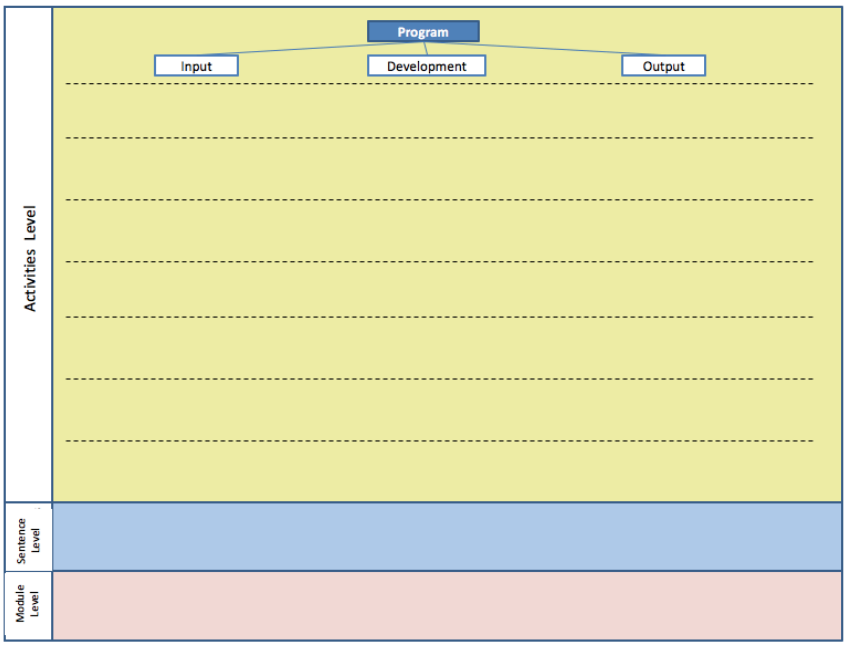


Fig. 3 R&G Canvas Design. It helps to describe the design of the solution proposed, through a graphic language, in which the activities that solve the problem are detailed. At this stage, it is possible to obtain the set of instructions that solve the problem, from successive refinements of activities that have a high level of abstraction.

3 Methodology

3.1 Description

Problem-solving skills with respect to introductory programming courses refer to understanding how to apply knowledge to solve real problems. The use of the R&G methodology could allow students to develop problem-solving skills through teamwork. The first step is to identify and describe the problem. The second step identifies what data we need to solve it (input) and what data we will get as a response after solving it (output). The third step describes the main process for solving the problem, and finally, students must identify if there are pre-defined solutions that can be reused. While working in teams, students realize that there are multiple points of view for a given problem. Working as a team would help students to have a broader understanding of the problem. Using Canvas Analysis (Fig 2) allows students to focus on specific parts of the problem: inputs, outputs, and processes. Also, students can write down their initial ideas. Canvas templates strengthen students' ability to work as a team, as they can establish an area where they can identify all input results and parts of the process and then carry out discussion or deliberation on the best solution alternatives (Fig 4)



Fig. 4 Students using Canvas Design. It is used to discuss group discussion for a proposed solutions in a graphic approach.

3.2 Materials and Methods

This experience was implemented in Ingeniería de Sistemas and Ingeniería Electrónica undergraduate at the Universidad Nacional de San Agustin de Arequipa (UNSA) in 2019. The study corresponds to the use of R&G methodology in the first programming course that is based on the ACM CS2013 curriculum international recommendations [8]. From the learning outcomes related to problem-solving described by the ACM CS2013 [8] we focused on: (1) Discuss the importance of algorithms in the problem-solving process, (2) Discuss how a problem can be solved by multiple algorithms, (3) Create algorithms to solve simple problems, (4) Use a programming language to implement, test and debug algorithms to solve simple problems and (5) Apply decomposition techniques to divide a program into smaller parts.

The first programming course is taught in the first year of study. It lasts 17 weeks with 4 academic hours and 2 laboratory hours. Students have no prior programming experience. Students attended laboratory sessions in groups of 20. In the laboratory sessions, students were asked students to solve weekly assignments. Student grades are based on two midterm exams, a final exam, and laboratory assignments. Student grades are evaluated from zero to twenty in Peru.

To answer our research question **¿Does the use of R&G Methodology based on team-work allows the development of problem-solving skills?** we conducted a quasi-experimental study. The study population is established in the set of students of the first year of studies of the mentioned careers. We have considered a non-probabilistic convenience sampling with 120 students. The students are between 17 and 20 years old without previous experience in programming The total number of students in the sample was: 50 students for the control group and 70 students for the experimental group. The control group had traditional programming laboratory assignments (individual assignments). Students in the experimental group were required to complete

their laboratory assignments using the R&G methodology (team-work). Students in the experimental group were randomly assigned in groups of four to six.

4 Results and Discussion

The application of the pre-test and post-test was divided in two dimensions: a) Problem identification (define the problem, explore the problem, and plan the solution) and b) Problem solution (implement the plan and verify the solution). The objective was to verify if there were differences in the results regarding the scores between both groups and if these were significant. We presume that:

HI: There is a significant difference between the scores obtained in the pre-test and post-test of students who were exposed to the R&G Methodology.

To test the hypothesis, we use a T-Student test for two independent samples. We verified the criterion of the normal distribution of the data (through the Kolmogorov-Smirnov and Shapiro-Wilk tests). The criterion for deciding was: if the probability obtained from the P-value <= alpha (5%), HI is accepted. If the probability obtained P-value> alpha (5%) Hi is rejected. Table 1 summarizes the pre-test and post-test averages for each of the two dimensions, both for the control group and for the experimental group.

Table 1 Results

Group	Dimension	Pre-test	Post-test	P-Value
Control Group	Problem Identification	11.75	12.78	0.380
	Problem Solution	11.58	11.58	1
Experimental Group	Problem Identification	8.19	16.48	0.000
	Problem Solution	11.14	14.88	0.01

It is observed that the P-value obtained in the two tests for the control group does not show a significant difference between the scores obtained. On the other hand, the experimental group presents a P-value in the two tests of less than 5% that shows a significant difference in the scores obtained after having used the R&G Methodology in both dimensions. The results show us that the application of the methodology based on team-work generates a positive impact on the development of problem-solving skills. A review of the literature has found other approaches that make use of programming to develop problem-solving, such as media computation or game orientation [12-15] or even the use of applications such as Google Earth [16]. The related works had shown important results in the development of problem-solving through programming courses, but we have observed that the focus is oriented on

motivational issues. In the related works [12-16], the problem-solving practice is carried out individually and focused on the product (code) and not on the process of how to solve the problem. The main difference from our experience is the work-team base that allows students to discuss different points of view and to observe that a problem can have many solutions. Likewise, we consider that the graphic component through the use of canvas facilitates the discussion. Having a process that guides the steps for problem-solving and facilitated discussion is a good tool for students.

5 Conclusion

The results obtained showed us that the use of a Programming Methodology based on team-work could help in the development of problem-solving skills, in our case we made use of R&G Methodology that guides the analysis and systematic problem-solving. The canvas templates provide by R&G used in the problem definition and problem design phases allowed students to write down ideas while solving a problem. The students define, explore, analyze the problem, and design solutions graphically. We can affirm that the R&G Methodology could allows students to enhance the development of cognitive abilities. The limitations of the use of the R&G Methodology are given in the availability of the canvas template which must be provided by the professor to achieve a greater impact on the discussion process. While they can be printed on individual sheets, we have found that it has a greater impact when students discuss in groups with a large canvas. The methodology can be incorporated into any programming course independent of the programming language to be used (Java, c ++, Python, etc.) since it focuses on problem-solving and not coding. As future work, it seeks to extend the application to other Engineering courses that present strong elements of problem-solving and to see its application beyond the programming courses.

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Digital learning tools for security inductions in mining interns: A PLS-SEM analysis

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Abstract. New pedagogical tools have been introduced in educational contexts in recent years. They have been shown to have a positive impact on learning compared to conventional education strategies. Before implementing new learning tools, a study of technological acceptance is needed for its application to be successful. For this reason, the objective of this research was to measure the intention and acceptance of the use of new digital learning tools, such as mobile applications, holograms, interactive platforms, virtual and/or augmented reality, through the Technology Acceptance Model 3 (TAM3) in safety on-board training inductions in a mining company. This measurement was based on the analysis of a survey carried out in Google Forms based on the Likert scale; the results were processed using the partial least squares technique in structural equation models (PLS-SEM), processed through SmartPLS 3. As a result, we got positive correlations between the instrument's variables and acceptance by the participants studied. The findings indicate that it is essential to take into account the opinions of the participants a priori to the implementation of new digital education tools for managerial decision making, considering highlighting the teaching about safety in mining companies, since this allows contributing to engineering education and protect the most precious resource of any company, the human being.

Keywords: TAM3, Technology Acceptance Model 3, PLS-SEM, SmartPLS, Mining Company, Safety, Safety Inductions, Safety Talk, Learning, Education, Teaching, Technology, Learning Tools.

1 Introduction

Technology is developing exponentially; it has covered fundamental aspects in human beings such as learning, focusing on eight topics: institutional environment, presence, pedagogy, technological elements, design, behaviors, affective elements, and learning outcomes [1]. It is worth mentioning that new technologies are gradually replacing the

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traditional approach to teaching with a more social learning approach [2,3] as the number of publications about how the use of technology can be successful so that teachers can teach effectively [1], taking advantage of the opportunities of technological advances, generating an innovative learning environment based on play. Awakening students' interest in its use will lead to a better understanding of information [4,5]. However, research on technology-enhanced learning has been written mostly by authors working in the educational field, representing approximately 70% of articles of all studies collected by a bibliometric analysis carried out in 2019; on the other hand, so only 9% were from articles written by authors who are working in engineering areas [6]. There is a lack of attention in applying digital learning tools in engineering areas, such as the training and inductions directed mostly by safety engineers in mining companies. If the knowledge that they want to teach through training or induction is not transmitted adequately, the most valuable resource of companies, that is the human, would be more exposed to danger due to ignorance about the topics of safety, highlighting the great importance of education in the field of engineering.

The world's leading mining companies advise providing experiential learning in inductions and training through new interactive and immersive technologies such as podcasting, social media, interactive whiteboards, and virtual reality [7]. A study where the positive impact of the digital learning tool called EPIC was examined on 14,000 people found that the actor-based teaching application generates a more interactive and immersive pedagogical experience than a conventional classroom [8]. It is also necessary to specify that a study that u<<sed high fidelity simulation (HFS) identified that carrying out simulations more frequently and having the opportunity to "repeat" the experience would improve student learning [9]. It is essential to mention that training, technical, and financial support requires the mining company's attention to implementing digital learning tools and achieving success in terms of technology-supported education [1].

1.1 Digital Learning Tools

Nowadays, traditional teaching methods such as 2D presentations, conferences, workshops have been innovated by technological learning tools such as simulations, immersive virtual reality, augmented and mixed reality, mobile devices, online training platforms, game engine techniques, among others [10]. The importance of learning tools lies in improving teaching quality to meet external challenges and demands in education [11].

1.1.1 Benefits for Students and Teacher Trainers

The use of digital learning tools would allow the student to obtain more virtual practical experience, being able to make mistakes since it is considered a safe place, and thus improve their performance and dexterity when facing a real situation [4,9], solving problems with confidence and without anxiety [2]. This benefit would improve the student's emotional attitude, making them feel motivated and satisfied with learning in a non-traditional way [5,12]. It is worth mentioning that using these tools allows the

student to assimilate the information better when dealing with difficult subjects to understand [13]. It also creates opportunities for discussion within the classroom since digital learning tools allow students to play an active role, unlike conventional classes, where they play a passive role [14].

Digital teaching tools provide the teacher with better pedagogical technologies than traditional methods to explain and make their students understand, thanks to these tools' interactivity capacity, making the learning process more attractive, fun, and collaborative [4,13]. These results encourage teachers to continue using innovative learning tools with their students [3], increasing teacher effectiveness, increasing the quality of education, reducing the burden of teaching complicated subjects, and improving student performance [4,14].

1.2 Safety Culture and the Peruvian Regulation of Safety and Occupational Health in Mining

It is an essential medium to ensure good performance in safety matters, significantly to reduce accidents [15]. The development of a safety culture in a mining company is essential to improve the rule-following behavior of employees to avoid the existence of incidents and/or accidents [15-17]. According to a study carried out in the United Kingdom, the economic loss due to occupational accidents represents approximately 8.5% of the project costs. For this reason, companies could be interested in providing safe working conditions to avoid expenses and safeguard human lives [18], where unique pedagogical campaigns such as training, inductions, health promotion, risk assessment, and the environment can be offered [19]. In Peru, mining companies are governed under the D.S. N ° 023-2017-EM [20] in terms of occupational health and safety, article 72 specifies the minimum number of hours of necessary induction (eight (8) hours during four (4) days in mining activities of high risk and eight (8) hours for two (2) days in lower risk mining activities). There, an entry to the mining operation must carry out, very apart from the necessary induction, the number of courses may vary according to the area to enter. In the necessary induction, topics such as occupational health and safety policies of the company, Internal Regulation of Safety and Occupational Health, Traffic Rules, High-risk jobs, emergency plan in the mining company, definitions of danger and risk must be learned effectively. , risk controls, among others. So, trainers must be committed to the quality of learning that students will receive to ensure compliance with the law and safeguard lives.

2 Theorical Framework

2.1 Technological Acceptance Model (TAM3)

The TAM3 was used to define the adoption of practitioners and interns working in mining companies in southern Peru to use new digital learning tools [21] in safety

inductions before entering the mine. In the following link, represented in Table 1[1], all the variables of the TAM3 used in the present investigation are defined. There is currently not enough research about the implementation of new digital learning tools in training and induction in mining companies. Since applying these tools in schools or universities is more studied, leaving aside the attention that industrial companies need in terms of education in security [6,22]. Therefore, this study's main objective is to carry out a pilot test for practitioners and interns of mining companies in southern Peru to know their acceptance of digital learning tools, using the TAM3 model developed by Venkatesh [23]. It is essential to know the participants' opinion to analyze whether a new learning tool [2] is going to be implemented and properly used, bringing with it considerable benefits [4] for students, teacher trainers, and the company where the pedagogical innovation would be applied.

3 Methodology

3.1 Participants

This study was directed to 46 practitioners and interns from different mining companies in southern Peru. They have between 20 and 30 years old; the majority have between 22 and 25 years old, representing 85% of the sample. The survey was shared using Google Forms [24]; so that it could have reached each participant overcoming any territorial limitation. Next, in the following link, Table 2[1] shows the distribution of survey participants; they were divided between people who work in surface mining (open pit) or underground mining (sinkhole).

3.2 TAM3 measuring instrument

The Technological Acceptance Model (TAM3) proposed by Venkatesh was used. A network of variables was developed for adoption, information technologies use and empirically tested in the proposed integrated model, focusing on the application of TAM3 both a priori and after implementing the technology. It was shown that TAM3 provides necessary help in making managerial decisions for the implementation of new information technologies [23]. The TAM is used to primarily analyze the technological acceptance of innovative methods and tools in education, where it was shown that it is an excellent instrument to understand the intention of using the participants [14]. We decided to use the TAM3 over other essential instruments in the measurement of technological acceptance such as the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) since the latter includes variables such as age, gender, and price [25] whose parameters were considered not necessary for this research. A survey was conducted, taking into account the considerations of each TAM3 variable. They are defined in Table 1[1]. It was decided to use the Likert scale to establish a multiple-choice response range [26], having a range from 1 up to 7 points, where one meant "Strongly Disagree" and seven meant "Strongly Agree." In the appendix, Table 3 shows the questions of the questionnaire carried out on October 24, 2020.

3.3 Statistical Analysis with PLS-SEM

The obtained results in Google Forms were exported to an Excel file, delimited by commas. Finally, the Smart-PLS 3 software was used to obtain, through the partial least squares technique in structural equation models (PLS-SEM), statistical data such as minimum and maximum responses for each variable, standard deviations, the correlation coefficient between variables, coefficient route, hypothesis t-test, frequencies, percentages, arithmetic means, and discriminant validity [27].

4 Results

In Table 4, that can be found in the appendix, we observed that all the arithmetic means of the responses of each variable of the Technological Acceptance Model exceeded the neutral state given in the Likert scale (4 - "Neither disagree nor agree"). There is also highlighted that all the questions had the highest level of the Likert scale had a maximum score (7 - "Totally agree"), so we can affirm that the surveyed participants has the intention and acceptance of the use of new technology learning tools to be implemented in safety induction classes before entering the mining company. The variable with the highest average response was (BI), with a value of 6,326 on the Likert scale; this was followed by (USE) with a value of 6,196 on the same scale, reaffirming the technological acceptance by participants for the implementation of mining educational tools. Likewise, these last two were the variables with the lowest standard deviation, having a value of 0.957 and 0.947, respectively, which means the homogeneity of the surveyed responses. It should be mentioned that these are two of the most critical variables of the TAM3 [23]. The variables with the lowest average response were Experience (EXP) and Subjective Norm (SN) with values of 5.500 and 5.674, respectively; in the same way, these two variables had the highest standard deviation with values of 1.514 and 1.445 respectively, demonstrating the high dispersion of responses from each intern and practitioner, having a minimum of 1 and a maximum of 7 on the Likert scale.

The bilateral correlation of the TAM3 variables is presented in Table 5[1]. It shows all the correlations have a strong and positive correlation, indicating coherence between variables. In Table 6[1], we appreciated to determine if the constructs have discriminant validity, a statistical test, that is used to demonstrate the multicollinearity of the proposed model; this should be addressed if certain variables exceed the threshold for possible multicollinearity (0.7) [28]. As mentioned, we demonstrated that the model has good reliability and construct validity. In Figure 1, that can be found in the appendix, the standardized trajectory coefficients between all the variables performed by Venkatesh [22], and the substantial variance (R2) in each of its four endogenous variables [29] can be appreciated. It is essential to mention that only four hypotheses were validated for the study according to the t-test where the value of 1.96 has to be exceeded [30], these being the relationships between IMG -> PU, REL -> PU, SN -> IMG and BI -> USE, 2.422, 2.174, 4.139 and 5.488 respectively.

[1] Link: https://osf.io/qy6er/?view_only=74fffc619c994e50bd8db81619a90da6

5 Discussion

Our results show that interns and practitioners' technological acceptance were successful since they are willing to adapt to new digital learning tools, such as in research where a group of students intends to use new pedagogical strategies [4]. They could find the implementation and its functionalities interesting supporting their knowledge, as happened in a study that adopted an interactive web environment technology called MAgAdI at the University of the Basque Country [3]. It is intended to give the initiative to implement new digital learning tools in the mining industry, as recommended by a study where its findings foster crucial management decisions for the future implementation of information technologies [23]. Helping to improve the academic performance effectively in the induction classes of the interns and practitioners before entering the mine, as is the case of a study that provided facilities of its results to school providers to use new innovative pedagogical methods [31]. It is necessary to highlight that the topics offered in the induction classes of the participants are both theoretical and practical, so that the new learning tools could contribute to the improvement of their performance, as argued in a study where the Perception of Mining Engineering students, concluding that the use of technology in education is necessary to improve student performance [4]. Learning tools allow the user to be transferred to a virtual environment where it is allowed to make mistakes and learn through experience safely, as indicated in an investigation with simulated immersive learning platforms where their findings indicated that students could avoid taking risks to demonstrate their capabilities in a safe environment [9]. A study conducted in 2019 mentioned that virtual laboratories may have the same or better learning outcomes than t laboratories traditional [14], providing a unique learning experience [3], breaking the traditional scheme and overlapping conventional learning [6], as we stated in the present study. In the present study, 46 pilot samples of different interns and practitioners of mining companies located in the macro-southern region of Peru were investigated to determine technological acceptance through TAM3, as was done in an article where 44 respondents were studied, specifying that no there would be a problem in working with a small sample size since the results will be stable [32]. As we mentioned in the survey instructions, by new learning technologies, we mean: "*virtual and/or augmented reality, holograms, interactive platforms, and mobile applications"* according to the results had a positive impact on all TAM3 variables, as formulated by Venkatesh [33], especially in Use Behavior (USE) and Behavioral Intention (BI). The same situation occurred in a scientific production that shows that students' perception of virtual laboratories, simulators, interactive learning activities, and game-based learning positively influenced satisfaction, usefulness, and perceived ease of use [14]. An additional question was asked to the TAM3 to determine the preference of the studied participants towards a conventional class or a class with digital learning tools, where 89.13% of the total participants chose classes with innovative learning tools since these can keep employees focused positively and proactively as mentioned in a study conducted in Australia [19]. The participants in the presented studies rejected a conventional class, defined as: "*lesson given by a teacher or trainer using 2D tools, such as slides, whiteboard, flipcharts, non-interactive videos";* it can

[1] Link: https://osf.io/qy6er/?view_only=74fffc619c994e50bd8db81619a90da6

generally cause stress and anxiety, reducing the value of learning [9] and being an obstacle to the adoption of a digital learning tool [21]. For the present study, the partial least squares technique was used in structural equation models (PLS-SEM), being very powerful, and not having a minimum sample parameter, gives us extra support for the validity of the results, as Said Al-Gahtani comments [29]. SmartPLS 3 software analyzed these data; it was used from the same firm by different studies associated with the evaluation of TAM [28-30], [34,35]. The results of the discriminant variance correlations mostly exceed the threshold of 0.7, confirming the construct's validity and the trajectory correlations of the present study. These were positive and strong, as evidenced by studies conducted between 2015 and 2020 [28,29,36]. The results also indicate that IMG significantly influences PU, as happens in a study carried out in Saudi Arabia, where it is specified that the processes of social influence were shown to affect significantly Perceived Profit. On the other hand, the same study found that the instrumental cognitive process positively impacts Perceived Utility, as happened in this article when validating the REL -> PU hypotheses [29].

6 Conclusions

Safety is essential for all companies, especially mining companies, so the structure and culture of safety are essential elements to safeguard workers' lives [37]. It is necessary to provide qualified education to collaborators to increase their effectiveness [14] by voluntary rules compliance, preserving the human resource that is the most crucial element of the companies, and saving accident expenses. It can be achieved with the use of more effective pedagogical tools than traditional ones. However, it is essential to know if staff are willing to accept new learning technologies such as virtual and/or augmented reality, holograms, interactive platforms, and mobile applications [4].Interns and practitioners intend and accept using new technological learning tools in induction classes before joining a mining company. For future research work, we recommended expanding the sample of hired workers since they receive constant safety talks as specified by the D.S. N ° 023-2017-EM [20], since integral management of the safety culture, is being promoted that goes from the highest rank to the lowest rank; consequently, this would cause a change in attitude in the members of the company making them take care of each other. We recommend mining and industrial companies to implement new digital learning tools to train human resources and improve the development of their skills in occupational safety and health. Worth noting there is limited research on technological acceptance to help management decision making [23]. It is necessary to imply that studies on the implementation of pedagogical technologies should not be centralized only in schools or universities [6], mining and industrial companies where education can save lives, so we recommended to continue developing scientific production in that theme and domain.

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Appendix:

The questionnaire provided to the participants is shown below in the Table 3, where the different variables taken into account are appreciated.

Table 3

Variable	Questionnaire
Image (IMG)	Receiving induction classes using learning technologies raises the status of the mining company where I work.
Job Relevance (REL)	I feel that using learning technologies in induction classes will positively impact the various tasks related to my work.
Output Quality (OUT)	I think that learning technologies could have excellent results in my understanding regarding different induction topics.
Result Demonstrability (RES)	It could explain why the use of learning technologies can be beneficial in understanding the information received in induction classes.
Perceived Usefulness (PU)	I think it is possible that the use of new learning technologies in my induction classes would improve my job performance.
Computer Anxiety (CANX)	I feel safe and comfortable using new learning technologies.
Computer Playfulness (CPLAY)	I am excited about using new learning technologies in my induction classes.
Computer Self-efficacy (CSE)	I have the necessary skills to use new learning technologies without difficulty in induction classes.
Perceived Enjoyment (ENJ)	I think it would be more fun to use new learning technologies in my induction classes at the mining company where I work.
Objective Usability (OU)	I think the new learning technologies would be easy and dynamic to use.
Perceptions of External Control (PEC)	Having the necessary opportunities, knowledge and resources, it would be easy for me to use new learning technologies.
Subjective Norm (SN)	I think induction teachers think that the use of new learning technologies could be useful.
Experience (EXP)	Cuento con experiencia en el uso de algún sistema tecnológico de aprendizaje.
Voluntariness (VOL)	I think that I would voluntarily access my induction classes with new learning technologies.

Perceived Ease of Use (PEOU)	I believe that the use of new learning technologies will be easy to use.
Behavioral Intention (BI)	If I have the opportunity to take induction classes using new learning technologies, I would be happy to try it.
Behavioral Intention (BI)	I would use new learning technologies frequently in my induction classes.

In Table 4, shown below, you can see the statistics obtained from the data collected by the survey.

Table 4
Descriptive statistics

	Nº.	Mean	Min	Max	Min	Standard deviation
PU	1	5.870	2	7	2	1.172
IMG	2	6.000	2	7	2	1.123
REL	3	5.783	2	7	2	1.301
OUT	4	6.000	3	7	3	1.043
RES	5	5.761	4	7	4	1.087
PEOU	6	5.804	2	7	2	1.262
CANX	7	6.022	4	7	4	1.011
CPLAY	8	6.065	3	7	3	1.009
CSE	9	6.152	4	7	4	1.042
ENJ	10	5.978	1	7	1	1.242
OU	11	5.848	3	7	3	1.179
PEC	12	6.152	4	7	4	0.999
SN	13	5.674	1	7	1	1.445
EXP	14	5.500	1	7	1	1.514
VOL	15	6.109	2	7	2	1.184
BI	16	6.326	4	7	4	0.957
USE	17	6.196	4	7	4	0.947

In Figure 1 shows Path coefficients and variances explained (R^2).

Figure 1

Path coefficients and variances explained (R^2)

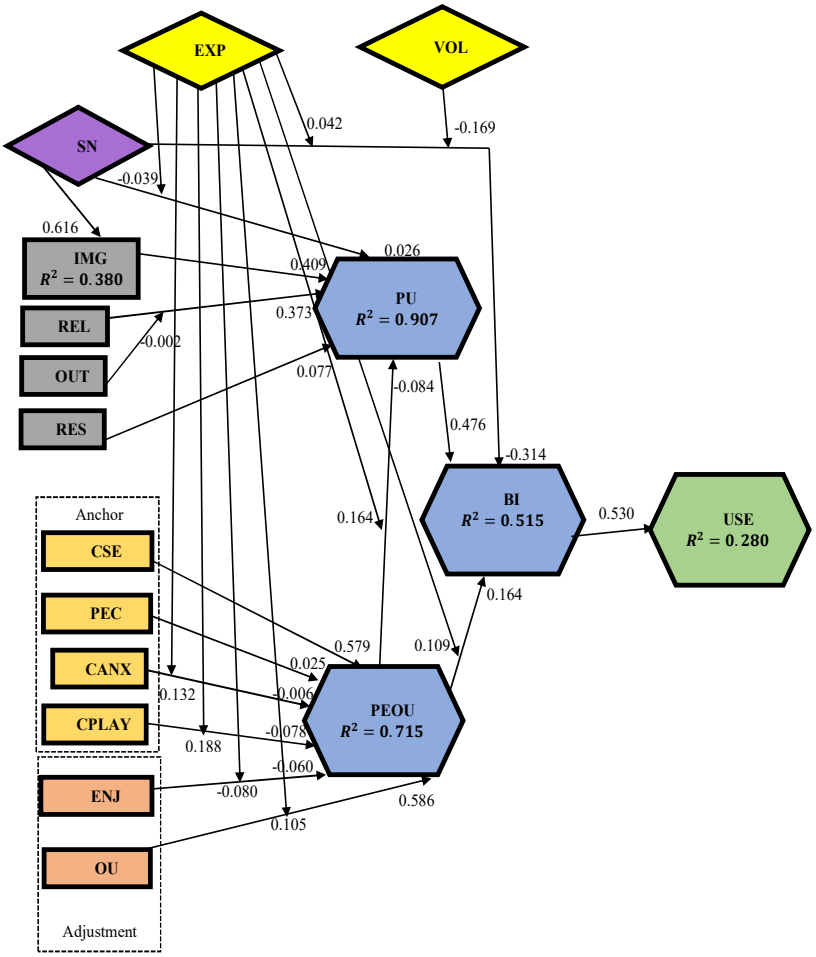


Image (IMG), Job Relevance (REL), Output Quality (OUT), Result Demonstrability (RES), Perceived Usefulness (PU), Computer Anxiety (CANX), Computer Playfulness (CPLAY), Computer Self-efficacy (CSE), Perceived Enjoyment (ENJ), Objective Usability (OU), Perceptions of External Control (PEC), Subjective Norm (SN), Experience (EXP), Voluntariness (VOL), Perceived Ease of Use (PEOU), Behavioral Intention (BI), Behavioral Intention (BI)

The experience and cognitive performance as a gamer during the use of educational video games.

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Abstract: *Video game* have surged in popularity and usefulness in education; higher-education institutions have seen an increment in student's interest on interactive content for learning complex subjects, especially in the field of engineering. This study explored the effects of emotions and cognitive performance during the use of serious games. **Methodology:** A quasi-experimental approach was used to assess cognitive processing during the execution of a challenging matrix-related activity within undergraduate engineering students (n=9). An initial baseline was made on emotional dimensions through the EMOTIV software and later analyzed to evaluate student's cognitive load through a semi-structured interview. **Results:** Six basic emotions were identified: commitment (24.31%), relaxation (21.7%), emotion (21.04%), interest (12.43%), focus (16.31%), stress (9.25%). Cognitive dimensions emerge such as effort, frustration, performance, mental demand, physical demand and temporal demand. **Conclusion:** higher task commitment is identified when students utilize serious games and cognitive performance is mediated by individual adjustments to video game's complexity.

Keywords: Educational videogames, Emotiv EPOC, User Experience, Cognitive Load.

1 Introduction

The high capacity of immersion generated by video games has purged geographical boundaries and age groups regardless of socioeconomic conditions. For instance, it is noteworthy mentioning that the American entertainment software Association recently featured that 75% of the general population has at least one video game at home, with the majority of users being 18-34 years old [1]. Furthermore the

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increasing advent of educational *games* "serious games" in higher education [2], compared to the first entertainment-driven games, had led to changes in the market. Hence, this aforementioned evolution is frequently described as a sound response given the high-pitched demand to respond to educational requirements among students [3].

How the teaching content is displayed makes a difference to the learner experience [4]; [5]. While in the teaching experience it is common to find low indicators of participation, poor student interest in overly complex courses; the popularity of video *games* has validated for the implementation of educational content as a learning strategy. For example [6] demonstrated the effectiveness of implementing a constructivist educational model for courses with low-student interest, succeeding greater participation and sense of achievement by expanding video *games* for teaching. It is believed that school-related content's appropriation is of paramount when acquiring new information, and that is advanced when the student becomes the main protagonist of their own knowledge building toward a more meaningful learning process [7] while relating with interactive tools such as video *games*. Therefore, educational video *games* are of great importance for imparting complex theoretical content, especially for thought-provoking task or tasks involving decision making.

Pedagogical model for learning based on digital games

The Transformational Game Theory (TGT) proposed by [7] provides a robust basement to sustain the impact of a *"perceptually and semantically enriching"* learning content on student's cognitive performance. Although several teaching methodologies have tried to offer explanations of how it is better to teach, the TGT theory is one that proposes a better, guided framework to explain meaningful learning by integrating a virtual context, people and educational content. In this study we focus on the video game as a learning environment that enhances and / or activates the learner's proactivity, positioning the educational video game platform as a context that provides greater opportunities for participation and reinforcement of content, compared to a traditional classroom.

Generating immersive strategies to involve students into their self-learning process is not a contemporary controversy. Systematic studies refer about the existing constraint across educational institutions to offer enriching educational experiences; Moreover, in view of the insufficient deployment of interactive methodologies, the usage of educational video *games* may potentially bring into line the student, the content and the pedagogical context effectively [7]. The same authors report higher levels of commitment and motivation to learning through educational courses, based on video *games*, which appear to be promising in the development of problem-solving skills.

Serious Games in Teaching Programming

"Serious *games* are (digital) games used for purposes other than entertainment only"[8]. These tools stimulate learning by facilitating feedback through an interactive environment. On the other hand, game programming has managed to capture the attention of students in the fields of computing, but also in other fields of education. Also, this sort of *game* programming provide useful tool to instruct programming students toward programming [9].

Some examples can be found in Hilton and Janzen [10], whose research demonstrated the effectiveness of serious games to teach divisibility through Zombie-based activities. Likewise, immersive journeys had proven being effective to solve real issues. For instance the literature reported the "Circuit Wars", where electronic engineering students were immersed into tangible situations; students were expected to repair logic circuits effectively against the clock, the game used a didactic approach through varied complexity puzzles responding to student's progressive knowledge and domain [11].

Effects of emotions and cognitive performance during exposure to video games

Given the wide range of complex, cognitive processes that take place in the human being, some reports depict the great value of improving their performance [5]. Its identification is relevant not only for measuring academic results [4], but also for exploring student's motivation towards learning [12]. In fact, related research suggests that cognitive processes, such as attention span [13], and sense of peer collaboration may be enhanced in learners by using digitalized *games*. This aforementioned had been reported in Hughes, who described higher rates of homework engagement and skill improvement when using video *games*, in an 8-week experimental study with elementary school students [14].

Evidence on video *games*' devising effects on human emotions and cognition support this study. For instance, Snodgrass et all, registered greater wellbeing on continuous videogame players. The author hypothesized that, emotions generated from the virtual experience may go even beyond the "well-being threshold", whose effects interestingly may have an impact on the immune scheme. Another study measuring creativity report association between action videogame, inventiveness and flexibility, it is clear then that videogame involvement significantly generates positive emotions [5, 13, 15]. Individual differences may play a role on emotions and cognitions. Specifically analyzing the "theory of cognitive load" it is noticed that performance will largely depend on the level of mastery of content. Thus, as long as the learner is novice, he or she will require greater cognitive demand to solve the tasks appointed by the tutor [16].

This study contributes to the understanding of educational video *games* and their effects on emotions and cognitive processing, those experienced during the student's learning process. Given the current ongoing challenge of engaging students into educational activities, video *games* perfectly allow enhancing the learning experience by providing enjoyable activities to keep absorbing content [17]. Moreover, as stated in the "flow experience" model proposed by Novak and Hoffman [18], It appears to be relevant to explore the student's control perception over their task and the underlying level of complexity that might predict the level of participation in their learning experience. Under this context, players are better aware of their own capability to take decision on virtual environments with real challenges, combining formal instruction and experiential assessment [12].

In addition to exposing students to serious *games*, the researchers in this study exposed students to a semi-structured interview by asking participants about their subjective experience after their immersion in the video *game* designed by UCSM researchers. The following questions were asked: (1) Does the level of complexity in video *games* predict the increase of cognitive resources? (2) Do emotional responses

predict the level of immersion in gaming-based learning contexts? (3) How does game-based teaching influence emotions and cognition?

The paper is organized as follows; second section presents methods for this study. Third section presents the procedure; the fourth describes statistical analysis and fifth describes the discussion and results. After that, we present our conclusions.

2 Methodology

2.1 Participants

First-year undergraduate students enrolled at the school of Systems Engineering participated in the program (n=9). Recruitment criteria were limited to male students because of the low female population in the program. The participants (mean age = 19 years) were instructed to use the video game "Engineers Escaping" to solve engineer-related challenges. Parallelly, the emotions of participants were measured through an advance hardware sensor "EMOTIV EPOC" located on the forehead section of each student. Furthermore, the participants took part on a semi-structured interview to identify the cognitive load experienced after the *videogame* exposure.

2.2 Materials

2.2.1 Emotion assessment through "EMOTIV EPOC" hardware

The "EMOTIV EPOC-EEG" (electroencephalograph) is a brain activity map hardware to identify cognitive processes, which may be experienced during the use of *videogames*. Emotions such as: relaxation, interest, focus, commitment, emotion, stress were analyzed. This device has 14 electrodes (saline solution sensors) located in AF3, AF4, F3, F4, F7, F8, FC5, FC6, P7, P8, T7, T8, O1, O2 and two additional sensors that serve as reference channels (one for the left and one for the right hemisphere of the head). The 14 data channels of the Emotiv EPOC-EEG collected data on emotional dimensions during the use of a software.

2.2.2"Engineer scaping" serious game

"Engineers Escaping" is a video *game* that exemplifies a real situation in the daily life of a systems engineering student. The story begins in the classroom of a programming course, where the protagonist discovers a tape that indicates that the engineers had been kidnapped and must rescue them. As part of the story, it should be noted that the student (character) will depend on the performance of the same within the video game. The main character is a boy who will represent the player; he will be able to move around the platforms, collect clues and crystals.

This *game* is built on particular principles. For instance, there are clear goals, alongside a level-based story which is straightforwardly described for students to feel that they have a challenge to pursue. The platform provides immediate feedback to player, who must jump and avoid obstacles to reach checkpoints showed through a progress bar on the screen. The *game* involves some basic skills to use the control command unlike other *games* platform. Moreover, the game poses a horror-based style to provoke tension on associated traps in each level (see Fig.1).



Fig. 1. "Engineer Scaping" game- control panel.

The serious game: Engineers Escaping was implemented to achieve motivation in learning matrix-based programming, testing, algorithm design, and geometric transformations. Each game level is organized in chapters whose main character must go through, the user will find traps that must be avoided or deactivated. In this scenario, there are controls which requires solving puzzle to disarm the traps and progress while collecting crystals and clues that contain key information. The character will be able to jump, move left or right, open doors within each floor or level. There are specific saws such as electric, lasers, spiked platforms that made levels difficult. Additionally, the controls are designed to deactivate the traps in the room; these controls contain puzzles that must be solved to advance in the level. Upon reaching the door, students must press the "e" key, which will take the user to the first puzzle of the game, which requires deciphering the combination in a 3x3 matrix by pressing specific color-based boxes (See Fig. 2. Test cases).



Fig. 2. On the left: Test cases in which the student has failed.
On the right: Successful test cases unlock the level and move on to the next.

2.2.3 Cognitive load interview

The Task Load Index Scale of the National Aeronautics and Space Administration (NASA-TLX Scale) was chosen to determine the perception about cognitive workload during the use of the video game "Engineers Escaping". The instrument measured 6 categories: effort, frustration, performance, mental demand, physical demand and temporal demand in the participants. Each of the items was reported at low or high levels, in the form of a semi-structured interview.

The NASA-TLX Scale was developed by Hart and Staveland in 1988 [19] to quantify the physical and mental workload associated with the performance of a given task, allowing the assessment of possible interference. The Scale has demonstrated a

very low variability of intervening variables, due to its category weighting system that takes into account the individual's self-reported strengths and weaknesses.

3 Process

It should be mentioned that before the study commences, the approval of the local ethical committee of the Catholic University of Santa Maria was obtained, in addition to the written consent of each participant. Participants received information to partake in the study. They were informed about the study objective and its implicit risks.

They were seated in a comfortable chair and given a personal computer to use the video game. Investigators explained detailed instructions to take part on the video game "Engineers Escaping" for 60 minutes and that they had to advance as much as possible in the game (a platform game aimed at understanding different programming concepts applied in the early years of the career). For the real evaluation, each participant started the game in the computer lab. While the participant was playing on the computer, the lights were turned off to help immerse the player in the game and reduce the brightness of the room lights. The examiner installed and verified the connections between each electrode of the EMOTIV EPOC device and the student's scalp.

Emotional dimensions were captured in sync with the EEG data as the game is deployed. Then data was recorded on the same computer with all non-essential programs closed. After completion of the initial task ("Engineers Escaping"), participants were informed that they would undergo an interviewing process, where they would be asked about the cognitive load they were exposed to.

4 Statistical analysis

Descriptive statistics have been used to determine differences between participants and to characterize the variables measuring cognitive demand and emotional response to *videogames*. The statistical package SPSS 20 was used for quantitative analysis.

4.1 *Quantitative analysis*

Descriptive statistic was used to analyze emotions, whose dimensions are a) relaxation (21.7%), b) interest (12.43%), c) focus (16.31%), d) commitment (24.31%), e) emotion (21.04%), and f) stress (9.25%). It should be noted that a greater percentage of the “engagement” dimension (24.31%) is observed with respect to the other dimensions measured by the EMOTIV EPOC brain activity software. Additionally, the "stress" dimension has not had variability, which means it had been maintained in the pre and post assessment (*fig. 3*).

We also analyze normality using statistical package SPSS 20 (*see fig. 4*), we obtained that the data is parametric, particularly the dimensions of: stress and focus are even more homogeneous with respect to data normality. When comparing

performance in the pre and post-test, we identified a student t-score of 0.038, with a variation of 4.2 points of the pre and post intervention (*fig. 5)*. It is important to emphasize that in the post-test, the dispersion of data in the evaluated sample is reduced.

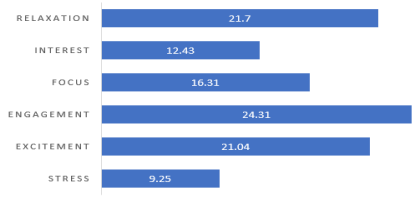


Fig. 3. EMOTIV EPOC Variation.

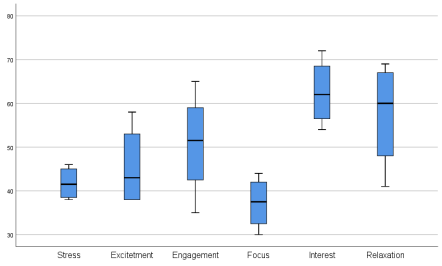


Fig. 4. EMOTIV EPOC Normality

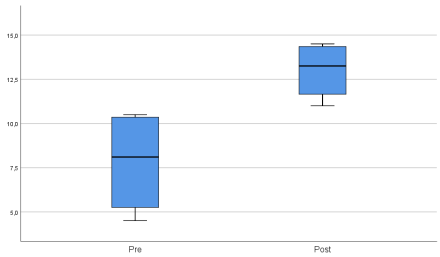


Fig. 5. Comparison Pre & Post test

4.2 *Qualitative analysis*

After collecting data from semi-structured interviews to investigate cognitive workload. A content analysis technique was used to examine the response patterns of the interviewees [20]. This methodology identified most of the recurring responses to classify the data into categories (*see table 1*).

The content obtained from the interview went through an initial categorization process guided by the "cognitive load" test (6 categories) classified into two levels (high-low) for each cognitive load category. The exploration contained the following dimensions:

Category **1. Mental demand,** in this category it is evident that, the greater the complexity of the challenge level in the video game, the greater the mental demand, in terms of mental concentration.

Category **2. Physical demand,** we found non-levels of physical activity, because the participants are in a sitting position in front of the monitor to access the video game.

Category **3. Temporary demand**, while some participants describe moderate-high pressure to finish the game within the stipulated time frame, others comment that the time is adequate for the task assigned in the game.

Category **4. Effort**, the responses obtained in this element are determined by individual differences. Some participants mention the effort to pass each level of the

video game, on the other hand, we find students who give greater value to the entertainment role, while "have fun" playing, the effort is implicit in the game.
Category **5. Frustration**, in this element we explored the feeling of discomfort-satisfaction with their own performance, while some students are frustrated by not completing all the levels of the video game, others express discomfort-anxiety at feeling observed by other players and not "reaching the good level" expected.
Category **6. Performance,** this element allowed us to find that some students experience a sense of success by participating in the platform, and since it was an educational game it imposed a different challenge in reference to the entertainment games, they are used to participate in. On the contrary, we found that some other students are dissatisfied because they could not complete the objectives and/or levels of the virtual challenge.

Table 1. Cognitive demand categories

Categories	Low	High	Notes
1.Mental demand	X		The activity has a light demand, it is an easy activity with instructions and guidelines.
2.Physical demand	X		The activity does not contain physical activity, except for typing and sustained sight.
3.Temporary demand		X	High and constant time pressure, time was limited for activities.
4.Effort			The activity requires incremental effort over time as work levels escalate.
5.Frustration		X	As work levels increment, incremental frustration is also reported. Irritability when not finding patterns in the game
6.Performance		X	The activity requires incremental effort over time. The user's performance responds to the incremental complexity.

5 Discussion and results

Transformational play has been positioned as an innovative tool that offers to enhance the learning experience [14, 21, 22]. The proven effectiveness of educational digital *games* in academic performance accelerates potential improvements in the way knowledge is transmitted [23].

These basic findings are consistent with previous research showing that varied emotional responses are generated during the exposure to educational *videogames*. We found MacMahan who evaluates the experiences of participants with assorted modes of stimulation and suggests that the Emotiv EPOC is a tool that evaluates the experience of the player during the game being an accessible tool because of its low cost [5]. While this study found higher levels of engagement during execution of activities, the multiple emotional and cognitive reactions will largely depend on the type of game. This is corroborated by Brilliant et al. [24], who describes categories of

games such as "3D adventure, first-person shooting (FPS), puzzle, rhythm dance, and strategy" and its wide-ranging influence on the brain activity. Additionally, our study casts a new light on demonstrating the deployment of a guided *video game* of strategy called "Engineers Scaping" by involving first -year university students. This *video game* provides evidence to manage complex content, such as matrix programming and geometric transformations, through more didactic methodologies for data programming. Although the video content was enjoyable, the authors declare challenges on maintaining motivation and attention span among students.

Cognitive processing among students is of paramount to guide teaching methodologies. It is widely known that virtual and non-virtual content imposes a significant burden on the students' ability to receive and process information [23]. Particularly, the task performance resulting from mental effort by using online *videogame*s has been reported in numerous studies where the design, presentation and evaluation of content had raised multiple interventions in education. One of the points of analysis for this research is the NASA-TLX scale, which was reported as a relevant tool to identify subjective perception resulting from complex content exposure [25, 26].

The following contributions are evidenced in the area of educational research: a) videogame-based teaching improves student's motivation to analyze cases before the solution, as already reported in previous studies [10], b) students might better design and cognize the access and withdrawal of complex algorithms by providing a block-based structure [8]. Furthermore, this study demonstrated the importance of c) having a fairly clear and intuitive feedback to improve the ability to identify and diagnose problems timely [9].

The limitations of the present studies naturally include the sample size. Because of lack of a specialized video-game laboratory, we decided to include a short sample to control better the experience of gamers while learning complex contents. Another limitation is the availability of female students at the School of system engineering. Hence, this study involves the issue of not considering gender differences.

Despite these limitations, some implications of this study are raised. Results demonstrate that emotions make an impact on the way students process new information. As discussed, game-based curriculum should be considered on the basis of positive emotions such as engagement to allow students better involvement on their own learning [7, 27, 28]. Finally, more attention is needed on the game-based learning-teaching approach [22], given students not only need guided content but also digitalized learning environments to enhance a meaningful education in the context of real-problem solving.

6 Conclusion

This study identified the emotional dimensions and cognitive load during the use of a serious game called "Engineers Escaping". The findings depict a sort of emotions, which are manifested in the context of virtual learning. These emotions are stress, excitement, commitment, focus, interest and relaxation.

Furthermore, in the qualitative analyses it is found that cognitive performance depends on the levels of exposure to the game, confirming the hypothesis that, the *videogame*s complexity increases the use of cognitive resources. These results are supported by previous studies that distinguish the subjective disparities in terms of emotional responses and cognitive load. Finally, it is critical to carry out more longitudinal research to capture the role of video games, emotions and cognitive resources to predict academic attainment on young university students.

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This study was part of a series of research on *games* in education. We thank the students who were involved in the development of the platform. The authors declare no conflict of interest.

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Foundation of the need for the development of digital skills in teachers: The case of Continental University

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Abstract. This research aims to support the need for the development of the digital skills of Continental University teachers, based on a series of needs identified in the context of the Fourth Industrial Revolution, in which as a higher education institution it aspires to be a key player. The method presents the results of a knowledge and procedural test on digital topics and tools that the teacher has been using and could use; the structure and questions of this test have been framed in the dimensions understood by the DigCompEdu Framework, finally describing the conclusions and future work that originate from this study.

Keywords: Digital skills, university, teachers, DigCompEdu, digital transformation

1 Introduction

Throughout history, education has become more important and relevant in training and shaping the workforce of its eras, education has contributed - since the first industrial revolution - to economic development and prevailed one that maximized the relationship between a teacher and a group of students, at this time a pedagogy according to the workers of the industrial revolution began to be implemented, acting on the child's body, disciplining him, it tried to achieve order, install a correct posture, silence and submission, even when they were not observing them. The industrial revolution influenced education by provoking initiatives of change that gave a particular direction to the developments of different types of pedagogies both directly and with education in factories, as indirect, bringing people together in urban centers giving the necessary conditions to bring about change. It is clear that this fourth revolution is not only the use of a new generation of technological resources and interconnected and digital intelligent systems, its scope is broader and we can barely see its social impact, these changes mean in public and private higher education institutions, a huge responsibility to contribute with the greatest relevance to the development of the country through the advanced training of a growing number of professionals, the generation and innovative application of knowledge, the dissemination of culture and attention to local and national problems. Therefore, the development of the Digital Teaching Competition is key to training competent and successful citizens of the 21st century in the Fourth Industrial Revolution, many

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authors agree that this digital competence is a "metacompetence" or a "competence of competences", because it involves the integration, internalization and implementation of a set of technical and cross-cutting skills for the management of digital tools and content within the teaching-learning processes and is that the digital teaching competence not only engages teachers, for which it is a key professional competence, but also students.

2 Foundation for the development of teachers' digital skills

There are five reasons identified, which underpin the need to develop the digital skills of teachers at Continental University.

2.1 Need for accelerating digital transformation

We live in an increasingly digital society, accelerated as a result of the Covid-19 pandemic, digitization is the most relevant feature of the Fourth Industrial Revolution, traditional information and communication technologies (ICTs) have evolved into digital technologies, which are part of people's daily lives and as a result, digitization is a profound process of transformation for many educational institutions in the country and in the world.

Today, the key factor of such digital transformation depends not on the mere incorporation of technologies or the provision of means or simple access to technology, but on having the knowledge and skills sufficient to make effective, autonomous, creative and critical use of these technologies. Therefore, we need to have a clear strategy and start the necessary processes to form a digitally competent university community, which engages teachers, students and all the staff of a university.

Accordingly, digital technologies; assume a role of great importance and relevance, in the knowledge society. Thus, “being immersed in a digital society does not ensure the same opportunities for all citizens in terms of their access and use, nor, consequently, is a unique requirement for it to develop such competence naturally […]” [1], they adds that “it is necessary for the population to master their languages, that is to say, being literate and competent” [1].

The Continental University has initiated this transformation since the creation of the non-in-person distance mode in 2013; which has been seen in the need for extending its teaching training practices and processes to its face-to-face modality as a result of the pandemic originated by Covid-19 in 2020 and which has become the creation of the Vice-Chancellor of Digital Development and Learning; this emphasizes the incorporation of technology on the physical and virtual campus; and has incorporated digital technologies into its different fields: teaching, research and management. On the other hand, the Continental University, has been proposed as an institutional vision "By 2021, to be the best university for Peru and the world in the context of the Fourth Industrial Revolution", so its adaptation and digital transformation is a strategic issue, and it is clear that digital transformation, not only involves the implementation of technologies, but the knowledge, use and application

of technology in a responsible and effective way that guarantees the educational quality of education , the modernization, digitization and satisfaction of its users.

2.2 Need for developing key 21st century skills

The skills of the 21st century may be considered necessary to understand contemporary life and to train and prepare the workforce that society will need in the coming years, including professions that do not yet exist, but will be shaped by technology that changes workplaces and lifestyles. The 21st Century Skills Assessment and Teaching Framework (ATC21S) "underscores new skills, but also places a new emphasis on old ones, equipping people for new ways of thinking, ways of working, tools to work and live in the world, this Framework defines competition as the ability to adjust skill performance to situational demands" [2]. "This view covers the quality and transferability of skills over time and context, recognizing the fact that no one performs a skill at the same level or operates to the fullest each time" [3].

Because of that, "there is the need for powerful changes in teaching/learning processes and learning assessment, with related challenges. The ATC21S perspective on 21st century competencies recommends new forms of learning and forms of teaching that should be considered for the development of appropriate assessment strategies" [4]. US Partnerships 21 "expresses similar views on how to catalyze education for the 21st century. They support merging traditional academic disciplines using the 4C (critical thinking, communication, creativity and collaboration) made up of life/career skills, technology and media skills" [5]. The OECD 2030 document defines these competencies as "key to addressing the challenges of a volatile, uncertain, complex and ambiguous world, leveraging digital tools and artificial intelligence" [6] [7]. En la Fig. 1, the P21 Framework is shown, which encompasses a series of knowledge, skills and attitudes necessary for every student of the 21st century (as represented by the rainbow arches) and also those support systems that the teacher has in his daily practice (as depicted at the bottom of the figure).

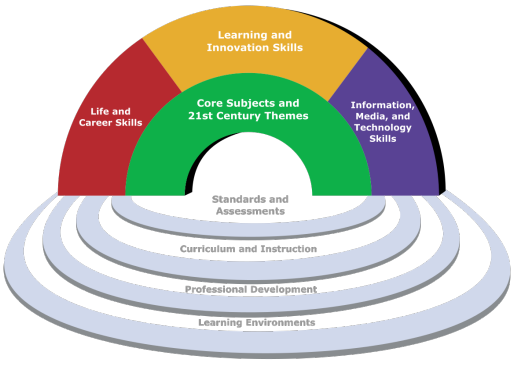


Fig. 1. Education of the 21st century and 4 Cs.

Promoting student skills in the 21st century "poses new challenges for teachers, particularly in student evaluation and more broadly in teaching professional

development" [3]. It follows that teachers should understand, implement, evaluate, model and promote such key competencies. The competencies and skills of the 21st century need interdisciplinary collaboration and problem-solving powers related to TPACK (Pedagogical Knowledge of Technological Content). "This also requires educational institutions such as vocational learning organizations, with school practice communities, participants engaged in a permanent dialogue to promote cycles of development and reflection in students and teachers. That is, where teaching competency frameworks can be useful for all those interested in education" [8] [9].

2.3. Need for a new teaching role in digital society

The pandemic has accelerated the digital revolution in the education sector and at all levels; "has transformed the way children and people play, access information, communicate and learn. Preschoolers are already familiar with digital devices. Today's young people are more connected than ever, using the Internet for games, talks and social media, with a significant increase in their use" [10].

However, the type of technology and what it is used for can determine its effects [11], for example, "the use of ICTs in the classroom or at home for school work; use of the mobile phone for social interaction or gambling; watch TV or videos to relax". Understanding "how and why technology is used and the variety of devices available to children and youth are needed to help educators and families make informed decisions about the use of technology in childhood and adolescence" [12].

The digital revolution has not yet been accompanied by general transformations of education, teaching and learning systems in schools. In addition, "mixed findings on the impact of technology use on student outcomes point to the need for reconsidering the way teachers use technology to support learning" [13]. This highlights the need for teachers to know and apply new pedagogies that use technologies, "promote peer learning in education systems worldwide, and catalyze the development of indispensable cross-cutting competencies: problem solving, collaboration and creativity. These pedagogies should be based on the learning associations of students and teachers, taking advantage of their intrinsic motivation and integrating the knowledge, pedagogy and technology of system change" [13].

It is the responsibility of teachers to promote and stimulate environments and opportunities to generate deep, relevant and meaningful learning experiences that allow discovering and improving students' skills. "Teachers are called to be important learning triggers, not just facilitators, to be creative in choosing from a wide range of strategies to mix and match context and learning. Mentors who build trusting relationships with students; individual and group learning orchestrators; alchemists who combine strategies, techniques, and resources to stimulate student creativity; welders connecting bits of knowledge and activities into a meaningful whole; team players, understanding and unfolding their potential and that of others to the fullest: teachers must cover all these roles" [14]. This learning, driven by the use of technologies, "has the potential to develop creative and collaborative participants in an interdependent world based on knowledge. For this meaningful learning to thrive, teachers must be excellent lifelong learners, both individually and collectively" [15]. Currently, Continental University has an evolving teaching training mesh (Fig. 2),

whose figure is shown below, and where we can visualize that in the dimension: Applied ICT use, includes courses that encourage the use and application of digital technologies for education.

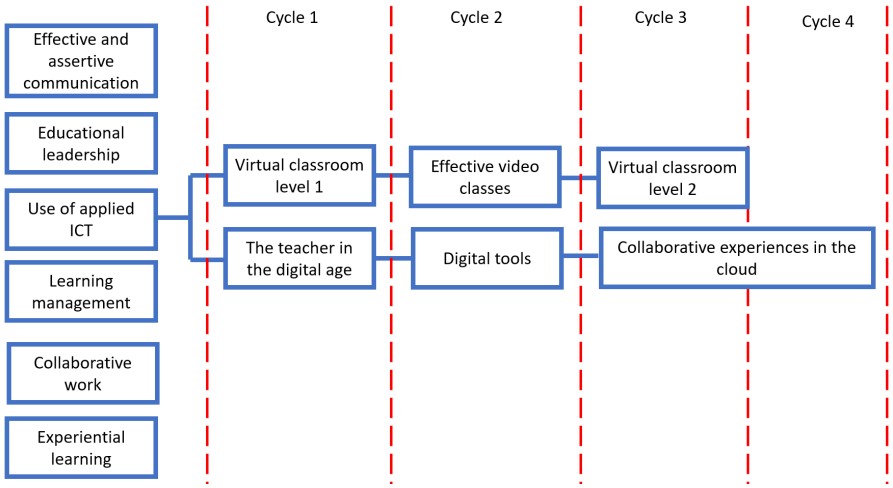


Fig. 2. Teacher training mesh at Continental University.

However, as you can see the courses follow lines – sometimes separate – where what is missing is greater synergy between them and raise the dimension of ICT Use applied to that of Digital Skills.

2.4. Need for developing digital skills in teachers

"Educational institutions are currently facing the challenge of finding new ways to do their educational work, especially in light of the recent technological, economic and social changes currently taking place" [16], with the aim of empowering and educating new generations for an uncertain and bewildering future.

"Never in history has humanity had as many technological tools available as in the present. Technologies that double at high speed thanks to digitization, resulting in transmedia, that is, the display of multimedia contents on different devices. This multiplies the ways in which people can interact with information" [17,18]. "This problem is constantly evolving, as is the development of technology" [19]. Thus, skills development must be perceived within the idea of lifelong learning. "In addition, forecasts indicate that in the Fourth Industrial Revolution, within which we find ourselves, most future works will require digital skills" [20].

"Therefore, and without forgetting that this same technological penetration entails the so-called technological stoppage, the only way to overcome it is through the development of skills related to digital technology" [21,22]. As a result, the development of digital skills, inherent in our society, are directly related to the success, employability, creativity and prosperity of each individual. "Within the professional skills of the teacher, different authors refer to those dexterities or skills

related to the use of technological tools for the development of their professional activity in the classroom, which are different in many respects from the use that could be given to them at home or in the environment" [23].

2.5. Need for a Digital Skills Framework

Teachers in general, with the highest impact at the top level, live in a constant struggle to keep pace with technological innovations almost every day, not only by incorporating technologies in the different areas of knowledge, but also by the need to generate stimulating and efficient learning experiences in their students and at the same time to ensure that students learn the contents and develop skills for their success lifetime [24], especially because of the abrupt challenge of teaching in times of the Covid-19 pandemic, face-to-face confinement and the need for adopting educational technologies in virtual learning environments that force them to achieve the same skills planned in each subject but in a virtual and remote way. It is anecdotal, but although there is a lot of literature and educational experiences regarding the adoption of educational technologies in learning in the context of formal training, there is little research at the qualitative level.

Prensky [25] defined new types of students in the digital age, calling them "digital natives," supported by research results [26] who argued that these students were constantly immersed in technology and learned differently from previous generations. Subsequent research on the concept of digital native, however, found little substantial evidence of such innate digital characteristics in the new generation of students [27], but the transfer of those skills in the classroom seems not entirely true. Still, the concept of digital natives possessing unique digital skills and dexterities remains widespread, mostly not questioned by the global educational community.

The proper use of technology for learning requires the development of digital skills on the part of the teacher and the student in an ideal scenario, so frameworks or models of digital competences emerge, which, until before 2017, existed various proposals arising from institutions or governments to have a framework that understands a path of capacities and dimensions and to be able to guide policies and actions that allow the development of the digital skills of teachers. In the "Report of analysis and conclusions on existing frameworks (CCAA and international) of digital teaching competence", prepared as part of the work of the project in 2013, and shared in the common space of the Lecture in CConectAA, they conclude "that the existing situation is quite diverse in terms of plans for the development of teaching digital competence and that there is a clear lack of a common reference framework with standards and indicators that facilitate its evaluation and accreditation".

In the "Report on the analysis and conclusions on the existing frameworks (CCAA and international) of digital teaching competence", published in the common space CConectAA, they conclude "that the existing situation is quite diverse in terms of plans for the development of digital competence teacher and that there is a clear lack of a common frame of reference with standards and indicators that facilitate their evaluation and accreditation ", the same report raises the need for the reference of a common framework with sufficient recognition, which specifies evaluable indicators for each area of digital competence. In 2017, the European Union published the

European Digital Competence of Educators (DigCompEdu) framework, which aims to align and guide, providing a framework of reference for governments, national and regional bodies, educational institutions at all levels of education, teacher trainers and teachers themselves from a set of digital skills and strategies, the DigCompEdu framework aims to capture these specific digital competencies for the educator. In several European Member States, the framework has been used as an explicit reference for national guidelines, particularly in the orientation of school education. In Germany, for example, the Kultusministerkonferenz (KMK) refined it for its digital student competence framework [28].

An interesting research that "through the judgment of experts, they chose a framework of competencies that becomes the focus of a broader investigation" [29]. 179 responses were received applying the Expert Competency Coefficient, totaling 148 experts. Following the results, it can be found that the Digital Teaching Competency framework (DDC) and the European Union Digital Teaching Competency Framework (DigCompEdu) "have excelled".

As noted in the following table (Table 1), the self-assessments assigned by the experts could be considered high and very significant; this would suggest that the initial criteria used by the authors for identification could be regarded as valid and significant for the objective pursued. Presenting the data that led to the experts' choice, the result of the values assigned for the different frameworks was presented by the experts who exceeded the value of 0.8 in the expert competence coefficient.
By sorting from highest to lowest average score reached by each frame the two frames with the highest score were:
5.56 Framework of the European Union of Digital Teaching Competence.
5.41 Common framework of digital teaching competence of the "National Institute of Educational Technology and Teacher Training".

Table 1. Means and deviations from the different frames.

Framework or Framework of Reference	M	D.typ.
European Framework for Digital Teaching Competence (European Union)	5.62	0.41
"ISTE" standards for M2 teachers	5.25	0.65
ICT Competency Framework for Teachers (UNESCO)	5.37	0.56
INTEF's Common Framework for Digital Teaching Competence (Spain)	5.41	0.59
Digital Teaching Framework (UK)	5.40	0.55
ICT Skills for Teaching Professional Development (Colombia)	5.40	0.57
ICT competencies and standards for the teaching profession (Chile)	5.27	0.68

3 DigCompEdu

At the end of 2017, JRC publishes the European Digital Competence Framework of Teachers "DigCompEdu", “which aims to assist member states in their efforts to promote digital teaching competition and drive innovation in education” [30]. The

"DigCompEdu" framework is the result of different conferences, working days, debates and deliberations with experts and professionals. It is based on an initial bibliographic review and represents a synthesis of existing instruments at local, national, European and international level [30] [31]. The result is a consensus on the main areas and elements of digital teaching competence, which follows a progressive logic in each area of competence. It is a digital competency model for trainers. Its areas of competence are shown in the figure 3.

These dimensions are:

1. Professional commitment: This dimension will encourage teachers to generate and stimulate professional interactions with their peers, students, parents and other interested parties.
2. Digital resources: Dimension that encourages the creation and distribution of digital resources for learning in an effective and responsible way.
3. Digital pedagogy: The teacher manages, administers and organizes the use of digital tools and technologies in the teaching and learning process.
4. Digital evaluation: Addresses the use of digital strategies to improve evaluation.
5. Empower students: Focuses on the use of digital technologies to develop student-centered teaching and learning strategies.
6. Facilitate the digital competence of students: Through specific pedagogical competences, it facilitates the digital competence of students.

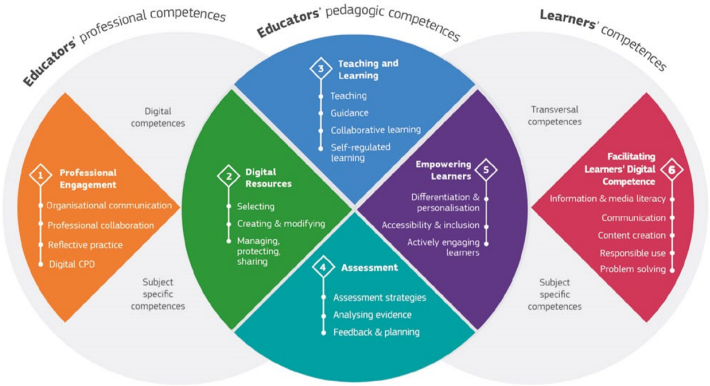


Fig. 3. Conceptual vision and competence areas of the European Framework for Digital Competence of Teachers "DigCompEdu".

4 Diagnostic evaluation

Teacher competence frameworks can have “three main purposes: defining the results of teacher training, criteria for teacher recruitment and selection, and professional development needs of teachers” [8]. They can provide teachers with a clear picture of their roles, promoting attitudes towards professional reflection and autonomy throughout the teaching career.

Then, "as benchmarks for key professional knowledge and skills, they can support effective professional development at the individual and institutional level, helping to focus on learning priorities and needs at different stages of the career" [8].

By providing shared standards for professional profiles, teacher competency frameworks can also contribute to ensuring an effective teaching training offer. Finally, depending on the characteristics of the context, the competence of the teacher. "The frameworks can also help recognize achievements in the careers of education professionals" [8]. In general, "teacher competency frameworks can support the quality, empowerment and accountability of teachers if they have a formative approach and have been shaped by promoting teacher appropriation" [8].

On the other hand, the Continental University has prepared an evaluation test with questions at the level of knowledge and procedural, corresponding to each dimension; it was not in the face of a self-perception assessment, but it was taken as a reference to the proposal of the global classification system and area classification system proposed by [32], this proposal is validated by various related studies [33] [31]. Table 2 shows the distribution of questions by dimension.

Table 2. Distribution of questions by dimension.

Obtained Rating	Number of questions
Professional commitment	16
Digital resources	16
Digital pedagogy	12
Assessment and feedback	12
Empowering students	12
Facilitate students' digital competence	20
Total	**88**

Following the proposed overall classification system by level of competence [2], the results obtained were tabulated:

Table 3. Digital Skills Assessment Results.

Obtained Rating (Out of 88)	Competitive level	Number of teachers	% teachers
<20 points	Rookie (A1)	51	15.1%
20 to 33 points	Explorer (A2)	16	4.8%
34 to 49 points	Integrator (B1	75	22.3%
50 to 65 points	Expert (B2)	171	50.7%
66 to 80 points	Leader (C1)	24	7.1%
>80 points	Pioneer (C2)	0	0.0%
Total		**337**	**100%**

The following is a brief description of the results obtained in Table 3, based on what is described by the authors when making the competitive level proposal:

- 15.1% of teachers, have very little experience and contact with educational technology, use the basics and what is necessary. You need ongoing guidance to improve your teaching digital competency level.
- 4.8% of teachers have little contact with educational technology. They have not developed specific strategies to include ICTs in the classroom. You need external guidance to improve your teaching digital competency level.
- 22.3% of teachers experiment with educational technology and reflect on their suitability for different educational contexts.
- 50.7% of teachers use a wide range of educational technologies with security, confidence and creativity. They seek the continuous improvement of their teaching practices.
- 7.1% of teachers are able to adapt to their needs the different resources, strategies and knowledge at their fingertips. It is a source of inspiration for other teachers.
- 0.0% of teachers question contemporary digital and pedagogical practices, which they themselves are experts. Lead ICT innovation and are a role model for other teachers

5 Conclusions and future work

This research has raised the need for developing digital skills of teachers at continental University considering five main axes: a) Need for accelerating digital transformation, b) Need for developing key skills of the 21st century, c) Need for a new teaching role in the digital society, d) Need for developing digital skills in teachers and e) Need for a Framework on Digital Skills. It has also allowed to show the results of a test of knowledge and procedures of teachers classifying according to the levels proposed by DigCompEdu, although the remote modality that emerged as a result has accelerated the development of digital skills, there are still many training and reflection actions to adopt in an orderly, complete, systematic and evolutionary way the DigCompEdu as a reference framework in teachers.

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Learning Styles and Flipped Classroom: An Experience in Secondary School

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Abstract. Flipped Classroom (FC) has been gaining prominence in recent years and multiple articles have appeared that highlight its ability to increase the academic performance of the students who use it. This research asks how students' academic outcomes vary when using FC compared to traditional class based on their learning style. The sample used to carry out the research were two groups of 3rd level of Secondary Education who took math classes using FC during a quarter. The methodology used has been quantitative, at the beginning of the quarter all students took a questionnaire to determine their learning style (CHAEA questionnaire) and also, before and after each topic, conducted evaluation tests. The results show that students improve their academic performance by using FC compared to the traditional class; however, this improvement is not statistically significant. When we focus on the different learning styles, different results appear depending on the block of mathematical content treated and the active style is the one that gets the best results. The main contribution of this research lies in the study of the correlation between academic results and the learning style of each student.

Keywords: Flipped Classroom, Mathematics, Academic Results, Secondary Education, Learning Style.

1 Introduction

The FC is a pedagogical model that is based on the investment of time and the role of students and the teacher [1]. When using the FC the transmission of theoretical concepts in class is usually replaced by the viewing of online videos at home by the students [2]. In this way students have already received the contents and face-to-face time in class can be used for top-level activities of bloom taxonomy [3] such as applying, analyzing, evaluating or creating [4]. Students go from passive recipients in the traditional model to having an active participation in the FC [5]. Moreover, the teacher goes from being a mere transmitter of knowledge in the traditional class to a guide and creator of learning scenarios in the FC [6]. Currently in the international databases, there are more than 5000 scientific documents on different areas and

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aspects of the FC [7]. This issue highlights the impact that the FC is currently having on the world of education and how important it is for its future.

On the other hand, learning styles in education is one of the most studied fields, but there is no universal definition of this concept [8]. Despite this, there is a consensus that it refers to each student's way of learning [9]. Authors such as [10-16], among others, have developed different types of learning styles and created instruments to classify students, but the most used in Spanish is the Honey-Alonso Questionnaire on Learning Styles (CHAEA) [17].

Students are a source of basic information to assess the quality, relevance and fairness of their training, as well as the strengths and weaknesses of the learning process [18]. This information is nourished by two sources: the learning outcomes and the assessments of their experiences during their training [19].

The objective of this research is to analyze the results of students' assessments based on the learning style.

This research raises the following hypotheses:

H1- The academic results of students with active learning style when using the FC get better results than students who follow the traditional class.

H2- Students' learning style conditions their academic performance when using FC compared to traditional class.

2 Theoretical framework

The FC began to become known from 2007, when two teachers Jonathan Bergman and Aarom Sams professors of chemistry at Woodland Park High School in Colorado, video-posted Power Point presentations from their classes and published them online, for students who could not attend class. His surprise was that his videos went viral and many students began to watch them [20]. Another milestone that helped popularize fc was the emergence of the Khan Academy website, founded by Salman Khan in 2006, where videos of different subjects could be found [21].

Regarding the academic performance, you get from using FC instead of the traditional class in the ESO math area, most research supports that they increase. An example of this is the research of [22-29] and [30] among others. On the other hand, [31] claim that on an algebra issue the academic results were similar in both groups.

In relation to learning styles, there have been many attempts by researchers to define them [8]. In the 1940s, researchers focused on cognitive elements or psychological aspects [32]. Later there is a third trend that proposes the synthesis of both approaches that argues that the style of learning is constituted by cognitive style and learning strategies [33]. [34] Indicated that motivation, emotions and sociological aspects are variables that affect learning styles. In the 1980s with the increase in research in learning styles, the affective dimension began [35]. In the 1990s, [32], researched the relationship not only of cognitive style with learning strategies but also with the affective dimension and motivational aspect. From Goleman's so-called emotional intelligence [36] he resurfaces interest in the inclusion of the affective, as a way of indegging to deepen the theory of learning styles. [37] Analyzes different tools

and tools to diagnose learning styles and finds only six that analyze cognitive and affective styles together, among which the CHAEA questionnaire.

[38] Describes the characteristics of people with predominance in any of the learning styles, in Table 1 are the main ones.

Table 1. Characteristics according to learning style

Learning style	Main characteristics
Active Style	Emphasis on concrete experience. They are students who are fully and unbiasedly involved in new experiences.
Reflective Style	Emphasis on reflective observation. They are students who like to consider experiences and observe them from different perspectives.
Theoretical Style	Emphasis on abstract conceptualization. They adapt by integrating observations into logical and complex theories. They approach problems in a vertical.
Pragmatic Style	Emphasis on active experimentation. Its strong point is the practical application of ideas. They like to act quickly and confidently with those ideas and projects.

A study conducted by [39] using the CHAEA questionnaire, indicated that learning styles are not associated with age or gender. On the other hand, [40] found that learning styles are heterogeneous depending on the university career.

3 Methods

A quantitative approach has been used in this research. The scope of the research is correlational, in claiming to know the relationship between the learning style of the students and their academic performance when using the FC.

The participants in this research have been two groups of 3rd Compulsory Secondary Education (ESO) of the Ermengol IV Institute of the town of Bellcaire d'Urgell in Spain. The class A of 3rd level of secondary school A had 19 students and the class B with 18 students, of which 62% were girls and 38% were boys. The components of the classes did not vary throughout the research, and were already created at the start and were homogeneous. Students used FC throughout the first trimester of the course in math classes.

The instruments used have been a questionnaire and evaluation tests. On the one hand, the Honey-Alonso Learning Styles Questionnaire (CHAEA) consisting of 80 questions (20 items for each of the four learning styles) to which it responds dichotomy way by expressing whether you agree or disagree. The maximum score in each style (Active, Reflective, Theoretical and Pragmatic) is 20. At the start of the quarter, all students took the CHAEA questionnaire to determine their learning style.

In 1988 Honey and Mumford created the LSQ (Learning Styles Questionnaire), detecting four learning styles: Active, Reflective, Theoretical and Pragmatic. This four styles were took it by CHAEA (Honey-Alonso Questionnaire on Learning Styles) [33].

On the other hand, the evaluation tests consisted of ten questions related to the knowledge acquired by students on the subject to be addressed at one point each. A pre-evaluation (Pretest) and a final evaluation (Postest) were performed on each topic. The evidence contained the same questions only varied the figures contained in the advertised ones. Also after 4 months of carrying out the final evaluation of item 1 they were again asked to perform the same test, to see how their knowledge of topic 1 had varied over time. In this case we had a pretest, pre-evaluation and two postest, final evaluation and evaluation after 4 months.

Three topics were made from different blocks of the math subject. Item 1: Fractions, belonging to the numbering and calculation block; topic 2: Geometric places, block space and shapes and theme 3: Polynomials, block changes and relationships.

In topic 1 the students of 3rd ESO A used the master class and those of 3rd ESO B the FC methodology. In the next topic, they changed and the students of 3rd ESO A were the ones who used the FC and the 3rd ESO B master class.

Before each class, students of FC group had to watch at home a video of a maximum of 10 minutes, made by the teacher and with content of the subject. The videos were available in Moodle and were posted on the Edpuzzle page, which allowed the videos to contain questions and not be advanced.

Once in class they had to ask questions and doubts that had arisen from the video seen at home. After students were placed in groups of four (the members changed in each new topic) and carried out activities related to the contents seen at home. After every activity, a volunteer exhibited his solution on the board and the teacher corrected it and commented for all students.

4 Results

Below are the academic results obtained by students according to their learning style. To achieve this, students have previously been divided among the four styles from their responses to the CHAEA questionnaire. All 37 students answered the questionnaires, of which 62% were girls and 38% were boys.

Table 2. Results of evaluations unit 1

		Average pre-evaluation (pretest 1)	Average evaluation (postest 1)	Increase
Active Style	3rd ESO A (Master)	5,03	8,01	+2,98 (+59,24%)
	3rd ESO B (FC)	4,29	7,94	+3,65 (+85,08%)
Reflective Style	3rd ESO A (Master)	5,31	8,46	+3,15 (+59,32%)
	3rd ESO B (FC)	5,45	8,13	+2,68 (+49,17%)
Theoretical Style	3rd ESO A (Master)	5,88	8,09	+2,21 (+37,58%)
	3rd ESO B (FC)	6,11	8,40	+2,29 (+37,47%)

Pragmatic Style	3rd ESO A (Master)	4,68	7,95	+3,27 (+69,87%)
	3rd ESO B (FC)	4,76	8,01	+3,25 (+68,27%)
TOTAL	3rd ESO A (Master)	5,16	8,10	+2,93 (+56,97 %)
	3rd ESO B (FC)	5,09	8,11	+3,02 (+59,33 %)

Table 2 shows the results obtained by students in topic 1 corresponding to that of fractions belonging to the numbering and calculation block. We can see that the control group (3rd ESO A) goes from an average of 5.16, in the previous evaluation, to 8.10, which represents an increase of 2.93 points (+56.97%). On the other hand, the experimental group (3rd ESO B) in the pretest gets 5.09 and reaches 8.11 in the postest, which means an increase of 3.02 points (+59.33%). Thus, we can see that the two groups start from almost the same note and reach it, this is collaborated by the results obtained with the T-Student test (table 3) for independent samples.

Table 3. Results of the T-Student test unit 1

	Pretest	Postest	3rd ESO A (Master) Pretest-Postest	3rd ESO B (FC) Pretest-Postest
Active Style	0,301	0,942	<0,001	<0,001
Reflective Style	0,913	0,776	<0,001	0,002
Theoretical Style	0,857	0,841	0,011	0,002
Pragmatic Style	0,940	0,967	0,005	0,003
TOTAL	0,887	0,983	<0,001	<0,001

The first two columns in Table 3 correspond to the T-Students test for separate samples and all their values are $p>0.05$, so the results of the two groups do not differ either in the pretest or postest. This implies that, by not differing in prestest, they are comparable groups. However, not differing in postest means that the differences in results obtained by experimental or control groups are not statistically significant. Still, it is true that those who used FC get a bigger increase.

If you look at the results obtained by the students in each of the different types of learning (table 2), we can see that the active students are the ones who get the most increase when using the FC. They start on average 4.29 and reach 7.94 increasing by 3.65 points (85.08%), while the control group is on average 5.03 and reaches 8.01, an increase of 2.98 points (59.24%). The active type group when using the FC achieves an increment of 0.67, on average, higher than the control group.

In theoretical and pragmatic students the difference in results between the control and experimental group is very small, does not exceed 1%; in these cases, the use of the FC has given the same result as the traditional class. Finally, in reflexive types it has been the control group that has obtained the best results, 0.47 points of higher average in the increase than the experimental group.

The last two columns in Table 3 show the results of the T-Students test for related samples. In all cases the results have been $p<0.05$, this implies that the difference in notes between the pretest and postest obtained are not the result of chance, they are statistically significant. Therefore, the improvement of the notes is due to the use of the FC and of the traditional class, in each case.

Table 4. Results of evaluations unit 2

		Average pre-evaluation (pretest 2)	Average evaluation (postest 2)	Increase
Active Style	3rd ESO A (FC)	3,57	7,71	+4,14 (+115,96%)
	3rd ESO B (Master)	2,91	6,5	+3,59 (+123,36%)
Reflective Style	3rd ESO A (FC)	4,23	8,14	+3,91 (+92,43%)
	3rd ESO B (Master)	4,57	6,86	+2,29 (+50,10%)
Theoretical Style	3rd ESO A (FC)	3,56	7,35	+3,79 (+106,46 %)
	3rd ESO B (Master)	4,91	7,34	+2,43 (+49,49%)
Pragmatic Style	3rd ESO A (FC)	3,15	6,99	+3,84 (+121,9%)
	3rd ESO B (Master)	3,54	6,78	+3,24 (+91,52%)
TOTAL	3rd ESO A (FC)	3,59	7,55	+ 3,96 (+110,30 %)
	3rd ESO B (Master)	3,91	6,84	+2,92 (+74,93 %)

Table 4 shows the results obtained by students in topic 2 that corresponded to that of geometric places belonging to the space and shape block. It can be seen that the students of the control group (3rd level B) departed with an average of 3.91 in the pretest and reached 6.84 in the postest, reaching an increase of 2.92 points (74.93 %). On the other hand, students in the experimental group (3rd level A) went from 3.59 to 7.55 on average with an increase of 3.96 points (110.30%). Thus, in this second topic, students who used the FC scored an average of 1.04 points (35.37%) more increase than the students who used the traditional class.

Table 5. Results of the T-Student test unit 2

	Pretest	Postest	3rd ESO A (FC) Pretest-Postest	3rd ESO B (Master) Pretest-Postest
Active Style	0,352	0,217	< 0,001	0,003
Reflective Style	0,844	0,427	0,029	0,011
Theoretical Style	0,234	0,996	0,009	0,013
Pragmatic Style	0,694	0,903	0,011	0,024
TOTAL	0,549	0,282	< 0,001	< 0,001

All and this difference of more than one point, the results of the T-Students test (table 5) tell us that the differences in results obtained are not statistically significant. As in topic 1 the T-Students in the pretest and postest is $p>0.05$ and the differences in notes between the pretest and postest obtained are statistically significant.

In Table 3 we can see that the active, theoretical and pragmatic types, which used the FC, double the average obtained in the previous evaluation. Moreover, in the case of the reflective type they get 1.62 points more increase from the control group, that is, their grade improves by 42.33% compared to what increases that of the control group.

Thus, in the topic of geometric places belonging to the space and shape block, all styles except the asset surpass the control group, highlighting the reflective style students who get the most increase from the control group.

Table 6. Results of evaluations unit 3

		Average pre-evaluation (pretest 3)	Average evaluation (postest 3)	Increase
Active Style	3rd ESO A (Master)	3,14	5,83	+2,69 (+85,66 %)
	3rd ESO B (FC)	2,27	4,61	+2,34 (+103,08 %)
Reflective Style	3rd ESO A (Master)	3,95	6,19	+2,24 (+56,70 %)
	3rd ESO B (FC)	3,40	5,53	+2,13 (+62,64 %)
Theoretical Style	3rd ESO A (Master)	2,93	6,58	+3,66 (+124,57 %)
	3rd ESO B (FC)	3,59	7,19	+3,60 (+100,27 %)
Pragmatic Style	3rd ESO A (Master)	3,34	5,97	+2,63 (+78,74 %)
	3rd ESO B (FC)	2,79	5,35	+2,56 (+91,75 %)
TOTAL	3rd ESO A (Master)	3,30	6,07	+2,77 (+83,93 %)
	3rd ESO B (FC)	2,97	5,57	+2,60 (+87,54 %)

Table 6 shows the results obtained in topic 3 corresponding to that of polynomials belonging to the block changes and relationships. Students in the control group (3rd level A) get an average of 3.30 in the previous evaluation and increase to 6.07 in the assessment of the subject, reaching an increase of 2.77 points corresponding to 83.93%. In addition, students in the experimental group (3rd level B) go from 2.97 to 5.57 with an increase of 2.60 points by 87.54%. All and that the increase in the two chaos is very similar the students of the FC group get a higher percentage increase, 3.61% more.

If you look at the results obtained by each type of learning style, those of the active, reflective and pragmatic type get a higher percentage increase relative to the control group. These stand out those of the active type that double the results obtained in the previous evaluation and obtain a 17.42% increase than those of the control group. On the other hand, the control group gets the greatest increase in its valuations.

Table 7. Results of the T-Student test unit 3

	Pretest	Postest	3rd ESO A (Master) Pretest-Postest	3rd ESO B (FC) Pretest-Postest
Active Style	0,220	0,245	0,004	< 0,001
Reflective Style	0,611	0,624	0,023	0,012
Theoretical Style	0,535	0,688	0,004	< 0,001
Pragmatic Style	0,589	0,683	0,028	< 0,001
TOTAL	0,446	0,423	< 0,001	< 0,001

When performing the T-Students test for separate samples and related samples (table 7) we get the same results as in the previous topics. That is, the valuations of the control and experimental group do not differ between them in both prestest and postest and the difference in notes between the pretest and postest obtained by each group are statistically significant.

Table 8. Results of unit 1 evaluations after four months

	Average	Difference with	Difference with

			pre-evaluation	final evaluation
Active Style	3rd ESO A (Master)	6,89	+1,86 (+36,97 %)	-1,11 (-13,98 %)
	3rd ESO B (FC)	6,51	+2,21 (+51,74 %)	-1,43 (-18,01 %)
Reflective Style	3rd ESO A (Master)	6,84	+1,53 (+28,81 %)	-1,63 (-19,14 %)
	3rd ESO B (FC)	7,18	+1,73 (+31,74 %)	-0,96 (-11,68 %)
Theoretical Style	3rd ESO A (Master)	7,30	+1,43 (+24,14 %)	-0,79 (-9,76 %)
	3rd ESO B (FC)	8,27	+2,16 (+35,35 %)	-0,13 (-1,54 %)
Pragmatic Style	3rd ESO A (Master)	6,84	+2,16 (+46,15 %)	-1,11 (-13,96 %)
	3rd ESO B (FC)	7,28	+2,52 (+52,94 %)	-0,73 (-9,11 %)
TOTAL	3rd ESO A (Master)	6,95	+1,79 (+34,68 %)	-1,15 (-14,19 %)
	3rd ESO B (FC)	7,23	+2,14 (+42,04 %)	-0,87 (-10,85 %)

Table 8 shows the results of the evaluation of item 1 made after 4 months of final evaluation. Students who used FC in topic 1 (3rd level A) with respect to the previous assessment have increased by 2.14 points (42.04%) and in contrast those of the control group by 1.79 (34.68%), obtaining a 7.36% increase in the experimental group. In relation to the final evaluation, the students in the control group decreased by 1.15 points (14.19%) and the DSs lost an average of 0.87 points (10.85%), 3.34% less loss. Thus, we can say that the assessments of the knowledge of the students who used the FC in topic 1 after 4 months are better than those of the control group.

The results obtained by FC students are better than those obtained by the control group, when compared with results of the previous evaluation. Highlighting those of an active type with an increase of 14.77% more than that obtained by the control group. In relation to the final evaluation, all styles in the sense of the asset have a smaller difference in the FC than in the traditional class. The most significant is the case of the theoretical type that only decreases by 0.13 points (1.54 %) what was achieved in the final evaluation.

Table 9. Results of the T-Student test unit 1 (pre-evaluation - 4 months)

	Pretest	Postest	3rd ESO A (Master) Pretest-Postest	3rd ESO B (FC) Pretest-Postest
Active Style	0,301	0,623	0,004	0,003
Reflective Style	0,913	0,730	0,021	0,036
Theoretical Style	0,857	0,386	0,026	0,029
Pragmatic Style	0,940	0,653	0,030	0,005
TOTAL	0,887	0,523	< 0,001	< 0,001

When performing the T-Students test for separate samples and related samples (table 9) we get the same results as in the previous topics.

Table 10. Results of the T-Student test unit 1 (Evaluation - 4 months)

	Pretest	Postest	3rd ESO A (Master) Pretest-Postest	3rd ESO B (FC) Pretest-Postest
Active Style	0,942	0,623	0,016	0,123
Reflective Style	0,776	0,730	0,005	0,319
Theoretical Style	0,841	0,386	0,266	0,864

Pragmatic Style	0,967	0,653	0,060	0,418
TOTAL	0,983	0,523	< 0,001	0,036

Table 10 shows that the improvements obtained by students of a theoretical and pragmatic type, both in the case of the control and experimental group, are randomly attributable, are not statistically significant. The same is true of those of the active and reflective type of the experimental group.

5 Discussion

The results show that students using the FC have a greater increase in the evaluation, of prestest with respect to postest, than those using the traditional methodology. These results in the evaluation are consistent with those obtained in different researches of the FC and the mathematics carried out by [22-30].

On the other hand, we find that the results show that these differences in the academic performance of the students who used the FC or the traditional methodology are not statistically significant. Therefore, we cannot categorically affirm that they are the result of the use of FC, all and appear in the different topics and in the two groups. It should be noted that the control group and the experimental group has been changing in each topic, and in all cases, the experimental group has obtained better academic results. These results can also be found in other researches such as that conducted by [31]. Another reason for this fact could be based on [50] because there are no statistically significant differences in academic outcomes between FC and unvested, if two classes use active methodologies.

6 Conclusion

Two hypotheses had been raised in this research, the first saying that the academic results of students with active learning style when using the FC get better results than students who follow the traditional class.

Indeed, the results have shown that in the different topics of mathematics the students who have used the FC have obtained better results in the postest and a greater increase from the pretest than the students who used the traditional class. In addition, the ones that have been the most active learning style students. In item 2 (Geometric Places) is where this difference was greatest, the control group averaged 6.84 and the experimental group by 7.55, which means a difference of 0.77 points on average (10.38% increase). Also in this topic 2 the increase experienced by the experimental group between the prestest and postets was +3.96 points (+100.30 %) +2.92 points (+74.93%) that the students of the control group obtained on average, thus improving by 25.37% more.

It was also found that the use of the FC provides greater assimilation of long-term content. Since in the postest of topic 1 performed 4 months after finishing topic 1, students who used FC obtained a higher average grade and a greater increase from the first test pretest than the students in the control group as shown in the results.

The second hypothesis was that students' learning style conditions their academic performance when using FC compared to traditional class.

As seen in the results, students' academic performance has varied according to their learning style. In topic 1 (Fractions) the postest results were very similar, but not so the increase experienced between the pretest and the postest. Active students using the FC achieved a 25.84% increase than those in the master class. In contrast, in the item 2, (Geometric Places) students who used reflexive type FC scored an average of 18.65% more score than those in the control group, and a 42.33% increase between pretest and postest. In topic 3 (polynomials) again active-style FC students are the ones who achieved the best results, obtaining 26.46% more average postest score than those of the master class of the same style. Finally, in the postest of topic 1, conducted 4 months later, the FC students of theoretical style were the ones who made the most difference from those of the traditional class with an increase of 13.28% more.

We can see that active-style students are the ones who, when using the FC, improve their academic performance more than those who use the master class. In addition, that those of theoretical style when using the FC are the ones that best retain knowledge over time.

The results obtained in this research will allow teachers to have an approximate idea of which type of students get the best academic performance when using FC. Helping to make the decision to use the FC, with a certain group of students, in the event that you are considering it. For example, if an active learning style predominates in your class, you will get better academic performance when using FC than if reflective-style students predominate.

The research has limitations related to the sample size; the class of 3rd level A had 19 students and the 3rd level B 18 students. In addition, the time students have been using the FC has been reduced, one quarter. That is why it would be interesting to replicate research with more students and for longer. A post-test was also planned after 4 months under topics 2 and 3, but the 2020 pandemic situation prevented it.

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Assessment of Research Skills at an Undergraduate Translation Program in Lima, Peru

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Abstract. Implementing change in terms of learning growth and student development in higher-education institutions imply undertaking a process of informed decisions and allocation of resources that can be achieved by putting into effect quality assessment plans. The assessment process of the program-specific research competence carried out at an undergraduate Translation program in a private university in Lima, Peru employed a direct assessment method that provided systematically collected data. Such data, once carefully analyzed, revealed insightful information about how research competence can benefit from specific textual skills, allowing instructors to identify areas for improvement and implementing new learning tasks with the purpose of fostering student learning development.

Keywords: Educational quality assurance, translation pedagogy, translator training, research competence

1 Introduction

Translation competence, according to Hurtado Albir [1], is based on an underlying system of knowledge, skills and attitudes related to translating. This notion of competence corresponds to the theoretical advances and research that have been developed around translation since the 1970s, but whose general construct and refinement into sub-competences through empirical research began only in the 1980s [1, p. 261]. Nowadays training or educating translators based on a competence approach means that learning is to be meaningful for students and that evaluation be focused on their performance. Research on translation didactics, an applied branch of Translation Studies, has kept a growing productivity since the beginning of the 21st century. Yan, Pang and Wang's [2] scientometric study showed a sustained academic production between 2000 and 2012, with publication peaks in different years due to the appearance of new specialized journals or the publication of thematic issues. The subfields in which scientific production on translation didactics was classified are teaching (72%), learning (18%) and evaluation (10%). Regarding teaching, the authors point out that only 5% of the studies published were on research skills [2, p. 271]. It is not difficult to understand this type

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of findings considering that the focus of interest in translators' education has been homologated with the effective and utilitarian concept of translation competence, which inspires pedagogical models, and is "used to assign content to courses, courses to sequences, and sequences into coherent programs" [3, p. 39]. In this sense, the acquisition of translation competence has merged teaching, learning and evaluation into an approach known as "competence-based training" [3].

Bernardini [4] draws an important distinction between "translators' training" and "translators' education". The former refers to the trainee assimilating a number of preestablished procedures to solve problems related to their field of expertise. The objective of the latter, conversely, is "to favor the growth of the individual, developing her cognitive capacities, and those attitudes and predispositions that will put her in a position to cope with the most varying (professional) situations" [4, p. 19]. Thus, Bernardini's model allows us to look at a comprehensive university curriculum through which the training and education of future translators is achieved. Such curriculum does not merely focus on training translators based on translation competence, but also encompasses general competences. These notions are aligned with Kelly's proposal that [5], "the future graduate in translation is not only a translator, but also a graduate, i.e. shares a level of competence with graduates of other fields"(p. 89).

This paper deals with the assessment of a set of research skills that are part of the program learning outcomes of the undergraduate Translation and Interpretation (T&I) program at the Universidad Peruana de Ciencias Aplicadas (UPC) (Lima, Peru). These skills, together with a set of knowledge and attitudes, constitute a research competence in itself. This research competence, although concurrent with practical subjects conducive to translation competence, contributes to graduates who are competent in the search for and management of academic information, as well as in the application of qualitative research methods and techniques. The assessment of the Research competence was part of a process of educational quality assurance of this undergraduate program. The assessment functions are twofold: "verifying whether established objectives have been fulfilled, and whether and to what extent students have acquired the relevant competences" [6, p. 64] and the "evaluation of the functioning of the program itself, with a view to identifying areas for improvement" [5, p. 88].

In general, developing research competences in Translation Studies is expected in graduate students [7]. In that sense, the existing literature on research skills has to do with aspects of teaching and learning in PhD programs; for example, research models and learning activities for beginning researchers [8], contents and structure of research methodology courses [9], or the role of the supervisor regarding the learning outcomes of the doctoral student [10], [11]. Pym [12] has elaborated a list of problems related to the lack of preparation of PhD students to design and carry out research projects. This list points out that many of the missing skills are not exclusive to doctoral students in Translation Studies and could be complemented through research programs in the social sciences, i.e., through general research content and skills. Addressing a different level of university education, this study allows us to find effective ways in which translator trainees develop research skills, as well as the aspects that require more attention to solve problems similar to those found by Pym.

2 Assessment of the Research Competence

Leading higher-education institutions seek incremental improvement over time through the implementation of continuous improvement processes. Such processes often involve competence assessment that aims to measure the student learning outcome level. In light of this, as part of its quality assurance processes, the UPC implemented the Institutional Assessment Plan in 2014, whose goal is to systematically collect data and measure both general (read institutional) and program-specific learning outcomes, in order to implement academic policies and to make informed decisions that facilitate learning growth and student development. Under this institutional framework, the T&I program has evaluated its eight specific competences following the standardized procedures stated by the Educational Quality Assurance Office of the UPC.

The assessment of the Research competence at the program consisted of the following procedure. Firstly, a team of experts was appointed to devise the competence rubric. Then, this team revised that the term papers, which will be referred to as sets of evidence, were aligned to the competence rubric. At the end of the semester, the sets were collected, evaluated and then analyzed, so that the final report was drawn up and an action plan was implemented.

2.1 Research Competence Rubric

Rubrics have been adopted widely as the preferred instrument to measure competence assessment [13], [14]. Galan-Mañas and Hurtado-Albir [6] state that a rubric is a guide where the elements to be appraised and the levels of achievement are described with the purpose of stating clearly what is expected of students, rating their work and assisting with providing feedback. These notions were adopted and adapted in the T&I program in order to assess competence and not merely to grade a piece of work [6]. Consequently, as part of the Assessment Process, a team of experts was appointed to devise the Research Competence Rubric (RCR), which turned into the instrument to measure the Research competence operationally. The team of experts used specialized literature and the research courses syllabi to elaborate the RCR. The crafting of the RCR was an iterative process resulting into a final version, which was then validated and approved by the Educational Quality Assurance Office at UPC (see Table 1 below). This stage of the assessment process lasted approximately three months.

Being part of the standardized dossier of the Institutional Assessment Plan, the RCR comprises each of the following elements, which is intertwined with one another, and thus contributes to making the rubric as a whole.

a) The competence definition. This is the first and foremost important element for the crafting of the competence rubric, since its wording has to be carefully chosen to provide the basis upon which the competence dimensions are to be devised. Furthermore, this definition is intrinsically connected to the graduate profile of the T&I program.

b) Competence dimensions. The Research competence comprises five dimensions which aim to operationalize the competence definition. These dimensions comprehend

the development and building of the competence throughout the different Research courses in the T&I program. Table 1 shows the five dimensions.

c) Indicators of level of achievement. The specific competences at UPC comprise five levels of mastery (Levels 0 - 4) which are expected to be gradually developed as students complete their degree. While Levels 0 and 4 are not measured in the assessment process, Levels 1-3 constitute the actual core of the process. The rationale behind this distinction is that Levels 0 and 4 are not developed within the courses offered in the undergraduate curriculum of the T&I program. To elaborate, Level 0 corresponds to a beginner level in the specific competence. In other words, it is the level at which students start nurturing the specific competence. At the other end of the spectrum, Level 4 corresponds to a graduate level, a master's program for instance. In contrast, Levels 1-3 are developed within different courses that build up the specific competence. As per the specific competence of Research, each level correlates with a course that develops the competence. Table 1 displays the three levels.

Table 1. Research competence rubric for the undergraduate Translation and Interpretation program (UPC).

	Level 1	Level 2	Level 3
Analysis	The student states a reasoned research problem based on a relevant object of study, and conducive to a set of coherent research questions and objectives, as well as to theoretical assumptions and to a basic methodological design.	The student produces research results following the process of data collection and analysis, and the identification of coincidences, differences and causal relationships.	The student presents the research results considering methodological and theoretical criteria, and synthesizing them effectively in a scientific paper.
Theorerical work	The student prepares an *ad hoc* literature review and a set of theoretical categories and concepts relevant to their research topic.	The student draws an analytical strategy for the data collected, based on deductive theoretical categories and inductive themes emerging from the data.	The student argues for the contribution of their research based on the discussion with relevant earlier research and generally accepted theory.
Methodology	The student establishes their research paradigm and approach, and the scope of the research, all of which are coherent with the research methods, techniques, and instruments.	The student monitors the operational strategy, adjusting the procedures when appropriate and controlling the quality of the research.	The student presents the components of the methodological design which are relevant to the purpose of the piece of research being documented in the scientific paper.

Data management	The student selects reliable and current sources relevant to the research topic. The student critically reads and synthesizes the information from the sources. The student writes according to academic conventions.	The student produces a report of the findings according to the conventions of academic writing. The student presents the information alternating their own insights with theory and pieces of information that are representative of the data.	The student compares their research data with specialized and current research. The student writes according to academic and discipline-specific style criteria.
Ethics	The student knows the ethical aspects of an academic work and takes them into account when developing the research protocol.	The student applies ethical guidelines when producing and systematizing the data collected.	The student assesses the ethical implications of publicly sharing their research data.

2.2 Data collection and processing

We employed a direct method of assessment, since the measures of learning outcomes are based upon student performance, i.e. the term papers of the following research competence courses in the 2019-1 academic semester: (a) Research Methodology, (b) Thesis Seminar 1, and (c) Thesis Seminar 2. As per the sampling for the assessment, Research Methodology, corresponding to Level 1, had a total of 10 evidences, whereas the other two courses corresponding to Levels 2 & 3 generated a slightly fewer number of evidences: 8 and 7 respectively. All of these sets of evidence were collected electronically at the end of the semester. It must be noted that each set of evidence was made in pairs by the students enrolled in said courses, making a total of 50 students.

Once the sets were collected, they were sent to the team of raters appointed to measure the three levels of achievement. It is worth mentioning that with the purpose of preserving assessment reliability, the raters were not the same instructors of said courses. By the same token, validity was taken care of by calibrating the assessment tool among the raters. In order to further operationalize the competence rubric when rating and given that each of the courses focused on different aspects of the competence, the raters used adapted versions of the term papers rubrics for each course. These rubrics or sub-products were inspired and adapted from the RCR so that each level would reflect all of the Research competence dimensions. The resulting rating was expressed both quantitatively and qualitatively. The former ranged from a score of 0 to 20, being 13 the equivalent to a passing score. It is important to point out that quantitative data served the only purpose of operationalizing the RCR, given that such scores did not represent any actual marking. On the other hand, the latter, comprised the following indicators: In Process, Competent and Outstanding. The qualitative data was then expressed as Levels 1, 2 and 3. All of this data was processed in Excel spreadsheets, and then fed into the assessment plan document provided by the Educational Quality Assurance Office.

3 Results

We will first introduce the findings of the absolute achievement level of the Research competence. The absolute level of achievement signifies that the sample achieved the desired level in all five dimensions of the competence (see Fig. 1). Nearly three quarters of the sample (74%) in Level 1 or Beginner reached the desired level of achievement. As per Level 2 or Intermediate, half of the sample (50%) met the desired outcome wholesomely. Lastly, a little under half of the sample of Level 3 or Advanced (43%) reached the desired level of achievement in all five dimensions.

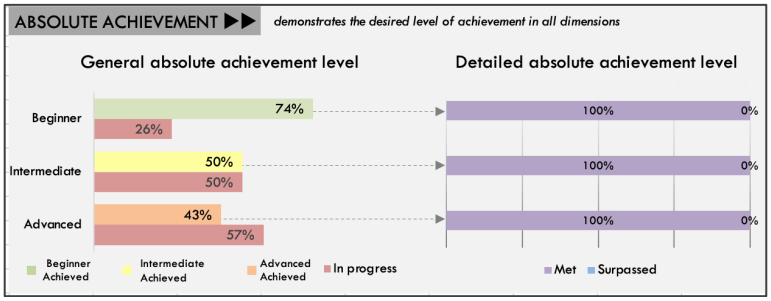


Fig. 1. Absolute level of achievement of the research competence.

We will now examine the most salient results of Levels 1-3 per dimension. The findings reveal that the samples met the desired level of achievement in each of the five dimensions of the competence in all three levels. As per Level 1, Theoretical work was the highest achieving dimension (100%) while Analysis obtained the lowest achievement (74%) (see Fig. 2). With regards to Level 2, Data management was the lowest achieving dimension (50%) while the other dimensions (Analysis, Theoretical Work, Methodology, Ethics) obtained rather high percentages of achievement ranging from 75% to 88% (see Fig. 3). Interestingly, in Level 3 three dimensions (Analysis, Data management and Ethics) reached 100 % of achievement, while the other two dimensions (Theoretical Work and Methodology) reached around 75% (see Fig. 4).

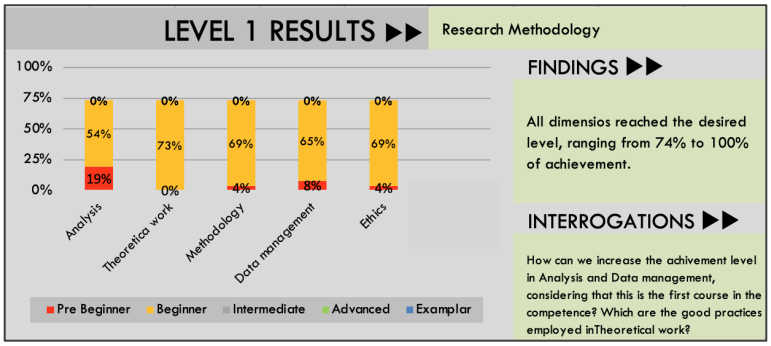


Fig. 2. Level 1 results.

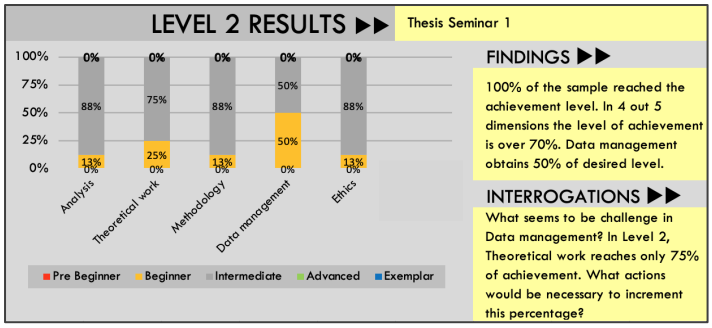


Fig. 3. Level 2 results.

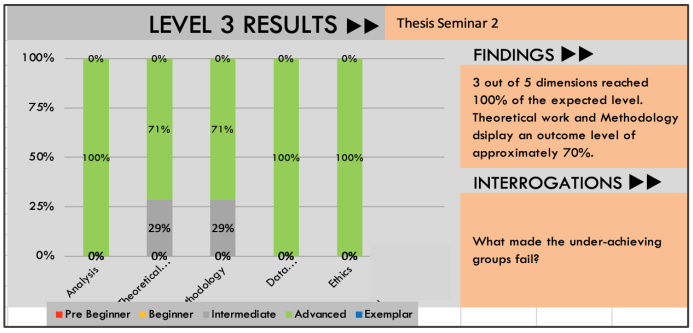


Fig. 4. Level 3 results.

To understand the different results of achievement for each level of the Research competence, it is necessary to explore the term papers used for the assessment. As per Research Methodology (Level 1) the final product is a research project; the Thesis Seminar 1 product is a report of research findings, while Thesis Seminar 2 requires a publishable scientific article as term paper. This learning evidence is coherent with a situated research learning model [15] through which students do research as part of a maximally real situation designed by the instructors. Since the instructors not only teach how to conduct research but they are researchers themselves and are used to publishing: the necessary setting for a community of practice is therefore assured. The aim of such a teaching/learning model is that students learn through a meaningful relationship with experienced researchers where students willingly assume the role of apprentices. Therefore, we may argue that the maximally real situation of carrying out a research project until the final product is synthesized as a scientific paper publishable in a specialized journal on their area of knowledge meets the situated learning model.

Term papers of the three courses, each corresponding to a level of achievement of the competence, are used as evidence of what students can do, but also of the declarative knowledge they have about doing. As for Level 1, students focus on knowing the most

relevant information produced on their research topic, since they do not yet have work experience and the information they may have on the topic is mainly theoretical. In consequence, the understanding of specialized literature and the synthesis of such information is relevant to set up a benchmark (the basic assumptions of the research), as well as to contribute to the methodological design, and to set the underlying general structure of the research project [16]. Hence, the results for Level 1 are significantly high regarding the Theoretical work dimension, while the Analysis dimension is less successful as students still need a comprehensive (empirical and theoretical) understanding of the research object. This holistic view of the object of study comes with actual data analysis during the following course (Thesis Seminar 1).

As per Level 2, the weakest results correspond to the Data management dimension, while in the case of Level 3, the Theoretical work and Methodology dimensions have the lowest results. In both cases, the final papers reveal that students need to improve their academic writing skills. However, these skills are not only operational, but they also reflect a deep understanding, or partial lack of it, of the academic text genres being produced. For this reason, we believe that the learning outcomes used to evaluate translation competence correspond to basic skills that are also necessary for research. This simultaneous occurrence of translation and research skills is highlighted in the teaching and learning experience systematized by Villanueva Jordán and Calderón Díaz [17]

> While translation skills are used mainly for producing target texts […], translators and translator trainees draw on basic research skills on a regular basis. Thus, for example, the research skill to produce and report on findings may seem somewhat remote from translators' training; however, this skill is also relevant for translators-to-be since they have to analyze and report interlingual texts, prepare critical reports on translations, and also simulations of technical reports (p. 118).

A report of research findings and a journal paper are extremely specific scientific text genres, and each of them requires managing textual material not only with qualitative criteria, but also considering word-count limits. This is an insight not usually included in research literacy models, where the most important skills are information or data search [18]. However, we consider that students need to receive continuous feedback on their written reports, and instructors need to have declarative knowledge on academic or scientific writing to clearly signpost writing weaknesses, as well as opportunities for improvement. These weaknesses and opportunities may include deciding when to include information from the sources collected as arguments in one's own research, knowing how to highlight the research topic through the use of cohesive elements and also using definitions of key concepts, and knowing how to phrase novel insights based on one's own research.

4 Concluding remarks

According to the results of the assessment process, we can argue that occasioning translation competence can contribute to the components of research competences. This is relevant given that university training of translators is aimed at both forming professionals who are competent in specialized activities, and ensuring that they achieve gen-

eral skills such as critical thinking or information literacy. In other words, higher-education general competencies frame the specific competencies of a specialized professional program.

We can also conclude that student learning during the Research courses is effective. The learning outcomes show that students are capable of outlining and implementing a research project, as well as to conveying their findings by means of a publishable scientific paper. Nonetheless, the results also reveal that students need to gain empirical knowledge of their research objects at the beginning of the learning situation designed by the instructors. This can be achieved by including an exploratory activity during one of the learning units of the Research Methodology course (Level 1).

Regarding the results of Levels 2 and 3 and based on the insight gained analyzing the term papers, we strongly believe that students need to improve their academic writing skills. This does not mean merely learning how to cite or paraphrase properly, but also being able to communicate their findings and insights about their research objects according to the textual conventions of academic genres. This is where we see a productive common ground between Translation competence and Research competence. As students have been trained in linguistics, languages for specific purposes, and intercultural communication before taking the research courses, research instructors can use students' prior knowledge to monitor and provide feedback on how students carry out their research projects and use language to reflect on their experiences. We can then conclude that learning how to do research has a key textual component that needs to be nurtured along with other interpretative and operational research skills.

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Incidence of brain gym in improving concentration in first year architecture students

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Abstract. In many universities, students report problems concentrating on their studies. When a student gets a low grade, he blames internal and external distractions, his teacher and his own style of teaching. The teacher plays a very crucial role in motivating students' interest in class. The aim of this study was to determine the incidence of brain gym in improving the concentration of 30 first-year students at the Professional School of Architecture in a public university in Arequipa, Peru, who responded to the pre-test and post-test and took part in a relevant experimental program. The instrument used was d2. The Attention Test designed by Brickenkamp in 2012 was conducted. The results obtained by the Student's T test show that since the p value = 0.002 < 0.05, then the existence of a positive incidence of brain gym in the improvement of the concentration of students proves brain gym is beneficial to brain activity.

Keywords: Concentration, Motivation, Brain Gym, Higher Education.

1 Introduction

In many universities, students report problems concentrating on their studies [1, 2]. When a student gets a low grade, he blames internal (i.e. sleeping factor) and external distractions (i.e. loud noises, the television, or talking with friends), his teacher and his own style of teaching [2–4]. Many studies [3, 5, 6] that manipulate noise levels and distractions have found that such factors can increase, decrease or even not affect the students' concentration, leading them to conclude that distractors do not cause concentration problems directly, but rather the way students interpret distractors.

The world has experienced accelerated changes in the field of technology and social life as we know it [7]. Thus, humanity has witnessed the rise of the knowledge society that has represented a challenge for the educational system not only at universities but also at other educational levels [8]. These changes require that teachers and students

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acquire particular skills to face their learning in a more active, autonomous and conscious way, aimed at achieving learning objectives [8–10].

Concentration refers to the ability to focus the mind to maintain attention on one thought subject or academic task without being distracted [1, 11, 12]. Concentration is the best known quality of attention and consists of being physically and mentally immersed in a topic, idea or object with absolute exclusion of everything else [13]; it is long-term maintenance of attention. Attention and concentration are not the same [14]. Attention is considered essential for learning [15]. Through concentration, the mind and body learn to work together, without wasting physical or mental energy [13].

Attention is a central property of all perceptual and cognitive operations [16]. Given the limited capacity to process various options, the attention mechanisms select, modulate and maintain the focus on the most relevant, desired or required information at a given moment [11, 16]. Therefore, once a target has been selected, attention modulates how well information is processed, how fast and accurately a response is obtained and whether the event will be remembered later [16, 17]. There are two types of attention: (a) external, referring to the selection and modulation of sensory information; (b) internal refers to the selection, modulation and continuation of internally generated information, such as task rules, responses, long-term memory or working memory [16].

According to Piontkowski and Calfee [15], teachers often speak of attention and concentration as a general state of mind in which the mind focuses on certain special characteristics of the environment. Concentration and attention are skills that are learned and improved with practice; however, teachers rarely practice them in the classroom [11]. Motivation and interest are produced by several factors in people, such as the color of things, the environment, emotion, humor, rhythm, context, smell, among others. These factors become memory enhancers that in the long run will help student performance and as a starting point for the teacher when educating and achieving the required learning [18].

Motivation refers to states or processes that take place inside the individual such as impulses, desires, appetites, needs or interests [19]. Motivation is defined as a state induced by the interaction of two types of factors, the intrinsic or specific to the subject and the extrinsic or specific to the environment [19, 20]. The purpose of extrinsic motivation is to learn something to achieve good academic results or avoid a failure; while the intrinsic is that which the subject himself possesses, which arises from his/her interest and enjoyment of learning something [19, 21]. In academic contexts, motivation refers to the degree to which the student accepts responsibility for studying and doing homework to achieve academic success [1]. It indicates desire and energy, self-discipline and willingness to strive academically [1]. Motivation is therefore a key piece of deep and lasting learning [21].

The teacher plays a very crucial role in motivating students' interest in class, in helping them gain confidence in their abilities to learn and perform [20]; and, be more conscious of their learning [22]. Motivation is an important factor in students learning and progress and it will be effective if students are interested, so teachers can create positive motivation and transfer knowledge in different ways, encouraging them to work better and learn, which over time will help improve education and academic achievement of students [20].

There are several factors that influence concentration in the classroom that are categorized into: (a) factors associated with the teacher, such as their ability to motivate, knowledge of the subject, understanding of the subject, use of educational aids, teaching ethics and uniformity of the teacher's voice [23]; (b) factors related to the student, his/her attendance to class, drowsiness in the classroom, his/her individual intellectual participation, interest in the subject, his/her diet or malnutrition suffered during certain sensitive periods of his/her life [24, 25]; (c) factors related to environmental aspects such as noise pollution, the quality of light and ventilation in the classroom, or the excessive number of students in class [5, 26].

1.1 Brain gym in higher education

Brain gym is a brain-enhancing method designed by Paul Dennison (creator and founder of Brain Gym® International) and his wife Gail in 1969, both educators and reading specialists, to improve the attention, memory and academic skills of their students [27, 28]. It is an educational kinesiology program that consists of a set of physical exercises combined with body movements through techniques that involve the cerebral hemispheres, the body and the eyes. Brain gym demands that the appreciation and corporal and mental production be integrated from school age in order to achieve better learning [27, 28]. Brain gym is a system of coordinated mental and corporal exercises that are combined to promote and accelerate learning, and obtain very efficient results with great impact on those who practice them [29]. Thus, movement becomes a fundamental aspect for learning and the development of thought, since the constant practice of exercises facilitates the construction of neural networks [29].

Likewise, the Dennisons' view of learning through movement aligns [27, 28] to Gardner's Multiple Intelligence Theory to enhance their visual, auditory, and kinesthetic skills for easier and more pleasurable learning. For this, breathing and relaxation techniques are applied that facilitate the unblocking of energies, the activation of neurons, the improvement of cognitive and emotional functions in order to exercise brain plasticity, strengthen memory and live with full consciousness and vitality. Currently, brain gym demands that its integration be carried out from school age [30]. Although it contains strategies and exercises, this is also a tool to develop and increase the creativity of students in an effective and fun way.

Regarding the studies on brain gym and its relationship with other phenomena, numerous studies have highlighted: (a) brain gym as a movement based program and brain-based strategies designed to develop creativity in students [30]; (b) the contributions of brain gym in the development of attention in boys and girls of 2nd grade of elementary school [31]; (c) an exercise guide based on brain gym, developed by Aceituno and Pérez [32], to improve short-term memory function in 6th grade students; (d) brain gym influences cognitive function and psychomotor performance in older adults [33]; and, brain gym program's influence in members of an active elderly club to detect and prevent cases with cognitive impairment and to reduce the risk of dementia [34].

Although professors are prepared to teach their subject, there are few occasions in which they develop exercises to stimulate the brain of their students through brain gym

with the main objective of improving intellectual, physical and emotional capacities as well as the attention, concentration, discipline and behavior of their students. Therefore, the studies on brain gym are diverse and address various topics. However, few studies have been carried out in the field of higher education, a context where learning dynamics are different from other educational levels.

Therefore, this research aims to determine the incidence of brain gym in improving the concentration of students from the first year of the Professional School of Architecture of a university in Arequipa, Peru.

2 Methodology

This study is exploratory in nature [35, 36], given that brain gym is a topic has attracted little attention in Peru, especially in Arequipa region, where this study is carried out. It is a quasi-experimental study design because it involves the use of intact groups, when it is not logistically feasible to conduct any random pre-selection processes [35, 37]. The aim of the study is to determine the incidence of brain gym in improving the concentration of 30 first-year students of the Professional School of Architecture of a university of in the city of Arequipa (Peru), who participated voluntarily when answering the pre-test and post-test.

Non-probability sampling was used, for convenience, where students were selected given their accessibility and availability to participate in the study [38]. Furthermore, the sample was homogeneous because all participants possess a similar trait or characteristic (first-year students) [38, 39]. Participants were informed in the field about the purpose of the study and their rights to refuse to participate; likewise, they were guaranteed that their answers would not affect their grades [39]. The instrument applied was the d2 Attention Test, designed by Brickenkamp [40].

The d2 is a time-limited test that assesses selective attention using a cancellation task. It measures the processing speed, the following of instructions and the goodness of the execution in a task of discrimination of similar visual stimuli. The test offers nine different scores that report on speed and accuracy along with other important aspects such as stability, fatigue, and the effectiveness of attentional inhibition. The d2 has been especially useful in basic research, as well as in the clinical, neuropsychological, educational, human resources and sports psychology fields, becoming one of the most relevant and important tests for the evaluation of attention in Europe [40].

The test can be conducted individually or collectively, with a variable time, between 8 and 10 minutes, including the previous instructions. If this is the case, the test allows a limited time of 20 seconds for the execution of each of the 14 rows. The instrument was applied collectively in two stages to the sample in the classrooms of the professional schools chosen. The application time did not exceed 10 minutes given the characteristics of the instrument. Prior to this activity, the corresponding permits were requested and personalized training was carried out in order to guarantee the correct collection of the data. Before starting the process, a brief presentation was made about the objective of the study and the characteristics of the instrument. It should be noted that,

between the two applications of the instrument, the brain gym exercises were done as an experimental program.

3 Results

In this section, the results obtained from the d2 concentration test [40] given to the participants to know the concentration of adolescent students in the pre- and post-test are shown.

Table 1 shows that regarding the total effectiveness in the test (TTE) and total correct answers (TCA), the students maintained their optimal performance levels both in the pre-test and in the post-test with 100%. On the other hand, an elevation in the percentage of the post-test from 90% to 100% is observed with respect to the pre-test of the concentration index (CON), which was reflected in practice with a frequency of 30 students who have the grade of optimal performance in the post-test giving as reference the highest peak in frequency and incidence, equivalent to the students raising their level of concentration.

Table 1. Pre-test y Post-test.

	Performance level	Pre-test		Post-test	
		f	%	f	%
TTE: Total effectivity in test	Optimum	30	100,0	30	100,0
	Intermediate	0	0,0	0	0,0
	Insufficient	0	0,0	0	0,0
CON: Concentration index	Optimum	27	90,0	30	100,0
	Intermediate	2	6,7	0	0,0
	Insufficient	1	3,3	0	0,0
TCA: Total of correct answers	Optimum	30	100,0	30	100,0
	Intermediate	0	0,0	0	0,0
	Insufficient	0	0,0	0	0,0

Table 2 shows that the percentile scores in the post-test were much higher than in the pretest, obtaining an average of 272.97. However, the values of standard deviation, minimum value and maximum value are also highlighted. Thus, the typical deviation was 30,820. Similarly, the minimum value was 185 (not very low) and the maximum value reached the figure of 299 in the post-test.

Table 2. Descriptive statistics.

	N	Average	SD	Minimum	Maximum	Percentiles		
						25	50 (Median)	75
Pre-Test	30	240,60	55,775	103	298	191,75	265,00	285,50
Post-Test	30	272,97	30,820	185	299	253,75	286,00	295,25

Analyzing the results obtained by the Student T test (see table 3), it is evident that if p value = 0,002 0,05 then we can confirm the existence of a positive impact of gymnastics in the brain, improving the concentration of the group under study.

Table 3. Paired samples Student T Test.

	Paired differences					t	gl	Sig. (bilateral)
	Mean	Std Dev	Std Err	95% Confidence interval				
				Lower	Higher			
Pre-Test - Post-Test	-32,4	53,311	9,733	-52,27	-12,460	-3,33	29	,002

4 Discussion

Regarding the aim of this study, it is observed that using the Statistical Student's T-test of paired samples, the positive incidence of brain gym is evidenced in the improvement of the concentration of first-year students of the Professional School of Architecture. This is corroborated by the research of Romero et al. [30], who concluded that after applying the instructional strategy based on brain gymnastics, 73% of the students presented high creativity and 27% normal creativity, thus demonstrating a notable increase in the creativity of the students. The authors conclude that the effective application of an instructional strategy based on brain gym increases creativity levels in students. However, in this research an improvement in concentration was also noted after the utilization of brain gymnastics.

According to the findings of Camargo and Camelo [31], professors state that after brain gym activities, students are more attentive to class activities and indicate that their learning improves significantly and better concentration is evidenced in classroom activities. These results are in line with De la Cruz and Gago [33] because there are significant differences between the pre-test and post-test of the experimental group, with no significant differences between a control group and an experimental group. It should be noted that this research was carried out with grown adults, showing the efficiency of brain gym at all ages. De la Vega [41] proposed a guide with 16 brain gym exercises to be done before, during and after the school day, which were combined with didactic elements such as alpha music to achieve a better impact. His results are consistent with previous reports by Paul Dennison [27, 28], based on three basic theories: (a) Orton's theory of brain dominance that is based on hemispheric indecision, referring to the same amount of skill in the right and left hemispheres and is often related to the hand itself [42]; (b) Doman-Delacato developmental theory which uses neurological repatterning to rewire the brain in cases where an individual may have missed a critical stage of development where it is assumed that by mastering the movements that mimic early development, one can rebuild neurons to leave the child neurologically intact and ready to acquire academic skills [43]; and (c) perceptual-motor training that suggests that

learning difficulties are the result of the inability to incorporate visual, motor, and auditory skills; therefore, it uses physical activities that require the coordination of these sensory skills to improve cognitive functions [43].

5 Conclusions

This research verifies the incidence of brain gym in the concentration level of university students at a particular educational establishment. Brain gym is an internationally program with the potential to affect the learning of university students in a variety of locations and cultures such as Arequipa (Peru). Brain gym can be used to facilitate concentration in various academic areas such as reading and thinking skills, oral reading, reading comprehension, spelling, mathematics, calligraphy, creative writing, comprehension, self-esteem, sports, games, memory, abstract thinking, creative thinking, speed reading, test-taking, among other areas. When analyzing the results, it can be concluded that despite being a new educational and well-being technique that is making its way step by step into the field of higher education, the activities related to brain gym are a valuable contribution to the concentration and academic performance of students.

The main research limitation is that the sample size is small, and it has been selected for convenience (they were first-year students of the Professional School of Architecture). On the one hand, these facts limit the power of statistical analysis, so it is possible that significant differences in the real population have been missed out. Furthermore, they prevent the results from being applicable in an extended way to the student population. On the other hand, this sample is only a very small proportion of the entire student body in Arequipa Region. Therefore, research studies with a much larger sample size - from other classes or universities - would be required to ensure appropriate for generalizing research findings. This study has relied on the quantitative data collection method|; therefore, the qualitative data collection method should be undertaken in the future to provide a wide perspective on the present study.

Despite these limitations, the results of this study may provide a starting point for future research that can be used by researchers, educators, education specialists, curriculum planners and policy-makers to improve broad areas of educational functioning such as attention and concentration. It is suggested to evaluate whether brain gym has a similar influence on different classes and university careers over a longer period of time and could be used to improve the educational outcomes of these students. Professors know that students are dynamic and do not like monotony or long-overdue unchanged tradition. In this sense, it is recommended to modify instructional strategies and classroom techniques to improve the attention, involvement, and acquisition of knowledge by learners. Finally, it is considered pertinent to develop university programs that allow this brain activation to increase concentration, mental cognition, and academic performance of students.

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Design Thinking and Business Incubators in Universities of Cusco, Perú

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Abstract. The aim of this paper was to determine the relationship of design thinking and business incubators, as well as to establish the relationship of concepts such as empathy, definition, conceptualization, prototype and evaluation with business incubators in universities of Cusco. The research method used was correlational, as it was a cross-sectional study with a quantitative approach and a non-experimental design. The study sample consisted of 30 incubated people from universities in Cusco. The results show that 16.7 % of the people who use design thinking come from universities that are in the process of incubating; unlike the 36.7% that come from universities that have already implemented incubators. With a 95% reliability, we concluded with the help of Kendall's Tau b correlation coefficient that design thinking shows little significant correlation to the development of incubators in universities of Cusco ($p = 0.690 > 0.05$).

Keywords: Empathy, definition, conceptualization, prototype and evaluation.

1 Introduction

Business competitiveness, social policies, demands for the Government's modernization, and the innovative proposals to implement business incubators are tools of economic development that are not only encouraged by higher education institutions, but also by entrepreneurship strategies that seek to strengthen the generation of creative initiatives and innovation. Innovation is crucial as it provides differentiation and competitiveness, which is why it contributes to the entrepreneurial environment as it is in full evolution [1]. According to the study, higher education has a great responsibility before society, as universities have to provide knowledge that allows students and graduates to come up with creative and innovative solutions to the problems identified as urgent needs in the business environment [2]. In accordance with University Law - 30220, article 52 - Business Incubator, "The university, as part of its training activity, promotes the initiative of students to start small and micro-businesses by providing

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them with advice or space, such as the use of the institution's equipment and facilities" [3, p. 26].

According to the study "the business incubator is a support center that provides specialized advice to evaluate a business idea and make it become a formal company" [4, p. 664]. This would reduce business risk and increase the possibility of success with a competitive advantage in the market. It would be important to make use of the active practice of design thinking as a tool for the application of entrepreneurial thinking in potential entrepreneurial spirits to promote and develop initiatives related to entrepreneurship [5].

The research paper "Business Incubation Model: A Proposal" aimed at developing a model that can systematize the processes of business incubators in Cochabamba, Bolivia [6]. Being a descriptive and purposeful study, it reviewed successful incubation models and adapted them to the reality and characteristics of the country, such as its different cities and states, as well as the different sectors of the economy. It was also found that there is little knowledge about incubators there and very few people are familiar with these procedures.

In the research "Proposal of a Business Incubation Model in the Peruvian Entrepreneurial Ecosystem that Allows the Validation and Generation of New Businesses", Simon Sinek's Golden Circle model and Bill Aulet's Disciplined Entrepreneurship methodology were used [7]. The result was a model structured in 5 phases and 9 stages shown in Table 1.

Table 1. Logical process of incubation of companies

Phases	**Stage of the Incubation Model**	**Golden Circle Model**
1. Decision of undertake	Stage 01. formation of the team and motivation to start an entrepreneurship	What: companies know what they do, they know what they produce and what they sell on the market
2. Generation of the business idea	Stage 02. market segmentation and choice of target	How: companies know how they do what they do, what is their value proposition and their positioning
	Stage 03. value proposition, and competitive position	
	Stage 04. channel, sales process and customer relationship	
3.Business Model Design	Stage 05. business model and pricing policy	
	Stage 06. economic and financial analysis	
	Stage 07. minimum viable product	
4. Development of Business Plan	Stage 08. business plan and search for seed capital	Why: companies know why they do what they do
5.Creation of the Company	Stage 09. formalization of the company	

Design thinking is now being strongly used in problem solving, idea development, business model development and strategic planning [8], anticipating future trends, desires

and needs of the labor market and within social and cultural contexts [9]. During the last 15 years, the design thinking methodology has evolved to become an innovation technique in both business and academic fields [10], creating greater productivity and business competition [11].

Regarding the academic field, it is being applied as an alternative research method [12] and as a basis for solving problems in an innovative way in teaching-learning processes. It is important for professors and instructors of business incubators to have some design thinking in their teaching since they will be the ones educating students with this methodology, thus promoting communication skills and teamwork [13].

The author defines design thinking as a problem-solving methodology, making use of creativity in the generation of ideas and solutions [14]. Other authors [15] describe it as the way of thinking of the designer, who constantly challenges his own standards, thinks deductively, and develops a new way of solving problems using the emotional aspect of the user in order to create products and services that are built from their functional value [16], coming up with not only one solution but several alternative solutions [17].

In his study, the author points out that design thinking has a 5-step interactive methodology [18]. The first step is to "empathize" with the client, that is, to get to know them, delve into the problem, and understand their motivations and needs. After empathizing with the user, the specific need to be solved must be "defined", that is, to identify opportunities for innovation, and then "conceptualize" and/or generate ideas and creative solutions. The next step is to "prototype", that is, to implement or carry out the best ideas; and finally, there is the "testing" step, in which the prototype is validated by users (feedback). This phase will help us to identify possible failures and/or improvements until confirming that the idea is convincing, efficiently solves the problem, and can be monetized.

Business incubators are defined as a place where companies are provided with management and financial advice and training on basic issues that allow them to start new projects [19]. They also help them during the initial phases of the project not only to avoid failure at this stage, but also to overcome the risks that may appear on the way. The weaknesses observed in the research study on developing countries that implement incubators are: "((1) their focus on tangible services rather than intangible services; (2) their dependence on governments; (3) a lack of management and qualified personnel; and (4) a lack of incubator planning and creativity in solving problems" [20, p. 3].

The incubation process requires a set of steps and a combination of elements for its development [21],. The incubation process is composed of three stages: pre-incubation, incubation and post-incubation.

The Pre-incubation Phase is the first phase that future incubated companies go through. In this stage, the business idea that a company owns takes shape, and this may be a product or a service [22]. On the other hand, the authors call it "the start-up of the creation stage" [23, p. 3] , in which all kinds of activities should be carried out to support the potential entrepreneur with the development of their idea and thus achieve an increase in the chances of survival in the following phases.

In the Incubation Phase several means are assigned, such as facilities or office spaces, knowledge-intensive business services, like financial and business development services, consulting, mentoring, advising, incubator networks, idea validation, etc. [21] Incubation should have special emphasis on supporting the entrepreneur during their path; thus, they consider incubation as a set of subprocesses of incubation in general [23]. New tenants, as the authors call them, go through three main subprocesses within the incubation stage [24]. The general process takes about three years: Incubator Management, Tenant Management, and Incubator Affiliations.

The Post-incubation Phase, called the "expansion stage" is determined by the maturity of the incubator [23, p. 3]. In this stage, the incubated entrepreneurship meets the objectives proposed by the strategic planning. In some situations, the incubator services continue even when the company has become independent; it is a way of keeping it in the incubator network [22]. In the post incubation stage, the following are also developed: the analysis of the company, evaluation of the company's strategy, access to credit, venture capital, graduation of the company, diversification and growth [25],.

The justification and importance of this study is based on its social relevance since this kind of activities are intended to guide the implementation of a business culture based on university education. From a theoretical point of view, it will contribute to the existing knowledge on the relationship among study variables, and methodologically speaking, it will help to create and validate the data collection instrument.

The purpose of this research was to determine the relationship between design thinking and business incubators, as well as to determine the relationship between dimensions like empathy, definition, conceptualization, prototype and evaluation, and business incubators of universities in Cusco.

2 Method

The research approach was quantitative since statistics were used to measure the study variables. The scope of this research was correlational, the study's variables being Design Thinking and Business Incubator were described, and then correlated. The research design was non-experimental because it was carried out without the deliberate manipulation of the study variables, the phenomena were observed only in their natural environment, from which the analysis was carried out, it was also cross-sectional since the data were collected in a single moment.

The population of studied were Business Incubators from three universities in Cusco. The sample was made up of 30 incubated from universities in Cusco. The technique used was the survey. The instrument for data collection was the questionnaire with closed questions with alternatives that was developed based on the indicators of the study variables that comprised 21 items (see Table 2). The Likert scale was used according to the variables, dimensions and indicators of the study (1. Never, 2. Almost never, 3. Sometimes, 4. Almost always and 5. Always). The statistical software used to process the data was SPSS.

Table 2. Research Instrument Matrix

Variables	Dimensions	Indicators	Quantity of items
Design Thinking	Empathy	Interview, Focus Group, Shadowing, People Tabs, Customer Segment Profiles, Empathy Map, Storyboards, Customer Journey Map	8
	Definition	Problem tree, Value curves, Context map	3
	Conceptualization	Brainstorming, Card sorting, Offer Map	3
	Prototype	Prototype, Mockup and Business Model	3
	Evaluation	Prototype Testing	1
Business Incubator	Pre-Incubation	Business idea with growth potential	1
	Incubation	Business plan with growth potential	1
	Post Incubation	Client Portfolio	1

The study research had the validation carried out by 3 experts in research methodology, business administration and statistics. Kendall's Tau-b correlation coefficient was used to make the association of the ordinal study variables: Design Thinking and Business Incubator, and as it was a small sample.

3 Results

The results of the present investigation are presented through the tables obtained from the information processing using statistics. To respond to the objectives of the research, the correlation of the study variables was carried out and then the correlation of the Design Thinking dimensions with the Business Incubator as shown in Fig. 1 and 2.

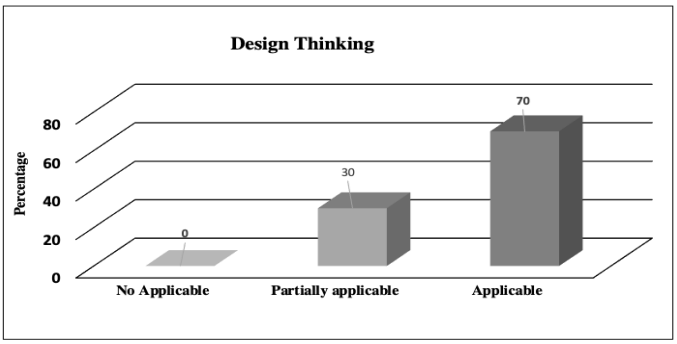


Fig. 1. From the survey applied in the universities of Cusco, 70% of those incubated are applying Design Thinking, and 30% are applying it partially.

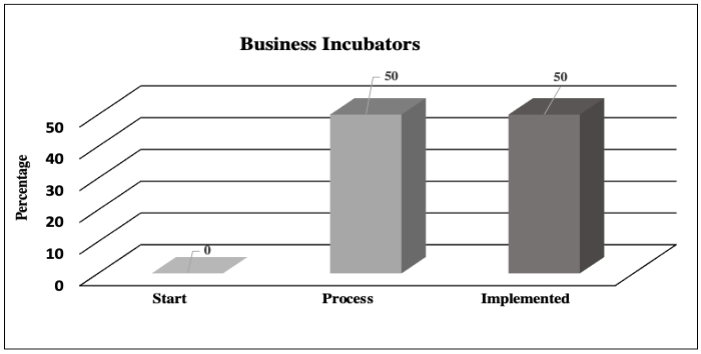


Fig. 2. Of the surveys applied in the Business Incubators of the Universities of Cusco, 50% are in the process of being implemented and the other 50% have already implemented their incubator.

The relationship of Design Thinking with the Business Incubator in the universities of Cusco is shown in Table 3, taking into account the interpretation scales for each of the study variables.

Table 3. Relationship between Design Thinking and Business Incubators in Universities of Cusco

Design Thinking	**Business Incubator**					
	Process		Implemented		Total	
	f	%	*f*	%	*f*	%
Partially applicable	5	16.7%	4	13.3%	9	30.0%
Applicable	10	33.3%	11	36.7%	21	70.0%
Total	15	50.0%	15	50.0%	30	100.0%
Kendall´s Tau b=0.073		p-value = 0.690				

In universities where design thinking is partially applied, 16.7% comes from universities that are in the process of incubating; unlike the 36.7% that comes from universities that have already implemented incubators. With a 95% reliability and through the correlation of Kendall's Tau b, design thinking shows a little significant relationship to the development of incubators in universities of Cusco, $p = 0.690 > 0.05$.

The relationship of the Design Thinking dimensions with the Business Incubator variable is shown below where Kendall's Tau-b test statistic is used (see Table 4).

Table 4. Relationship between Design Thinking dimensions and Business Incubator

Design Thinking	Business Incubator	
	Kendall's Tau-b Correlation	**p - value**
Empathy	0.392	0.020
Definition	0.420	0.009
Conceptualization	0.000	0.000
Prototype	0.333	0.053
Evaluation	0.333	0.053

From Kendall's Tau b test and with a reliability of 95%, we can conclude that there is a not very significant relationship between the dimensions of design thinking and business incubators in universities. Empathy is related in 39.2% to the development of incubators in the universities of Cusco, being p-value = 0.020 <0.05, the definition is related in 42% to the development of incubators in the universities of Cusco, p-value = 0.009 <0.05. In conceptualization, it is seen equally between those universities that are in the process of developing incubators and those that have already implemented incubators in their universities, so it gives us a result of p-value = 0 and Tau-b Kendall = 0. The opposite, the prototype and evaluation do not present a significant relationship to the development of incubators in the universities of Cusco, with the values of both p-value = 0.053> 0.05. The definition dimension of Design Thinking is the one that stands out with a moderate degree of association with the Business Incubator with Tau-b Kendall = 0.420, unlike the other dimensions that present a lower degree of association.

4 Discussion

The successful incubation models adapted to the reality and characteristics of the country were reviewed [6]. It was found that there is little knowledge about design thinking and that incubated individuals are not familiar with the execution of the procedures. Regarding the results of this study, we can conclude that design thinking shows little significant relationship in the development of incubators in universities of Cusco (p = 0.690> 0.05). In business incubators in universities in Cusco, incubated individuals apply agile methodologies other than design thinking, such as scrum methodologies for incubators, lean startups, among others.

The incubation model is structured in five phases and nine stages [7]. Each stage is similar to the traditional creation of companies, starting from the formation of the team and motivation to start an entrepreneurship until completing the formalization of the company. We observe that the phases and stages are related to the incubation model that has been developed in this research: pre-incubation, incubation and post-incubation, by associating phase 1 to pre-incubation, phase 2 and 3 to incubation and finally phase 4 and 5 to post-incubation.

Teachers and students are recommended to make use of the dimensions and indicators that come to make units of measurement in Design Thinking to become familiar and apply them in the teaching - learning sessions by generating various solutions to environmental problems raised. In this way, maximize its use when carrying out sustainable and successful entrepreneurship projects in their startup and growth stage.

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Current School Needs from the Intercultural Approach

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Abstract. It is need to rethink the school from an intercultural approach, from which diversity is considered something essential to human beings that affects to all groups and people. We propose a holistic change of the educational system, that includes so much the educational practices as the beliefs that sustain them. It involves to break up with the order established in the system, but also in our point of view. The school that recognises the cultural diversity requires changing power relations in schools. All opinions must be taken into account through democratic structures and methodologies, as participatory action research or cooperative learning.

Keywords: Diversity, educative community, Participatory Action Research, teacher training.

1 Introduction

What is the purpose of an intercultural approach? The educational system is permeated by a homogenization trend, that does not allow the recognition of cultural diversity in the student body. It is needed, given the high school failure rates, to rethink the school from an intercultural approach. Since the term 'intercultural' is so in vogue, and it is used in a way rather out of our perspective, we see pertinent, first of all, to make some conceptual clarifications.

What do we mean speaking about 'culture'? We consider 'culture' as a Dynamic concept, more linked to production and emergency conditions than to steady uses and rules, which constitutes the 'staging of daily life'[1]. Education is a cultural construction. To refer to students and other people who form the educational community, we do not refer to their culture, but to their cultural diversity, which we define as strategies, rules and values that, converted to uses, they are transferred from some groups to others in a Dynamic and changing manner [2].

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After this clarification, we can affirm that the intercultural focus understands *'education as a cultural construction, and recognises human diversity as normal. It promotes educational practices for each and every one of the members of the society as a whole. It proposes a model of analysis and action that affects to all dimensions of the educational process*'. [3].

From the intercultural perspective, school is considered as an essential agent to contribute to the social change. *'Ideals of educational equity and social justice that encourage that all students have the same opportunities to take part active and constructively in society'* [4] are pursued through a global transformation of school.

Any approach, methodology or educational practice, for the fact of being new or alternative, does not make sure that they will contribute to the goals proposed by the intercultural education. From our point of view, innovation should go beyond novelty production and it should pursue success for everybody, keeping a human vision of academic achievements. That is why any initiative, no matter whether traditional or innovating it is, it will be convenient only if it gets valuable achievements, referred to all students.

It is common that, the concept of 'innovation' used at schools, involves terms like 'ICT (information and communication technology)' or alternative methodologies'. A school that gives weight to technics, strategies or tools, can be confusing methods with goals. In addition, an educational establishment innovative in media but not in goals, can be reproducing traditional practices disguised as novelty, which will perpetuate social inequality and unfairness.

In this situation, we propose a holistic change of the educational system, that includes so much the educational practices as the beliefs that sustain them, overcoming the dichotomy between theory and practice. We suggest starting by a change of vision, new tools to take over a deep conceptual review of diversity in school. We cannot start by generating new practices or using innovative tools, because to do different things, previously we have to see and think about them in a different way from when we have been doing up to now.

2 We need a new perspective

The way a teacher interacts with their students is related to their vision of them. *It is our vision what many times encloses others in their most limited belongings, and it is also our vision what can release them* [5]. From an intercultural approach, we consider diversity something essential to human beings, a starting point instead a problem to face [2]. However, there is a standardization trend in our society, that sometimes brings segregation of people for the need of creating groups, that claim to be homogeneous, ignoring a diversity that is a part of our own nature. What happens in schools? How do we see our students? How are they seen in official documents?

We can find clear signs of the standardization trend we are speaking about, in the Spanish educational system. This system is based on a deficit model, where it is assumed that a group of students are 'diverse' and the rest are… 'normal'? They are

classified in a supposedly homogeneous way in groups and subgroups in an attempt to *sort, classify, control*. [6]. Let's see some examples.

If we look at the paper titled *Guía de Atención a la Diversidad* [7] *('Attention to Diversity Guide')*, published by the Spanish Ministry of Education, we will see that its content is grouped into three blocks, as show in Table 1: special educational needs, learning difficulties and superior intellectual abilities.

Table 1: Official diversity organization: groups and subgroups.

Special educational needs	Slight intelectual disability Average, severe and profound intelectual disability. Brain paralysis Muscular distrophy Spina bifida Hearing impairment Visual impairment Autism spectrum disorder (ASD) autism Autism spectrum disorder (ASD) Asperger Serious behavioural disorders
Learn difficulties	Attention deficit hyperactivity disorder (ADHD) Dyslexia Dysgraphia Dyscalculia Language-specific disorder Dysarthria Dyslalia Borderline intelligence
Superior intelectual abilities	(No categories)

Within programmes for attention to diversity, Compensatory Education is also included. According to the resolution regulating this program in the Community of Madrid (Spain) [8], it is provided to students that, in compulsory education stages *'are in a situation of socio-educational for belonging to ethnic and/or cultural minorities, for social, economic or geographic factors, and have a significant academic gap, with two or more years of difference between their curricular skills and the course they are enrolled in, besides educational integration difficulties and specific support requirements, arisen from a late incorporation into the educational system, or from an irregular schooling.'* According to this, we can add two more categories of diverse students: immigrants and ethic minorities that show curricular gap (if you show the same gap but you are not immigrant nor gipsy, you won't have access to this program). Surfing the web [9] we have found a last category within the attention to diversity: educational care for sick children.

This should be the end of 'diverse students?' according to official sources. In this categorization we can detect two serious mistakes. One of them is the use of the term 'diversity' in these documents is being confused with 'difference'. A description of students based on their differences has the risk of involving a moral appreciation [2] what might easily lead us to link different groups to labels like 'good/bad', 'better/worse'. Obviously, according to these classifications, belonging to 'the differents' is worse than belonging to the large group. The other clear inconvenience we appreciate in this sorting is the rigidity of the approach. These categories encourage us to organize children as if we quantified items from a stock in a delivery note. But cultural diversity for people in general, or for boys and girls in particular, is terribly complex, no Excel file would embrace it.

Opposite to this, from an intercultural approach we propose considering diversity as a fact, and the heterogeneity as the rule[6]. 'Diverse students' are not a minority group, rather the diversity affects all groups and people. Therefore, all our students would be included in the category of the ones who need attention minding their cultural diversity. In other words, all of them would be covered by the program for attention to diversity. All of them have unique features that make them different from others, and every one of them has their own set of particular needs, which could even be considered special. Then it would be very complex to organize them in groups and subgroups, since, taking into account all the variables that make up cultural diversity considered in schools, categories would be endless.

The change we propose is not simple, since it involves first of all to break up with the order established in the system, but also in our minds, in our point of view. It supposes to recognise all and every one of our students without taking into account previous, fixed and categorizing adscriptions [3]. We will use a metaphor to explain this change in the way of looking. To see different things, let's put on a pair of new glasses: lenses for recognition of the cultural diversity. When we use them, nothing changes in the objects' world, but everything gets complicated in the people's world.

What would happen to a teacher who used those glasses? She could no longer sort her students in those groups proposed by the guide mentioned above. Keeping in mind their cultural diversity, in the tables in which only students considered different were included, now all of them would be considered, with endless cells would be mixed with endless features. Then tables would stop looking like tables to become apparently irregular structures, but repetitions in different scales, like fractals objects.

This teacher, before putting on the glasses, sorted her students as vegetables in an orchard: 'lettuces in a row, cabbages in other, and so on…' But now, she sees them in a different way, and can't find enough students to fill a homogeneous row. She ends up discovering that what she handles is not an orchard, but a garden full of flowers, in which it is hard to find two similar ones. 'How to know on the basis of what criteria I would sort them? Colours, number of petals, sizes, month to bloom…' _she starts to wonder. She will be the gardener to water more the ones which do not have enough with the rain, to fertilize ones or add pesticides to others, to take the control over invasive ones… every one of them with their own specific needs. Her task will be

taking care of them and provide them with help them bloom, but not at the same time, nor with the same appearance. And, as we will see below, she is accompanied in her work.

3 New relations in the educational community

Working for educational equity and social justice requires changing power relations in schools. We need that all opinions are taken into account, and though this happens to some extent in some schools, it is not widespread. A participation that recognises the heterogeneity of the different social groups involved in the process teaching-learning, and the complexity of relations established between each other, is needed.

Who educates? Who is participating in a child's education? Traditionally, there have been some limits assumed between scholar matters and socio-educational ones, and we are encouraged to break borders. From our new scope, boundaries in all related to the world of people are blurred. These limits are like borders in maps: lines drawn by people, but not existing in reality. In the person who is being educated, learnings converge without making a difference between those which come from a formal and intentional learning, and those which not. Therefore, more than to need to break borderlines, we have to get aware that they do not exist, and action must be taken accordingly.

Sometimes it happens, that in the learning child's environment, there are conversations related to what is shown in scholar notebooks. But in the opposite side, there are cases in which what children learn outside educational institutions is not related to the official learning. We mean, sometimes formal and informal trainings are complemented, but it does not go always this way. No environment is considered 'deficit environment', since all of them bring knowledge. What is actually possible is school and background lacking common aims, a joint plan. This fact puts students who go away from the official culture that prevails in the school at a disadvantage, since they do not feel they are represented in educational processes offered by the institution.

To overcome this situation, we consider that teaching staff, families, student body and other educational agents in the environment must lead the educational process, build it up and understand it through a mutual collaboration and trust [2]. The educational centre has to be an institution to serve the neighbourhood, and to promote the democratic participation. It will not be so, if it offers finished products, just to be executed by others. That could be considered as help, but not as democratic participation. An example for a desirable participation is the one pushed by educational communities, that create mixed commissions formed by families, teaching staff, student body and other people involved in the educational process. In them, all of them together identify which problematic situations they want to face, and which improvements they want to achieve [10]. This way, the opportunity of giving and receiving help will be given, keeping in mind that the different parts can add something profitable for the others.

The participation so understood needs the educational centre management to be a shared task. It is a responsibility of the management team to help the community go towards horizontal democratic structures [10]. Leadership should not be centralized in a three-person management team, but distributed encouraging the collective co-responsibility, giving way to a plurality of voices [10]. Confidence in the work of others should be more important than control over it. But at the same time, conflicts are not avoided, it is just used to stimulate the dialogue between the parts in assembly processes, where agreements are reached sharing experiences and knowledge.

In this participation model, what is the weight given to the students body's voice? Their presence does not assure the participation. Sometimes it is supposed that children participate just for assisting to school, but being there does not involve their participation. Very often, their role is limited to integrate their opinions in questions proposed by adults [10]. The democratic participation we support, however, means that the voice of the student body gains importance at making decisions within the Centre, and leads changing processes [10]. Through this, the point is to encourage the training of citizens who feel that their opinion has a value, and their acts can bring changes in the environment they are a part of.

4 New methodologies

The school that recognises the cultural diversity needs new methodologies. Traditionally, the method is associated with how to face the curriculum. We have been referring to three issues: the methodology applicable to new relations in school, the methodology used in the teaching staff's training, and finally, the methodology to face the curriculum.

We propose, to regulate the new relations between the community, the Participatory Action Research as a method to integrate scientific and citizen knowledge, and to problematize the curricular practices [11]. It is all about a researching methodology, in which the educational community is not the subject of study, just they become agents in a process of transformation for their own scholar reality [10]. This transformation process consists of four phases [12]. First, the community defines goals to work on, based on deficiencies observed in the environment. This leads to a diagnosis followed by a collection of proposals in which all voices are taken into account. Then, these proposals are discussed and negotiated. Having drawn up the guidelines for action, the cycle is closed. These new patterns use to be, at the same time, the beginning of a new cycle.

On the other hand, it is needed to introduce new technologies in the teaching staff's training. Given the pessimistic vision of those who see in families the determining factor of the achievements that students reach in school, the intercultural approach highlights the importance of the educational practice in these achievements [2]. But also from the same scope, it is warned that *the increase in the last years of the educational offer for educators in subjects related to the attention to educational diversity has not brought a significative incidence in the transformation of the practices* [13].

For this reason, we propose to offer a training to teachers, focused on good practices according to the intercultural approach, this means educational practices that are recognising the cultural diversity of the student body, and are being carried out in a systematic and persisting manner [2]. The aim of this training model is that educators exchange and share efficient action guidelines and enhancing proposals that prioritize the cultural differences in students. The ultimate purpose is to make them modify their educational practice for a major recognition of the diversity.

To implement this training model it is needed the joint work between different professionals. Seminars and work groups organized within the same educational establishment allow to share experiences and to promote the reflection on the underlying theories. This facilitates alignment of the teaching team towards common pedagogical goals. It is also possible a collaborative training outside centres, creating communication nets that favours the exchange of experiences [13], and boost critical reflection processes.

Though we are dealing about exchange of good practice, this may not be confused with an exchange of recipes or a training in techniques. The revision of beliefs that sustain the educational practice has to be the starting point for this kind of training, that has to follow a scheme in spiral action-reflection-action [13].

And lastly, we need methods to work on the curriculum, that recognise the cultural diversity of students. As a teacher told us that the "*method included the ideology. If you are aristothelic-thomistic, authority arises almost from God. And if you are a facilitator (...) it is clear that you are a democrat in the broadest meaning of the word. You give participation to everybody, and listen to all their opinions".* [2]

Therefore, we plead for democratic methodologies and participatory methodologies, as it may be the learning in cooperation, and the learning based on projects. Though we consider that both harmonize largely with the intercultural approach, we do not want to reduce the 'right' methodologies to two, just we encourage the use of different techniques and strategies in recognition of different ways of learning and teaching between educators and students [2].

5 Conclusions

To introduce changes in school, we cannot start by generating new practices or using innovative tools, because to do different things, first we have to see and think of them in a different way from how we had been doing so far. The intercultural approach implies a new way of looking at education, it helps us understand diversity as normal, and promotes holistic changes on favour of educational equity and social justice.

We put in doubt the idea of 'attention to diversity" handled from official sources, according to which a minority of students with certain deficits are considered diverse, and deserving special attention. Against that, we defend the impossibility to organize students in homogeneous groups, and the right of all of them to have an individual education.

Recognising the cultural diversity makes necessary the effective and democratic participation of all social groups involved in the educational process. That is what relations in school have to change for. For learning purposes, no borders between formal and non-formal education exist. All members of the educational community have something valuable to bring, and we have to organize ourselves to make it possible. For that, we need a horizontal leadership that makes easier all voices to be taken into account and to have weight in the decision-making process, including the voice of the student body.

For all above to get real, we need new ways to follow, new methods to regulate: new power relations, training for the teaching staff to do, and educational practices in the centre and in the classroom. We propose:

- The PAR as a process by which the educational community becomes the subject of the transformation in their environment.
- A training for the teaching staff, where the collaborative work, the good practices exchange and the reflection on beliefs and theories that sustain them come first.
- Methodologies to implement the curriculum according to the rest of approaches, that is, democratic and participatory, as cooperative learning and learning based on projects.

All these things will be possible only by carrying out different strategies that recognise the diversity of cultural and communicative uses that govern the life of people involved in educational processes.

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Technological Accessibility and Online Educational Methodologies Associated with the Achievement of Learning in Obstetric Students during the COVID-19 Pandemic

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Abstract. This research was conducted to determine the technological accessibility and online educational methodologies associated with the achievement of learning in obstetric students during the COVID-19 pandemic. A cross-sectional investigation was carried out with 141 obstetric students from the Santiago Antúnez de Mayolo National University, Huaraz, Peru. An online questionnaire was applied; the information was processed using the SPSS V22.0 program and the Chi square statistical test was used. Regarding the results, the majority of students achieved a moderately satisfactory learning during Semester 2020-I (45.4%). Technological accessibility was limited in up to 54.6% of cases, applying the following online educational methodologies: virtual environments (66.7%), social networks (52.5%), collaborative learning based on ICT (57.4%) and personalized virtual tutoring (46.1%), which with the exception of tutoring ($p>0.05$), showed a statistically significant relationship with the achievement of learning ($p<0.05$). It was concluded that technological accessibility and the application of online educational methodologies are associated with the achievement of learning in obstetric students during the COVID-19 pandemic.

Keywords: e-Accessibility, Academic Success, COVID-19, Distance Education, Midwifery.

1 Introduction

Distance education based on virtuality has been applied worldwide in various countries for more than two decades [1], not having been considered with the same emphasis and interest in our country due to, among other reasons, the digital divide that it exists in the Peruvian population, especially in the most remote and poor communities, where only 52.5% of families have access to the Internet and the necessary computer equipment for its application [2].

On the other hand, various researchers have highlighted the importance and advantages of the use of technological resources for education and the achievement of

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student learning [1, 3, 4], especially in situations as difficult and complicated as those caused by COVID-19 [5, 6]. For example, in a study in Indonesia it is concluded that the ease of use perceived by students and the quality of the distance education service due to the COVID-19 pandemic, has a positive impact on satisfaction and performance with respect to the learning, the opposite happening when adequate guidance and information is not carried out on the objectives of the activities to be fulfilled; while the application of online educational methodologies positively influence the achievement of learning [7]. Likewise, a Peruvian study carried out at the San Juan Bautista Private University in Lima, allowed to conclude a high level of satisfaction of distance education users when appropriate virtual learning tools are used, constituting a positive mechanism for continuous improvement and achievement of student learning [8].

The Santiago Antúnez de Mayolo National University (UNASAM), like other public university institutions in the country, faces a difficult situation in the face of the health emergency caused by COVID-19, due to the deficiencies that its student population has, not only with regarding access to technological means and Internet services, but also to the scarce training on the use of the virtual learning platform available to UNASAM, whose use has been limited and unknown by the majority of members of the university community, situation similar to that observed in other countries such as Malaysia [5] and Iran [9] but different from other realities such as the United States and Sweden [10]. Likewise, to date the institution offers 24 professional careers, most of which teachers do not have training related to the use of technological and digital resources typical of distance education, a modality that had not been applied before with undergraduate and postgraduate students at UNASAM.

The current authorities have set themselves the goal of providing technological equipment and Internet connection to members of the university community in extreme poverty, a strategy that is still in the process of implementation, where the learning of online educational methodology It has been left to the particular interest that each teacher may have, as well as their personal knowledge of virtual education, not having considered the complexity of the careers of health sciences as obstetrics, so in front of the aforementioned considerations, it was carried out the present investigation with the objective of determining the technological accessibility and the online educational methodologies associated with the achievement of learning in obstetric students of UNASAM during the COVID-19 pandemic.

2 Methodology

2.1 Research Design and Population under Study

A cross-sectional research was carried out, whose study population was made up of 189 students from I to VIII cycle of the Professional School of Obstetrics of the Santiago Antúnez de Mayolo National University (Huaraz, Ancash, Peru), who met the inclusion criteria of being enrolled during the 2020-I academic semester and having a minimum attendance of 70% to virtual education sessions during the COVID-19 pan-

demic; while student desertion became the only exclusion criterion considered, deciding to work with the entire population under study mentioned above.

2.2 Data Collection Procedure

The information was collected through a questionnaire consisting of 12 questions, the first 4 referring to the characteristics of obstetric students: age (18-20 years, 21-23 years, ≥ 24 years), origin (rural area, urban area), monthly family income (<S /. 930.00, ≥ S /. 930.00) and academic cycle (I – III cycle, IV – VI cycle, VII – X cycle). The next 3 questions addressed students' technological accessibility to electronic devices (always, sometimes, never), Internet connection (always, sometimes, never), and availability of computer accessory equipment (always, sometimes, never). Regarding the online educational methodologies applied during the sessions with the students, 4 questions were considered about the use of virtual learning environments (yes, no), social networks (yes, no), collaborative learning based on Information and Communication Technologies (ICT) (yes, no) and personalized virtual tutoring (yes, no); ending with 1 question about the achievement of student learning according to the qualification registered in the university platform conforming to current institutional regulations: unsatisfactory (≤ 10), minimally satisfactory (11-13), moderately satisfactory (13-16) and satisfactory (17-20).

The validity of the questionnaire was evaluated through expert judgment, demonstrating such validity with a significance level of 0.001 as a result of the application of Kendall's concordance test; while the reliability was evaluated using Cronbach's alpha index, with a value of 0.857, after conducting a pilot test on 20 students.

The application of the final version of the questionnaire was carried out during the months of September and October 2020 virtually through an online form, the link of which was sent to the institutional emails of the students, whose participation was voluntary.

2.3 Statistical Analysis

The information was processed using the SPSS statistical package, version 22.0 for Windows, carrying out a descriptive statistical analysis according to the type of variable, using absolute frequencies and percentages; also using the Chi square test with a significance level of $p<0.05$, in order to determine the association of technological accessibility and online educational methodologies with the achievement of learning of obstetric students during the COVID-19 pandemic.

2.4 Ethical Considerations

The confidentiality of the data and the right to privacy of the students were respected at all times, for which the voluntary acceptance and virtual filling of the declaration of informed consent was considered, as stipulated in the current ethical standards of the World Medical Association and the Declaration of Helsinki [11]; the investigation protocol was duly submitted to the Ethics Committee of the Santiago Antúnez de Mayolo National University, who authorized its execution.

3 Results

Of the 189 obstetric students in the population under study, 20 of them agreed to participate in the pilot test; while 28 students did not respond to the online questionnaire and/or did not agree to participate in the study. A total of 141 students completed the questionnaire, whose main characteristics are disclosed in Table 1.

Table 1. Characteristics of obstetric students.

Characteristic	n	%
Age:		
- 18-20 years	98	69.5
- 21-23 years	26	18.4
- ≥ 24 years	17	12.1
Origin:		
- Rural área	66	46.8
- Urban área	75	53.2
Monthly family income:		
- < S/. 930.00	99	70.2
- ≥ S/. 930.00	42	29.8
Academic cycle:		
- I–III cycle	81	57.4
- IV–VI cycle	51	36.2
- VII–X cycle	9	6.4

Table 2 shows that the highest percentage of obstetric students presented a moderately satisfactory learning achievement during the 2020-I semester (45.4%), most of whom had limited access to electronic devices such as laptops, cell phones and tablets (27.7%), restricted Internet connection (32.6%), as well as reduced availability of computer accessory equipment such as printers, headphones and external web cameras (32.6%); evidencing that technological accessibility to all the aforementioned elements showed a statistically significant relationship with the achievement of learning of obstetric students ($p<0.05$).

Table 2. Technological accessibility according to the achievement of learning.

Technological accessibility	Achievement of learning										Chi-Square results
	Unsatisfactory		Minimally satisfactory		Moderately satisfactory		Satisfactory		Total		
	n	%	n	%	n	%	n	%	n	%	
Electronic devices:											
- Always	0	0	5	3.6	25	17.7	18	12.8	48	34.1	
- Sometimes	13	9.2	15	10.6	39	27.7	1	0.7	68	48.2	$X^2=79.559$
- Never	13	9.2	12	8.5	0	0	0	0	25	17.7	$p<0.001$
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	

Internet connection:											
- Always	0	0	2	1.4	18	12.8	16	11.4	36	25.6	
- Sometimes	11	7.8	17	12.1	46	32.6	3	2.1	77	54.6	X^2=88.733
- Never	15	10.6	13	9.2	0	0	0	0	28	19.8	p<0.001
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	
Computer accessory equipment:											
- Always	0	0	2	1.4	9	6.4	14	10.0	25	17.8	
- Sometimes	5	3.5	13	9.2	46	32.6	5	3.5	69	48.8	X^2=89.808
- Never	21	14.9	17	12.1	9	6.4	0	0	47	33.4	p<0.001
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	

On the other hand, regarding the application of online educational methodologies (Table 3), it is observed that the majority of students with moderately satisfactory learning achievement had participated in virtual learning environments (36.9%), as well as in social networks for educational purposes (32.6%) and collaborative learning methodologies based on ICT (31.2%); The opposite happens with personalized virtual tutoring, which was not carried out in 24.1% of students with the aforementioned learning achievement; evidencing that with the exception of virtual tutoring (p>0.05), the rest of online educational methodologies presented a statistically significant relationship with the achievement of learning of obstetric students (p<0.05).

Table 3. Application of online educational methodologies according to the achievement of learning.

Online educational methodologies	Achievement of learning: Unsatisfactory		Minimally satisfactory		Moderately satisfactory		Satisfactory		Total		Chi-Square results
	n	%	n	%	n	%	n	%	n	%	
Virtual learning environments:											
- Yes	8	5.7	15	10.6	52	36.9	19	13.5	94	66.7	X^2=36.343
- No	18	12.7	17	12.1	12	8.5	0	0	47	33.3	p<0.001
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	
Social networks:											
- Yes	1	0.7	9	6.4	46	32.6	18	12.8	74	52.5	X^2=55.529
- No	25	17.7	23	16.3	18	12.8	1	0.7	67	47.5	p<0.001
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	
Collaborative learning based on ICT:											
- Yes	5	3.5	13	9.2	44	31.2	19	13.5	81	57.4	X^2=36.657
- No	21	14.9	19	13.5	20	14.2	0	0	60	42.6	p<0.001
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	

Personalized virtual tutoring[a]:											
- Yes	12	8.5	15	10.6	30	21.3	8	5.7	65	46.1	X^2=0.145
- No	14	9.9	17	12.1	34	24.1	11	7.8	76	53.9	p=0.986
Total	26	18.4	32	22.7	64	45.4	19	13.5	141	100	

[a] Not significant.

4 Discussion

The results found with respect to the main objective of the study, allowed to determine that technological accessibility and the application of most online educational methodologies are associated with the achievement of learning in obstetric students of UNASAM, during the period of health emergency caused by COVID-19 pandemic; showing similar results in other studies [6, 12] with respect to the limitations found in the technological accessibility of students, whose authors highlight the disadvantage of not having the necessary electronic devices and adequate software for the development of the contents of the subjects, becoming a critical aspect related to the lack of support from the authorities and administrative personnel in charge of managing the resources of the universities, and there is no awareness of what virtual education really means [9], and should be prioritized the urgent search and implementation of alternatives according to the needs of teachers and students [13]; especially in educational institutions located in the provinces, whose student population generally comes from distant places with difficult geographical access and scarce economic resources, as is the case of UNASAM, where cultural barriers also play a preponderant role, aspects that as a whole, would allow us to explain the high percentage found with respect to the limited technological accessibility of the students.

On the other hand, regarding the online educational methodologies applied by obstetrics teachers at UNASAM and their relationship with the achievement of student learning, it is important to highlight the similarity of these findings with what was found in other investigations, in which it is concluded that virtual learning environments are also effective for exchanging perspectives and improving intercultural understanding [14] favoring interaction between participants [15], constituting in the case of the present study as the online educational methodology most used by teachers in their virtual class sessions, which is due to the fact that these environments were the ones that received the greatest emphasis in the training provided by the UNASAM authorities to teachers and students, a reason that would explain the results obtained.

Regarding the use of social networks, its application was also associated with the achievement of learning by obstetric students, spotlighting in recent years the accelerated increase in its use in terms of knowledge management based on the advantage of the greater interaction of the participants [15], which in turn generates considerable integration from the emotional point of view, an integration that, if it does not occur, causes a feeling of isolation, loneliness and lack of motivation [16], problems closely associated with distance education, and that through the use of

social networks such as Facebook, it could be diminished through the establishment of affinity relationships among students [17], although it is also important to emphasize that the promotion of such relationships would be diminished when their application is carried out as part activities in formal learning environments such as in the university, precisely due to the diffusion of unofficial content that is often carried out on these social networks [14], which would somehow explain why UNASAM teachers have made less use of this methodology compared to virtual learning environments, even more so if takes into account the little access that exists among teachers in countries such as Peru with little investment in research, to reliable sources of information, contributing to increase mistrust and lack of credibility in the data that can be shared by these social media virtual.

Much more positive results were evidenced with respect to collaborative learning based on ICT, which became the second most applied online educational methodology by teachers in the present study, with the possibility of continuing to increase in terms of its execution for the achievement of learning of students, because, as has been highlighted in other studies, this type of methodology promotes virtual collaboration under an approach of creating useful meanings not only for students, but also for teachers [18], with an ample development opportunity in different areas, where activities go beyond the simple fulfillment of tasks together, achieving significant interactions between students, who behave as peers seeking shared understanding of knowledge [3]. In collaborative learning through virtual education, ICTs play a very important role, since they facilitate and motivate cognitive interaction [19], but its application must always take into account the needs of the participants, especially those related to autonomy, affinity and competence, the same ones that have been demonstrated, can be approached in a more positive way through collaborative learning [20], turning higher education into a field of action with great potential for this methodology, with the consequent change in the teaching role [21], whose positive results have been demonstrated in university students in health sciences related careers [22], as happened in the present investigation.

Contrary to what was observed in the other online educational methodologies applied by obstetric teachers at UNASAM, personalized virtual tutoring was the least developed, not finding a statistically significant relationship with the achievement of student learning, whose advantages demonstrated in the virtual education such as the monitoring and evaluation of students' progress through appropriate indications according to their reality and the role of the tutor for the establishment of social interaction in online learning environments [23]; could not be evidenced in the present study, a situation that was due, among other reasons, to the lack of training of teachers with respect to the development of virtual tutoring, as well as the ignorance of additional feedback mechanisms [24] and synchronous and asynchronous follow-up [25], which can only be developed consciously by teachers when a true and profound change is achieved in their pedagogical thinking and knowledge [26], a very difficult situation to achieve in a context of great tension and forced adaptation that have teachers had to perform as a result of the COVID-19 pandemic.

On the other hand, it is necessary to spotlight the existence of several limitations in the present study, such as not having been able to evaluate in a more detailed way the

characteristics of the application of each of the online educational methodologies with the students, due to the variability in its execution by teachers, as well as the particularities of the different subjects, aspects that could be considered in the development of future research work. Likewise, the cross-sectional design limited the long-term evaluation of other aspects related to the variables under study, not having been able to evaluate other items with respect to the achievement of learning, because the university regulations only considered as a result of the evaluation of students to the classification already mentioned in the present study; no other data regarding performance and gradual achievement of capacities were recorded in the institutional platform; limitations that do not detract from the information provided regarding the level of technological accessibility and the online educational methodologies applied with students of a health sciences career such as obstetrics, especially from a national university located in a province of the Sierra del Peru, whose geographical and cultural characteristics differ from the city of Lima; making known information until now unknown, especially in the circumstances of a health emergency due to the COVID-19 pandemic; information that could be taken into account to carry out new studies.

5 Conclusions

Technological accessibility and the application of online educational methodologies are associated with the achievement of learning in obstetric students of the Santiago Antúnez de Mayolo National University, during the COVID-19 pandemic; reason for which the necessary actions must be carried out in order to reduce the limited access to electronic devices, Internet connection and computer accessory equipment of teachers and students in vulnerable situations. This responsibility not only falls on the authorities of the institution and the Ministry of Education, but also on the members of the university community, such as the teachers themselves, who must seek constant training in the use of additional technological tools that facilitate the development of personalized virtual tutoring, according to the reality and technological limitations of the students, as well as in the application of new online educational methodologies according to the particularities of the subjects in their charge. In this sense, it is proposed as an educational innovation solution to be applied in the obstetrics area, the creation of virtual simulation laboratories based on the exclusive use of social networks, which due to their lower data consumption and the establishment of cooperative relationships and teamwork with the constant guidance of teachers, would help enhance student learning, with the consequent achievement of the clinical competencies considered in their training profile.

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VIRTUALECTO Storytelling content creation platform using augmented reality and virtual reality

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Abstract. In recent years, technologies such as augmented reality and virtual reality have not only bridged the digital and real world, but have also become involved in education as part of immersive experiences, supporting the student's learning process. This research work shows the advances in the development of a digital platform called VIRTUALECTO, in which teachers can create content with augmented reality and virtual reality to reinforce learning activities that allow students in an interactive, educational way and immersive to improve reading skills, through the use of mobile devices. The results, so far, indicate that the proposal guarantees a virtual learning environment (VLE), within the ISO 25000 [1] quality standards, in addition to having some improvements compared to other similar proposals for storytelling.

Keywords: Augmented Reality · Virtual Reality · Virtual Learning Environment · Micro-services · Web Server · Application Server.

1 Introduction

Currently, technologies have become a very important tool in teaching and learning processes, as part of their advantages of modern education, and students compared to traditional education are no longer mere recipients of information [2]. At an early age, children interact with new technologies in their learning, as devices are increasingly used in their education and make this more funny with the help of videos, slides, online platforms, virtual and augmented reality [3].

Augmented reality (AR) and virtual reality (VR) are one of the emerging technological tools that have been gaining popularity in recent years. Its trend is increasing in relation to its application in the educational field, since they allow users to have an immersive experience, visual three-dimensional simulations combined with audio, superimposing virtual elements on reality, allowing them a greater understanding of an specific topic [4] [5]. There are some tools for Storytelling, the best known case is *StoryBird*. In addition to the fact that the vast majority of this type of tools are focused only on narrative texts, using only audio-visual resources, but now they are being supported with technologies such as augmented reality [6].

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In the present research work is shown the progress of creating a platform for storytelling, and interactive Virtual Learning Environments for content creation with augmented reality and virtual reality.

2 Related works

Recent studies aim to used virtual reality and mobile applications to improve the experience in education. ARVEE seeks combining traditional and immersive education in an interactive, fun and educational way, encouraging students to learn astronomy and motivation to pursue a career similar to the one they are learning. The project was tested in a group of students between 7 and 14 years of age, where a great acceptance was observed for this technology. In addition, 90.9 % of them consider that virtual reality can be of great help in the learning process and make some school subjects more interactive and easy to understand
[2].

Previous studies investigated about the use of augmented reality Game-Based Learning, that enriching students, experience during reading comprehension activities, its purpose is the design a game using Augmented Reality in order to promote understanding in primary school students, the tests included students from third to sixth grade, between the of 8 and 12 years old. With the help of teachers, a game called *AR Ole Cierraojos* was developed for tablets and smartphones with Android, the game is inspired by pop-up books and works using AR markers represented on each page of the book. Hendrys concluded that the results of reading comprehension with the game show no difference with the results of traditional approaches, however, the students show a greater motivation and interest in the activity [7].

at present there are investigations that Comparing reading comprehension between children reading augmented reality and print storybooks, measured the reading comprehension of children who read a storybook in augmented reality and They compared it to others reading the traditional print version of the same story. To animate the book with augmented reality, the *HP Reveal Studio* platform was used to create 2D animations with the help of images and audio materials, and show them on the pages of the book. Delneshin, concluded that the application with AR content has a positive influence on readers, and observed or a significant difference compared of the traditional method [8].

Other studies investigated about Virtual Reality, and the develop of an integration in the learning environment for education, which was developed a simulation platform to teach the water cycle to children, using COSPACES VR and its MERGE Cube complement. With the CoSpaces creation tools, it is easy to build 3D scenarios, students interacted with 3D objects and models. Ahmed concluded that using VR enables the user to feel more personally connected to their environment and helps them learn more effectively [9].

3 Proposal

3.1 Theorical framework

Augmented reality (AR) It is a way of Augmenting the real world with virtual objects, it consists of combining real and virtual objects in a real environment and in real time. AR technology has been applied to a wide range of fields: tourism, entertainment, marketing, surgery, logistics, manufacturing, maintenance, and others [10].

Virtual reality (VR) refers to an entire simulated reality, which is built with computer systems using digital formats. Building and visualizing this alternate reality requires powerful enough hardware and software to create a realistic immersive experience (for example, virtual reality headsets or dedicated glasses and 3D software) [11].

Storytelling Digital storytelling has been widely adopted in teaching and learning in educational sectors around the world. Digital storytelling is regarded as the art of telling stories with digital elements including text, graphics, sound and video. A typical digital story is a few minutes long narration with video and music to present ideas on a certain theme. [12] .

React Native React Native is a native scripting framework for cross-platform mobile development. The framework was originally developed by Facebook and released in 2015 for iOS only, but an active community has since added Android support and done many other contributions to the open source project. [13].

3.2 Objective of the platform

The objective of the platform is the creation of educational storytelling content, with augmented reality and virtual reality technologies, to improve reading comprehension, as a motivating effect, our target audience is teachers, who will be able to create content with AR, VR and activities for student evaluation from a web platform, the other target audience is the students, who will be able to consume these resources, through a cross-platform mobile application.

3.3 Platform architecture

Due to the special characteristics of the proposal, there are two client applications, both for content generation and for consuming mobile learning objects. An architecture is proposed that finds a balance both in design and the development of the different components that compose it. This work propose to divide into two parts, server and client side.

Server Side Considering the demand for data storage and transfer in the flow of the platform, it is necessary optimal requirements of the server side. That is why the trends in architectures based on microservices are taken as a base, which, unlike monolithic

architectures, allows a better use of the services provided by the cloud [14]. This model considers two main modules, a database module with *PostgreSQL* as the main database and *DigitalOcean Spaces* as the file storage system, and a Services module in DJango on Docker containers as see Fig. 1.

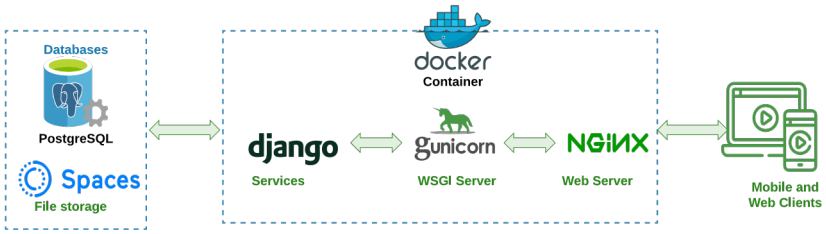


Fig. 1. Communication. Between the web server and the application server

- **Database** PostgreSQL is a relational and object-oriented database manager. It is considered among the most powerful relational database management systems, provides simple accessibility, is cross-platform, and is available for use on all major operating systems without compromising its performance [15]. However, it should be considered that it is easy to violate without the appropriate protection settings, another important point to consider is its small amount of data types, as see Fig. 2
- **File system** DigitalOcean spaces is a file storage, service that allows you to store large amounts of files. The data transfer is protected by *HTTPS*, and the scalability of the storage is simple, so its consumption is optimal and safe.



Fig. 2. Communication. Between the web server and the application server

Web services application : Django is a very powerful and popular web framework, which helps to effectively launch web applications implemented on Python. Features like its relational object mapper, Python API, and admin interface make it securely efficient in web development [16].

Usually, applications running on a platform, either on production or development, use a server to respond to a request of the client, the Django framework uses its own execution server to deliver content whenever a request is made [17].

Although this works good, it is not advisable to use this development server to run a production environment, so for this proposal Green Unicorn was thought for the communication between the application server and the web server, as shown in 2.

Client Side Client-side applications are those that can be operated by both web browsers and applications on mobile devices, generally are not well compatible with current technology. These applications not only need to share data remotely, but also cache and update data locally to continue responding to user requests through their interaction [18]. Existing cloud databases only provide remote data that is shared and the need arises to implement caching and buffering to application level [19]. In addition, on the client side, information processing is quite fast, allowing very complex tasks to be carried out, allowing applications to be very flexible and personalized.

In Fig. 3, the client-side architecture proposal for the mobile application is shown, which has several modules that help the generation of 3D digital scenarios, to create both Augmented Reality and Virtual Reality.

- **Object Learning Reader Module :** This module is responsible for reading the learning objects, which come as a query from each user in JSON format, which contains a set of metadata, which provides us with information such as: Title, Description, Creation Date, Object Type learning (AR or VR), Positions of the 3D models, Path of the 3D models, Keywords. All this information will become object data, which can be interpreted and processed by the client application.
- **3D Scenes Creation Module :** This module is in generates the different scenarios, based on the learning objects that were read in the previous module. This module is responsible for assembling resources that can compose a 3D scene, and prepare them both to become available in cache and buffer, to allow subsequent rendering, and it is very important the role of the graphics processor of each mobile , to optimize its correct operation and display.
- **AR and VR Rendering Module :** The most important part for the visualization of the 3D models is the present module, since from the creation of the 3D scenarios and already pre-loaded in cache memory, it is that we work with different technologies that have the same objective, create real or virtual situations, such as *ViroReact* open source library, which allows to create augmented reality such as AR Core for android and AR kit for iO's, and for virtual reality creation Google Virtual Reality SDK [20].

Fig. 4 shows the client-side architecture of the scenario creation platform and learning objects.

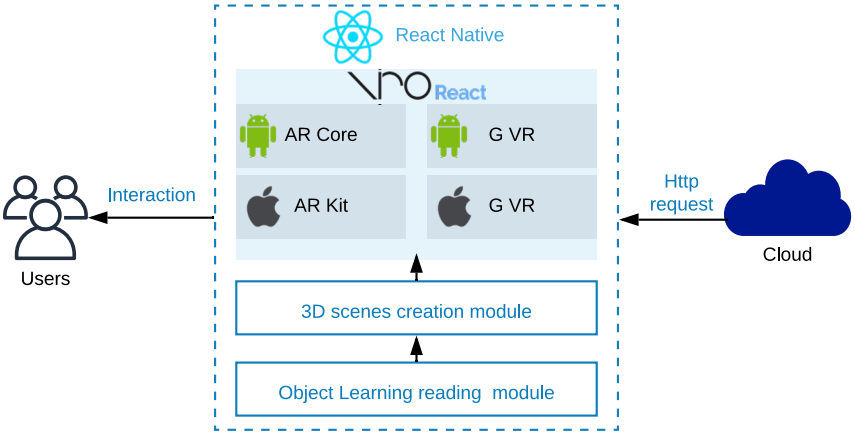


Fig. 3. Client side architecture proposal for mobile

- **Creation Object Learning Creation Module** This module allows us to create learning objects, which is made up of resources for immersive activities such as augmented reality and virtual reality, in addition to creating a set of questionnaires to verify the student's learning process. This module is supported by JavaScript technologies such as Three JS and WebGL, which allows us to build 3D scenarios.
- **3D Models Library** This library contains 3D models that allow different 3D scenes to be assembled with them, these models are categorized into: People, Nature, Buildings, Animals, Objects, which allows to help in the scene assembly process.
- **Audio visuals resources library** This library contains resources such as audio, videos, 360 videos, as part of the modeling of Storytelling scenes.

3.4 Features

Mobile application To measure reading comprehension, the following functionalities were proposed for the application:

- **Login:** The application has a validation to save the information and the user's progress Fig. 5
- **Library:** It is a view where all the stories available to the user are shown, each story has a list of chapters and each chapter has a questionnaire about that chapter.
- **Questionnaire:** It is made up of questions of different kinds. There are four types of question, *simple selection*, *multiple selection*, *true or false question* and *draggable questions.* as seen in Fig. 5
- **Reward:** If the questionnaire is successfully completed, a virtual reality view will be shown Fig. 6 or augmented reality Fig. 5 with 3D objects in relation to the selected story.

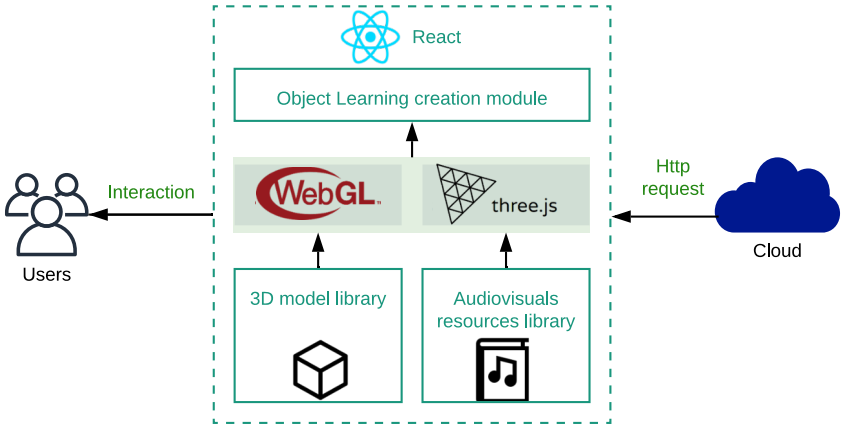


Fig. 4. Client side architecture proposal for mobile

- **Workgroups:** The user will be able to enroll in a work group and thus access new stories and see objects in augmented or virtual reality

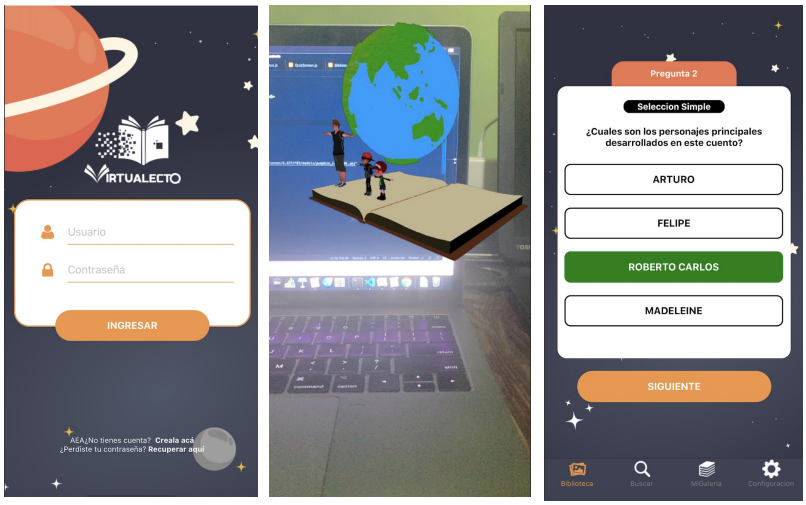


Fig. 5. Validation and simple selection question



Fig. 6. Virtual Reality.

Web application One of the main functionalities of the platform's client, we have the creation and display of content, and user interaction follows the same pattern as the mobile application. In the Fig. 7 show the Scene Editor

- **User login and registration** They can register and login in the web interface.
- **Contents library** In this module users can browse and view descriptions of learning objects.
- **Content creation module** Allows users to create their own storytelling material, as well as providing the ease of using objects, stages and sounds available in the platform's database, as well as their own that have the possibility of being imported.
- **Rendering module** allows to visualize and evaluate the quality of the content created, this feedback allows to have a better perspective of the material that is being built.

4 Evaluation of the platform

The ISO 25000 standard is called Software Quality Requirement Evaluation (SQUARE), it provides a guide for the use of the new series of international standards, called Requirements and Quality Assessment of Software Products (SQuaRE); which constitute a series of standards based on ISO 9126 and ISO 14598, and its main objective is to guide the development of software products with the specification and evaluation of quality requirements, allowing to define the quality model and the process to follow to evaluate said product, establishing criteria for its specification, its measurement and its evaluation [21]. The usability of VLEs can be evaluated in two different contexts: usability during the development process and usability evaluated by end users, that is, when the VLE is found as a finished product. This article will focus on determining the characteristics or aspects necessary for the evaluation of VLE as a final or

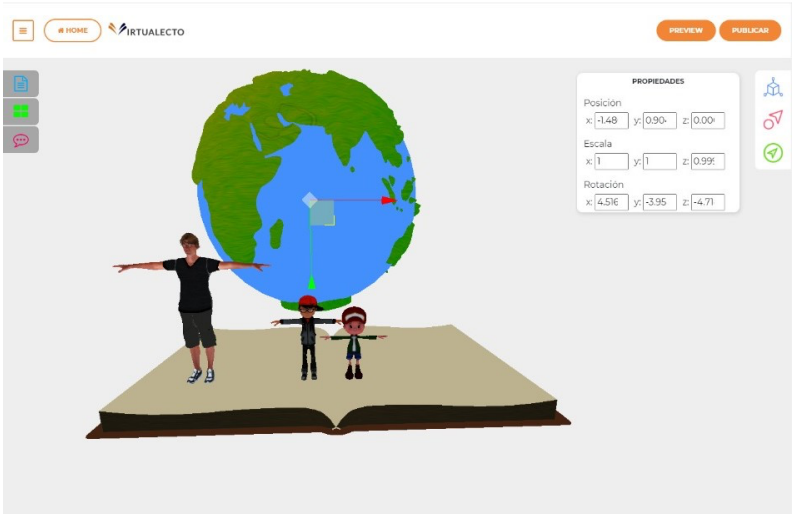


Fig. 7. Scenes Editor.

finished product, for which some characteristics are defined that an VLE must have according to product-oriented standards [1].

We use ISO 25000 as measurement tool, for which it will be applied in the Virtual Learning Environment called VIRTUALECTO, for this we will give a star-based evaluation where the minimum is 1 and the maximum 5, these evaluations were carried out by experts in software development and specialists in educational technologies.

Table 1. VIRTUALECTO platform evaluation under ISO 25000

Cod	Feature	Point
1	Ease of Learning	*****
2	Ease of Understanding or Understandability	****
3	Ease of use and operability	*****
4	Help facility	***
5	Technical accessibility	*
6	Degree of attraction or attractiveness	*****
7	Adherence to standards or conventions or complicance	****

As we can see, the proposed VIRTUALECTO, largely complies with ISO 25000 standards, it should be noted that this standard is based from the point of software engineering.

In the analysis and research carried out on the most similar platforms, which create both augmented reality and virtual reality content, and which are focused on education with the area of communication, the platforms, CoSpaces, Augmented, and Storybird were found, below The comparative table of the characteristics of the platform proposal

is shown, with respect to the other content platforms. In the Table 2 show the comparative.

Table 2. Comparison of VIRTUALECTO with other platforms

	VIRTUALECTO	CoSpaces	Augmented	Storybird
Augmented Reality	Yes	No	Yes	No
Virtual Reality	Yes	Yes	No	No
Education	Yes	Yes	No	Yes
Reading	Yes	No	No	Yes
Recommendation systems	Yes	No	No	No
Questionnaires	Yes	No	No	Yes
Cross-Platform	Yes	Yes	No	Yes
Web Editor	Yes	Yes	No	Yes

5 Conclusions

This research works on the storytelling content creation platform called *VIRTUALECTO*, developed with a set of tools that allow creating a scene editor with 3D models with technologies such as Threejs, React, WebGL. In addition, the proposal also shows us a robust architecture for the rapid creation of this AR and VR content with the use of cross-platform technologies such as ViroMedia. The proposal uses in its development standards for software such as ISO 25000, focused on educational platforms, from a product perspective, as well as where the strength lies in the ease of learning, operability, attractiveness and ease of understanding. In addition, it shows the set of architectures and technologies to give you the support and high demand for information exchange when using big data such as 3D objects, and audio-visual resources.

6 Acknowledgments

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The university teaching practice in virtual education: Reflection for teaching adaptation

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Abstract. The university education in virtual settings, assumed way because of the pandemic caused by the COVID-19 virus, made the teachers reformulate their habitual ways of teaching, which has revealed the need of checking the theoretical and practical guidelines of the university teaching practice as an answer to the teachers' concerns. In this perspective, and standing on a systematic review through the review of articles, thesis and books, reflection is made over the feasibility of university teaching practice in virtual settings, the features that teaching acquires in the virtuality, the learning theories analysis that sustain the didactical processes, the evaluation of the educational potential virtual platforms offer and the methodology strategies that boost leaning in virtual networks. The conclusions reached at this inquiry is that an own specific teaching approach is configured in the virtual settings, which properly structured from a virtual learning, promote the use of active methodological strategies.

Keywords: *University teaching practice, learning, teaching, virtual settings, strategies.*

1 Introduction

Today as yesterday, it is necessary to bear in mind that the didactics support the teacher "in the reflection and analysis of the teaching-learning process, deepen in its nature and in the foresight and permanent improvement of the stakeholders and elements that intervene in the educational act" [1]. Teachers find in it the sufficient support to underpin their pedagogical intervention not only to execute a class in a particular space "…but to investigate and ask about the learning processes and, through that, for the students' learning possibilities and the teaching perspectives that best match this context" [2]. Therefore, and agreeing with Zabalza [3], "Talking about Didactics is to talk about teaching and teachers". Consequently, if what is being looked for is the improvement of students, a good teacher needs to use that

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discipline which is so proper of education.

In a doubt and uncertainty time in the educational field transformed by the educational subjects' non-face-to-face situation, it is important to check the theoretical outline that base the university teaching practice on the virtual setting, which is a field not greatly studied until now, and it is where teachers support their work on virtual professional training courses, abandoning that old idea that to teach at the university it is enough with being an expert in certain area and knowing and managing the communication and information technology. If the in-person education already demanded from a university professor to stop being just a "specialist in the discipline" to be "a discipline didactician" [4]. Nowadays this demand is greater because it does not only require from a professor the field of specialization knowledge but also pedagogical competences – digital and interpersonal communication skills in virtual environments.

In the teacher's adaptation process to this new educational environment, it is imperative to reflect on the applicability of the university teaching practice in the virtual learning settings, identify the characteristic that the teaching acquires in the virtuality, analyze the learning theories that sustain the teaching and learning processes of virtual education, appraise the educational potential that the virtual settings or environments have to offer, as well as determine the methodological strategies that boost learning in the learning virtual settings.

2 Method

The methodology used in the investigation is the documentary technique that is based on the review of articles, thesis and books about didactics and its application on virtual learning settings. The gathered information belongs to different digital and printed sources and the content extracted from them, quoted directly or indirectly, aimed to justify the disciplinary didactics, which nowadays acquires new proportions because it is applied in an educational environment completely new for the university professor such as the virtual one, eased by the information and communication technology integrated to the university or superior education.

The investigation was based on the systematic review about application of the university teaching practice in the digital context and the implications that this situation net learning autonomous and collaborative learning, the virtual settings and methodological strategies that use virtual resources, were chosen. Emphasis is made on the identification of adequate concepts to the virtual education approach and the challenges that these topics must be faced by university professors in the search for of which were research articles, 19 books and three- degree thesis, Documents were filtered using source title, subject area, year, and document type.

3 Rethinking the University Teaching Practice

To place on the didactics field, always flexible and so proper of teachers, is to refer the pedagogical discipline that has a group of methods and techniques devoted to guide the teaching through all discipline suitable principles and procedures, so that their leaning is accomplished more efficiently [5]. Accordingly, it has a practical approach, but it is attached to regulations and its specific objective is to motivate and guide students in their learning process in an efficient way. Moreover, it has always been understood associated to a context, purpose, action or process [6] [7] [8]. Thus, talking about the didactic act is to refer to the intent that teaching has, to explain something with quality. In other words, it's said to be "didactic" "something that is adequate to teach and train (…) it's about the art of making things in such way that would make them easy to learn" [4] which reflects, summing up, two situations of the didactics per se: on one side, it refers to the teaching in generic terms, and on the other side, to the characteristics that the teaching act must have as a didactic one: learning facilitation, presentation of adequate and students' adapted content, content and relevant procedures selection, etc.[4].

In this line of thought, the university teaching approach is considered as a field of specialized studies about the teaching – learning processes at university [9]; in other words, it is a special didactic that is circumscribed to the teaching processes in higher virtual education [10] [11] [12] [5]. Therefore, it can be interpreted that university teaching approach not only studies the teaching intervention process in the educational act, but also projects itself as a linkage between the context and the university to promote the graduate students' profile training and strengthens the relevance of the university in its search for solving problems [13].

E-learning to plan, design, execute and implement teaching-learning processes require platforms or websites that are called Virtual learning environments (VLE) or Teaching-learning virtual settings (TLVS) which are structured with technological elements, but also with didactic elements [12]. They work as a means to host files, activities and communication; they provide services of hosting and repositories of tasks, providing feedback and communication tools to share knowledge. These technological tools do not teach on their own, structure must be done from the pedagogical and didactic intention so that they can support the different learning – teaching processes [14]; to the ones that are accessed by students and teachers if they have the possibility of permanent connection.

The performance from the didactic connection and interaction needs that the educational stakeholders have acquire minimum digital competences that allow a suitable development in virtual settings, as well as the management of the digital information in a safe, critical and efficient way [15].

3.1 Teacher`s Teaching Process: From the Board to the Screen

The virtual environment turns the educational act in a teaching network using active methodologies to facilitate the acquisition and practice of knowledge, to this effect,

it uses multiple virtual resources every time more varied and abundant; the student learns through the interaction with those objects and other users of that virtual world [16].

Teachers lead students to the center of the process, with lesson plans that encourage the curiosity, creativity, abilities, team work and knowledge acquired outside classtime. All this needed information to learn is available on the net, but it is necessary that professors provide students with it, to be analyzed, interpreted, interiorized and enriched. In virtual education, the teacher dedicates less time to explaining and more time to advise, boost, support, give feedback and guide students [17].

3.2 Virtual Learning or Net learning

Connectivism explains the impact that receives the human being from the multimedia technology in the learning process. In virtual education that is now part of the most citizens' lives around the world, people are connected thanks to internet, WhatsApp, smartphones, tablets and others. Siemens [18], author of Connectivism says that:

Learning is the result of the integration of the nets, the complexity and the self-organization. Hence it is presented as a model that reflects a society in which learning is not an individual activity anymore, but a continuous process of construction of nets.

The context is characterized by the existence of knowledge nets of different nodes, in which the principles of self-organization, to a personal level, as a micro process, is similar to what occurs to bigger organizations, in which is highlighted "the capacity of the apprentices to create connections between different information sources that are useful for them"; finally, "it involves the principles of the net, that are connections between people, groups, information nodes and entities to create an integrated whole" [18] [19] [14] [20] match with these ideas, who explain that connectivism has as central idea that knowledge is distributed through a connection net and, therefore, learning consists on the ability of building and trespassing those nets". Learning can be individual and autonomous, but it is generated from information and knowledge socialization, which requires is that people form nets. In net they share diverse information, courses, messages from different sources of information, or information nodes.

Viñals y Cuenca say that "learning is the equivalent to opening a door in a new way of perceiving and knowing, where our mind should adapt to the environment" [21], in which knowledge is not organized or in a package, but that it is presented in multiple sources and it is very varied. Nowadays that interaction with ICT learning overcomes barriers of time and space and it is produced in a multimedia context in which all the elements of the educational act are present: the contents, methodology related to educational resources, teaching styles and approach and the conditions of virtual learning.

3.3 Autonomous and Responsible Learning

Delegation of responsibilities in the learning activity makes that "students each time becomes owner of their own processes to learn according to their interests, objectives, strategies, tools and moments that they consider relevant to learn" [22]. It is as if students acquire maturity in the learning process on their own initiative, making the decisions that conduct them to autoregulation of their cognitive processes, according to an objective or a goal and in accordance with a context or learning conditions. It is not only about procedure or resources, it is above all a trust attitude in their capabilities, motivation, communicative, assertive and collaboration abilities [14].

The teacher facilitates the students' autonomy effort oriented to the management and construction of their personal knowledge, consequently it is important to promote and strengthen their personal learning environment (PLE), as the intersection of all the elements (information sources, relationships and connections, tools and strategies) in formal and informal learning [16]. Virtual learning environments allow a liberation in the students' participation, the interaction with different people, nets and access to a wealth of information make the autonomous learning possible, to which teachers pursue so badly to make their students independent, which makes it an ambition easy to reach.

3.4 Collaborative Learning

Collaborative learning, is what Vygotsky [23] calls *peer learning*, learn in a personal way, but in the context of a group; it is to be with others in *collaboration mode.* It is learning in interaction with others who are considered peers and with responsibilities to make common decisions.

Virtual environments facilitate collaborative learning, students are main characters of their own activities, they interact with their classmates and the teacher to publish knowledge, facilitate the text discussion and meaning building in groups, compose essays, elaborate concept maps, semantic networks, access to virtual libraries and source of reference [14]. Collaboration and learning together (Learning together) is substantiated, according to Castaneda, Gutiérrez y Rodríguez [24], in three circumstantial collaboration elements: *collaborative situation, collaborative interaction, collaborative mechanisms.*

According to these three aspects the teacher uses methodology strategies like forums, flipped classroom, project-based learning, service workflows learning and activities in which participation and everyone's opinion is important for the elaboration of products in collaborative learning [25].

3.5 Didactic Potential in Virtual Environments

Virtual learning environments make online training possible and they are structured in the space of a technological media such as: virtual platforms, web, blog, among

others. As physical classrooms that are the areas of the educational in-person act with certain characteristics, the virtual environments possess communication resources and media that allow didactic interaction, knowledge and learning management.

The virtual teaching and learning domains refer to "a system of programs designed to facilitate teachers the management of virtual courses for their students, which help them with the administration and development of the course" [22]. The virtual fields give the chance of having all the elements and technological tools under the same interface, which are needed to develop in a full way a process of didactic interaction [26].

3.6 Methodological Strategies for Autonomous and Collaborative Learning

The didactic strategies that are applied using the multimedia technology constitute authentic innovations on the educational field. These, are tools that provide dynamism to the learning processes, and make possible to create new collaborative and communicative interaction spaces among students, using new ways of presenting the information and to distribute, expose and clarify the learned contents, as well as the planning and delivery of activities [12]. These conditions of pedagogical work place the student in the center, incorporating active and collaborative ways that take advantage of the interconnection that virtual tools offer and give sense to the pedagogical content and activities for the development of professional competencies facing the reality.

One of the most common strategies is that is called *Collaborative work* which answers to the learning theory under the same name, based on the people interaction as members of a group, who interchange, differentiate and contrast their knowledge and opinions, and in that dialogue build a knowledge scaffold, useful for everyone, because the peer learning promotes the inner learning in each of them. Everybody wins in this virtuous collaborative circle [24]. The collaborative strategy is applied in periods of synchronous and asynchronous work with the teachers' direction and guidance.

The necessity of solving conflicts proper of the natural and social reality took us to the structuring of the strategy known as *Problem-based learning* in which students learn in the effort of solving together a problem from the reality. It has a basis in the constructivism, and it is done in group work, mentored by the teacher. Self-directed individual work is also carried out [27]. Its application to the virtual context allows to boost the resources such as video, graphic elaboration software, software for Project elaboration and group reports, etc.

Task-based learning (TBL) is a strategy or a series of actions in which students present solutions to a determined problem that is found in reality. In a collaborative way, they formulate a project that contains objectives, goals and a sequential series of activities that are coherent with each other. The purpose is always to solve a problem or satisfy a need generating a product that can be goods or service.

Resources of different types and periods of preparation, operation, processes and results evaluation time are considered [28].

Simulation is a didactic strategy, in which the student in a plausible and assumed context, generates situations and behaviors which are similar to reality. It can be considered as a tool in the teaching-learning process widely used in the ability training of different professionals, as the ones in different areas such as health, education, law, social communication, administration, economy, among others. Simulation allows to train students in environments that replicate substantial elements in the real world, which generates an experience that facilitates the constant practice with the advantage of the guide and interaction of an expert, in a totally formative way [29].

An strategy that promotes autonomy in students is the methodological tool *Flipped Classroom* which considers a sequence of actions in three moments: *Before, during* y *after* the learning session. In the first moment, students learn a new content through online video-tutorials, typically at home; and what before used to be assigned homework, are now made at home, -during class- with the teacher's guide who offers a personalized orientation in interaction with students, strengthening their learning" [30]. After the class, the student continuous with the development of tasks and projects. All the methodological development uses virtual platforms of didactic communication and interaction, as well as educational resources of different types, academic search engines, graphic elaboration software and others.

Gamification is a very motivating innovation which uses playful activities in a non- recreational learning area with the purpose of developing abilities and adequate behaviors. In this environment, "the application of game mechanics to non-recreational areas, is made with the purpose of stimulating and motivating both the competition and the cooperation between players" [31]. Produced videogames to achieve different competencies in students are for themselves fun and sustainable over time learning building strategies. These are the ones called *didactic games* "because they have a clear educational intention and in advance, it is known what has to be learned when it's played" [32].

4 Conclusions

Virtual education is assumed by universities in Peru to continue with the educational service of professional training, it reveals the necessity of rethinking and analyzing the principles and guidelines of the didactics as a discipline that supports the teacher in its performance in the classroom, subject of a reflection nowadays fort the integration of the information and communication technology.

In the virtual context, in which the didactic should play a booster role, the basis of learning is being enriched in its conception of social construction, which considered as an individual process, nobody could learn for another person, it is only generated if students are forming nets because knowledge is built in a social way,

sharing information, messages, opinions, emotions and affects. The information sources are many, the ones that build specialized nodes to which students can access without the teacher's intervention.

The structuration of the virtual learning environment or web spaces demand from the teacher and the student the development of digital pedagogical competencies, because technology should be used in this case for educational and training purposes, according to the institutional educational approach, the professional profiles and the curriculum of each career.

In this sense, the provided environments of communication spaces (forums, internal messaging system) favor the immediate and fluent didactic interaction of the educational stakeholders, which make the students' conduction possible through methodological routes displayed in virtual collaborative spaces, with the aim of supporting in the effort of achieving the acquisition and development of professional competencies.

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Toward a more coherent framework for Comprehensive Sexuality Education Policies in Peru

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Abstract. In this article, we argue for a new rationale for Comprehensive Sexuality Education (CSE) Curriculum that is more useful and less biased than the ones used in the Curriculum CSE Curricular Guidelines (CSECG). To provide both clarity and justification for the sexuality curriculum, we contend that a framework based on the idea that sex, gender, and relationships are identity spectrums. In contrast, we argue that the SGR identity spectrum framework does offer a coherent curriculum approach for the CSE curriculum. The current CSECG includes inconsistent definitions of sexuality and gender, that uphold and imposes a set of norms upon identities present in schools like heteronormativity, compulsory sexuality, amatonormativity, compulsory monogamy, and compulsory parenthood.

Keywords: Comprehensive Sexuality Education, Peruvian Curricular Guidelines, Identity Spectrums, Anti-Bias

1 Comprehensive Sexuality Education Policies

Latin America has initiated an accelerated process of incorporating sex education in its educational systems. This process is reflected in the number of public policies and specific programs that have emerged throughout the region. The United Nations Organization (UN) and two of its specialized agencies promoted these policies the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Population Fund (UNFPA). The main role of these organizations was to put on the political agenda the need for sexuality education as a general guideline for compulsory basic education and to outline the curricular guidelines for the region.

Comprehensive Sexuality Education (CSE) is a framework developed by UN, UNESCO, and UNFPA that promotes a curriculum-based process of teaching and

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learning about gender and sexuality. They define "CSE as a [human] rights-based and gender-focused approach to sexuality education, whether in school or out of school. CSE is curriculum-based education that aims to equip children and young people with the knowledge, skills, attitudes, and values that will enable them to develop a positive view of their sexuality, in the context of their emotional and social development. By embracing a holistic vision of sexuality and sexual behavior, which goes beyond a focus on prevention of pregnancy and sexually transmitted infections (STIs), CSE enables children and young people to i) Acquire accurate information about human sexuality, sexual and reproductive health, and human rights [...] ii) Explore and nurture positive values and attitudes towards their sexual and reproductive health, and develop self-esteem, respect for human rights and gender equality [...] ii) Develop life skills that encourage critical thinking.[...]"[1]

In Peru there is no national regulation with the status of an Act that supports a sex education program from an integral approach (or Comprehensive Sex Education - CSE) [2]. In 2008, the Ministry of Education promulgated guidelines for CSE in primary and secondary schools [3], but their implementation has been weak due to a lack of political will, reflected in poor teacher training and the absence of evaluation systems[2].

2 The Comprehensive Sexuality Education Curriculum Guidelines

In 2008 the CSE Curricular Guidelines (CSECG) were created by the Ministerio de Educación de Perú (MINEDU) [3]. These guidelines represent the first level of curricular development concerning Comprehensive Sex Education, as they set out basic educational aims and contents to be incorporated into all levels, modalities, and disciplines of the Peruvian educational system. The implementation has been very weak due to lack of political will. This is reflected in the lack of training for teachers and the absence of implementation of evaluation and monitoring systems to ensure quality CSE. Since the approval of the CSE Guidelines until the end of 2016, the issue was little present in the public debate. After the approval of the new curriculum in 2016, sectors of the Evangelical and Catholic Churches strongly questioned the proposal of CSE as a public policy and the use of the gender approach in the curriculum. Until the closing of this report, however, MINEDU successfully defended its presence in the new curriculum.

3 Sex, Gender and Relational identity spectrum as a framework for policy innovation

In contrast to the CSECG framework of sexuality and gender, here we argue to consider human sex, gender, and relational spectrum analysis because it offers an overarching view of people's identities. The spectrum concept arises from feminist and

LGTTTBQIA+ activists and/or scholars. This perspective argues that a better way to understand sex, gender, and relational identities is to recognize the norms that discipline our identities. Some of them are cisnorm, heteronormativity, compulsory sexuality, amatonormativity, compulsory monogamy, and compulsory parenthood[4–11].

Even though CSECG is being incorporated into classrooms, it generates exclusion and invisibility through the discourse that is being used, for example, it makes Trans, nonbinary (enby), asexual (ace), and aromantic (aro) people invisible. Bearing this in mind, we present here a framework that broadens and is respectful in naming different types of possible identities and experiences. This requires addressing gender and sexuality from a socio-cultural perspective, and we start by moving away from the cis-heteronormative view presented in the guidelines.

To take into account all possible identities and experiences, we must explicitly name the different forms of diversity possible in a person. Therefore, we choose to name and differentiate each of the possible variants that a person's identity may have, we denominate these communities as “Sex, Gender, and Relationship Identity Spectrum (SGRIS) Variant People". This term is often used in spaces of sexual and gender activism as it is more encompassing of all possible identities and being more inclusive than the LGTTTBQIA+ acronym. Some of these terms have begun to permeate the academy thanks to feminist and/or SGRIS scholars like ourselves. We specify each of these variants below:

- Biological sex. Biological sex is a complex category where the combination of three sexual characteristics are combined: genetics, gametes, the morphology of primary sexual characters, the morphology of secondary sexual characteristics. This type of classification allows for the incorporation of intersex people, who move away from the known sex binary. Sex is a cultural construction and the assignment of sex at birth is also cultural rather than biological and is based on the type of genitalia present at birth. People who have other types of genitalia at birth suffer from various types of medical violence and forced gender assignment.
- Gender. “Gender refers to sociocultural attitudes and behaviors that shape behaviors, products, technologies, environments, and knowledge”. i) gender identity: cis, Trans, transvestites, non-binaries, fluid gender, queer gender, agender, demigender, and non-conforming gender and ii) gender expression.
- Relationships:
    - Romantic. Romanticism can be divided into: (i) romantic intensity spectrum: alloromantic, demiromantic, greyromantic, aromatic, etc. In addition (ii) attraction according to gender: Heteroromantic, Homoromantic, Biromantic, Panromantic, Omniromantic, etc.
    - Sexual. Sexuality can be divided: (i) the intensity of sexual attraction: people are sexually attracted to others with different intensities from the normative allosexual to the asexual spectrum (demisexual, grey, asexual, etc.) and (ii) sexual attraction to different genders: gay, lesbian, bisexual, pansexual, omnisexual, etc.
    - Partnership. Depending on the exclusivity of love and sexual relationships

        - Type of Partnership: friendship, significant other, boyfriend, girlfriend, husband, wife, cohabitant, concubine, squish, alterous friend, queerplatonic friends, life partner, etc.
        - Sexual Partnerships: Casual Monogamy, Non-monogamy, Mutual monogamy, Polygamy, Polygyny, Polyandry, etc.
        - Romantic Partnerships: monoamory, polyamory, polyfidelity, queerplatonic, alterous relationships, etc.
    - Kinship:
        - Types of Families: consanguinity families, affinity families, marriage families, concubine families, co residence/shared consumption families, family-type relationships (for single persons), matrifocal families, conjugal families, avuncular families, extended families, non-binary families, etc.

4 Using the Sex, Gender and Relationship Identity Spectrum framework for the analysis of CSECG

Drawing on the SGR identity framework, we now seek to show how referring only to sexuality and gender, without naming any other possible variants outside the binaries, the CSECG contributes to upholding the cisnorm, heteronormativity, compulsory sexuality, amatonormativity, compulsory monogamy, and compulsory parenthood. To this end, the SGRIS concepts were identified from the CSECG documents. These documents were searched for the specific use of words that might be associated with each identity variant.

Sex Variants: terms like “intersex”, “intersexual”, “sexual character/s” were not used in the guidelines. Sex is not defined, and when used its referred in a binary way. Terms like “diferencias sexuales” (sexual differences) and “identidad sexual” (sexual identity), “sexo opuesto” (opposite sex) are used.

Gender: Gender is not defined in the documents. Different terms related to gender are present: “género” (gender), “identidad de género” (gender identity), “estereotipos de género” (gender stereotypes), “equidad de género” (gender equity), “ambos géneros” (both genders), “roles de género” (gender roles) as terms related to gender. Even though the guidelines claim to be gender inclusive, gender is always referred to in binary terms and binary gendered nouns are used throughout the document (for example, “Los niños y las niñas” -boys and girls-).

Sexuality: sexuality is not defined in the documents. It only mentions “Relaciones sexual/es” (sexual relationships), other types of sexuality identities are missing. The only term found to relate to non-heterosexual “identidad sexual” but it does not define it.

Romantic: only “amor” (romantic love) and “enamoramiento” (in love) are found. In all cases, the relationship is a romantic one and it is assumed to be between cis heterosexual people: “enamorado” (a boy in love) y “enamorada” (a girl in love). Partnership: “Amistad” (friendship), “amigo” (a friend that is a boy), “amiga” (a friend that is a girl).

Kinship: terms like “familia” “paternidad” “maternidad”, only nuclear family terms were found. Only women are capable of pregnancy and terms like “male pregnancy” or “person capable of pregnancy”.

5 Summary and Conclusion

Our intention in this article has been that the framework of identity spectrums offers a clear and coherent conceptual model for the sex, gender, and relationship identities spectrums (SGRIS) for all people in a society. Policy and standards documents should provide the educational field with a common conceptualization that explicitly elaborates on all aspects of SGRIS, something which the CSECG fails to achieve. In contrast to using only sexuality and gender as the central concepts, the SGRIS identity framework is grounded in activism and scholarship and is being used by communities that identify themselves in these ways providing a coherent approach. As such, they provide a more coherent model for the CSE curriculum for compulsory education in Latin America. Moreover, the SGRIS framework allows us to identify the prevailing identity norms in CSECG documents. Nevertheless, there are interstices in every policy [12] that can be used to expand a more coherent understanding of the nature of sex, gender, and relationship identities. This work can be useful for education authorities worldwide and especially from Latin America who want to adopt a more inclusive framework for their policies.

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Learning from students. Uses of non-formal digital spaces in distance higher education

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Abstract. Self-managed learning through non-formal uses of social networks and virtual spaces by university students is a fact of life today. Recognising this and assessing its possibilities is the starting point for this research, which aims to obtain keys that will facilitate the adaptation of our teaching to current scenarios. To this end, we have carried out this research in two successive phases: the first, based on the information gathered in an extensive questionnaire, offers a general description of the uses that students make of virtual spaces, both institutional and non-formal; in the second, we work with focus groups to deepen the experience of communication and learning in these spaces. The results offer guidelines for the improvement of our teaching platforms by indicating key aspects of the substance and form of the interactions, as well as technological considerations.

Keywords: self-managed learning, social networks, university teaching.

1 Introduction

Distance higher education has incorporated successive methodological and structural changes as technological innovations have appeared that can be used as pedagogical and communicative resources. Thus, the appearance of the Internet has already meant a significant turn towards digital connectivity, and the rapid and incessant increase in the possibilities offered by the Network continues to pose a challenge to distance universities in order to ensure their institutional sustainability in the medium and long term in such a changing and uncertain scenario [1].

In this sense, the emergence of COVID19 and its consequences in the education systems has accelerated this link between education and the Internet, increasing dependence on virtual connectivity and, therefore, providing an almost forced opportunity to rethink and recalibrate the multiple nuances inserted in this new situation of almost generalised blended learning [2]. Taking this into account, in the framework of distance higher education -which is our field of study- it will be necessary to make an extra effort to offer communication possibilities between the different educational agents, trying to incorporate among the institutional virtual resources the necessary improvements to

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facilitate dynamic, accessible and efficient interactive processes, which can also facilitate teaching.

The way in which the Internet has been incorporated globally into many people's daily lives suggests new links between distance education methods -and not only that- and online tools such as virtual social networks, among others, without ceasing to present complexities to be considered [3]. Some studies have shown how the integration of the use of virtual social networks in well-defined instructional designs can improve the students' experience during the course, especially in terms of social presence [4]; this being one of the dimensions to be improved in distance higher education, as we have observed in previous studies by our teaching innovation group [5].

Other studies have also provided evidence of the positive influence on learning of the use of instant messaging in dialogic tasks such as journaling, dialogic, transmissive, constructionist with peer feedback, helpline and assessment [6]. Furthermore, in tasks related to the debate within the framework of subjects, we have clues that while the use of the usual forums of institutional platforms may lead to communications that are more directed towards the construction of knowledge, the use of mobile instant messaging applications may lead to greater social interactions [7], although they also present certain limitations to be taken into account in communication between peers for educational purposes [8]. On the other hand, the characteristics of this type of instant messaging can also contribute to improve communication between teachers and students, modifying certain traditional practices and forms of relationship [9].

With all this we wanted to briefly explain the need to explore new forms of communication and educational use of digital tools and spaces in distance higher education in order to adapt teaching to current scenarios. This is the basic premise on which this study is based. As we shall see, a questionnaire was applied and five triangular focus groups were developed with students from the UNED (National University of Distance Education) to find out the reasons why they use other non-formal virtual platforms in the context of organising their learning in Bachelor's and Master's courses, thus trying to understand what benefits their use could bring to official virtual spaces to improve the teaching-learning processes at the distance university; understanding, furthermore, that the current context of blended and virtualized teaching due to COVID19 may also make this subject interesting for higher education institutions as a whole.

2 Context

UNED is a public semi-attendance university that combines virtual learning scenarios (videoconferences, forums, chats, teaching material in various formats, continuous

assessment activities...) with optional face-to-face learning moments (weekly or fortnightly tutorials for reinforcement in Associated Centres -spaces linked to UNED where tests and tutorials are carried out- throughout Spain and abroad) and other compulsory moments (external practices and exams, although this has been temporarily modified within the framework of COVID19). In this context, the UNED has the aLF platform as its main virtual e-Learning space designed to create and develop training courses and other pedagogical research projects. Although it has been developed specifically for UNED teaching staff and students.

The work presented here arises from a teaching innovation project on learning practices in open digital spaces and their impact on teaching at the UNED. The project has been developed from "*CO-Lab UNED. Open and collaborative laboratory for teaching innovation*" and financed by the Vice-rectorate for Digitalisation and Innovation of the University Institute for Distance Education (IUED) in the call for teaching innovation projects for the 2019/2020 academic year.

The reason for the study starts from a basic question: where are the students? This question responds to an observation shared in conversations between UNED teachers about the marked absence of students in the university's official virtual spaces (aLF platform). This situation is highlighted in the answers to the questionnaire applied in the framework of this research, as we will see later. Consequently, the objective is to find out where students are, what other non-official virtual spaces they mainly use, how and for what purpose in terms of self-organising the learning required in the Bachelor's and Master's subjects. The aim of finding out about these motivations, as well as the practices that take place in these informal spaces, is to be able to incorporate a series of improvements in the teaching practice at the UNED in order to offer more satisfactory educational scenarios, based on discussion with other researchers along similar lines [10,11].

This pedagogical adaptation of the official platforms and teaching methodologies is conceived, in any case, as an end in itself, independently of the decision corresponding to each student on the type of space in which to be most present; in other words, we do not intend for students to stop using non-formal virtual resources for their educational achievements, but rather to be able to incorporate some of the most valued characteristics of their use into the official learning spaces of the UNED.

3 Methodology

The research was carried out in two complementary phases: the first, extensive, aimed at establishing a exploratory map of the uses that students make of virtual spaces, both institutional and non-formal; the second phase looked in depth at the communication

and learning experience in these spaces. For the information gathering, a questionnaire composed of 31 items was initially used, where the informants indicated on a Likert type scale (1-5) the level of use of the different virtual spaces and what functionality they had for the study. In the next phase, small-scale discussion groups were proposed; this format is suitable for online development because it facilitates the participation of all components.

The questionnaire, which was applied online, has been completed by students of Bachelor's and Master's degrees in the Faculties of Education, Philology and Philosophy. It was disseminated through the communication tools of the official teaching platforms and through the mediation of student representatives, who reported on the questionnaire in non-official virtual spaces. The time frame for accessing the questionnaire was established between 12 June and 15 July 2018 and, in the end, 320 responses were collected, which allows us to justify their sufficiency in relation to the total number of students in these studies, accepting equality of variance, an estimation error of 5.3 and a confidence level of 95%. The unofficial virtual spaces asked about in the questionnaire were Facebook, WhatsApp, Twitter and YouTube.

The focus groups were developed based on a flexible script that allowed teaching to be rethought in terms of the role played by unofficial virtual spaces in students' learning processes. There were 5 focus groups, combining students from different studies, different academic courses and different degrees of participation in the official spaces: 1) 1st and 2nd year students who regularly attend the Associate Centre; 2) 1st and 2nd year students who do not regularly attend the Associate Centre; 3) Final year students, doing the Final Degree Project; 4) Master's students; 5) student representatives. A total of 17 students and 5 facilitators participated. The thematic analysis of the information has been supported by Atlas.ti, following a mixed categorisation process. The initially agreed categories (motivation, teaching aspects, cognitive aspects and social aspects) enabled the 4 participating analysts to organise their work.

4 Results

Firstly, results are shown on the use that UNED students make of unofficial virtual spaces during the course (Fig. 1.). The use of these networks is self-managed by the students themselves without the participation of the teaching staff.

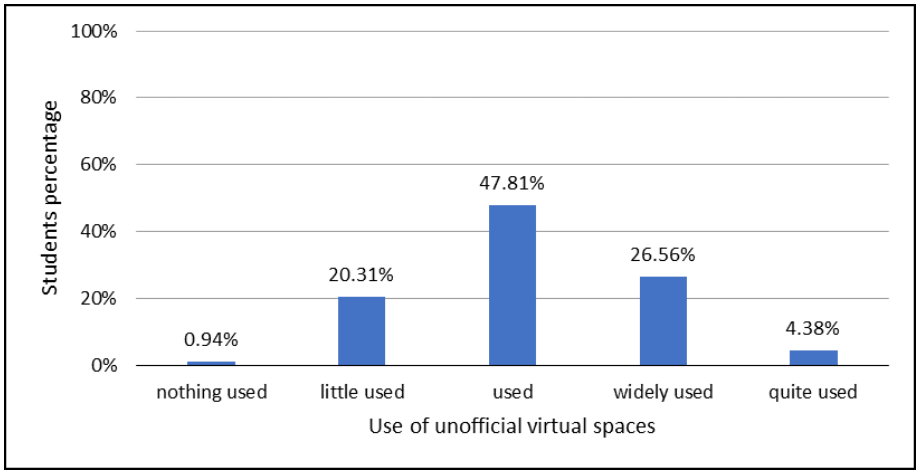


Fig. 1. Percentage of use of unofficial virtual spaces during the course.

Almost 80% (47.81, 26.56, 4.38) of students normally use these spaces to study at the UNED. According to the results, the most used is Whatsapp (66.3%), followed by Facebook (49.1%), and the least used is Twitter (9.4%).

About the purpose of the use that students make of the non-formal virtual spaces, we can see (Fig. 2 and 3)) that the vast majority use these spaces mainly as a means of communication and transmission of knowledge among classmates.

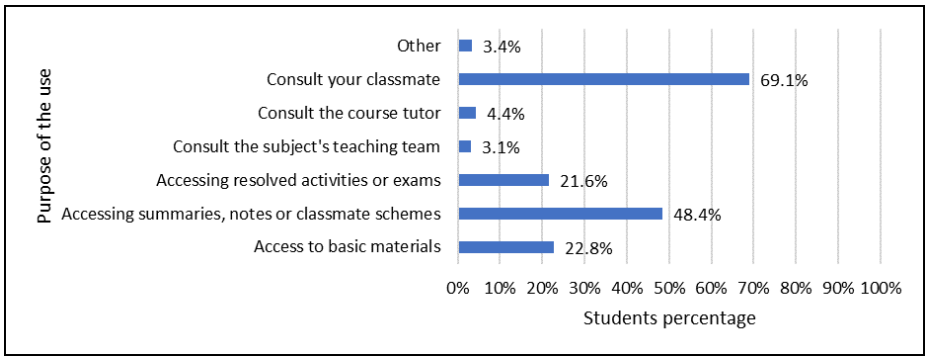


Fig. 2. Purpose of the use of the unofficial WhatsApp virtual space .

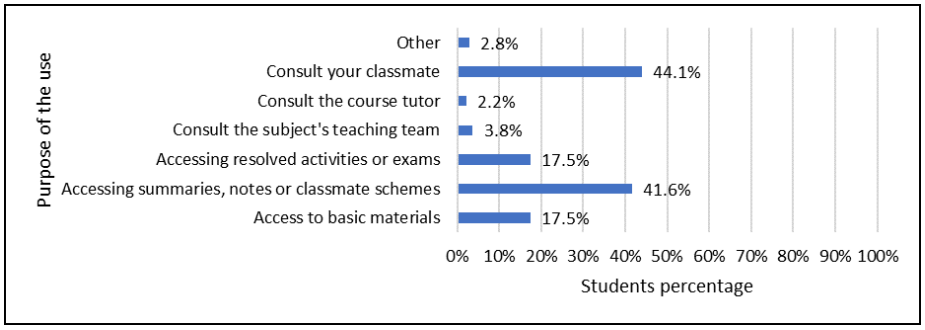


Fig. 3. Purpose of the use of the unofficial Facebook virtual space

These results show that communication and knowledge transmission between peers takes place in unofficial virtual spaces. Moreover, there is a small part of the students (approximately 20%) who use the non-official spaces to access basic materials of the subjects and exams and activities already solved, so, apart from the need for communication between peers, they also find in these spaces the possibility of sharing different resources and materials.

The analysis of the responses of focus groups reveals the contribution of the Social Networks and non-formal virtual spaces as facilitators of fundamental learning of the subjects. Among others, mainly Whatsapp and Facebook offer the opportunity to create and join groups of students who share studies. When investigating the valued aspects of these networks that support their use in front of/alongside official platforms, we found reasons related to content and form of communication.

These non-formal spaces are used for the purpose of *sharing resources and materials*, offering the possibility of finding almost all the information needed for the study and implementation of practical and evaluative activities:

> 5:46 the fact that you don't know well what the guidelines are for doing a job, that a colleague says to you: "oh look, if you want I'll give you mine so that you can see how it's done or how I've done it, or look they've given me a job from last year you can get an idea" [...], I've often done a job that I thought had to be done in a certain way and then I've seen the work of my colleagues and I've said: "...they're much better off", then I've taken mine, erased it and started again. That in the end makes you better, it makes you end up with a better grade

In addition to these materials and resources, the possibility of *raising questions and sharing answers* reinforces the use of these networks as learning spaces and, at the same time, fosters a sense of *fellowship*, including moral support.

> 1:150 a question from a PEC [practice of continuous evaluation], I don't know how to approach it, you put it in and it helps you a lot. It seems to me that UNED, if there is one thing I am getting out of it that is positive, above all, for me, it is fellowship.

Regarding the form that communication takes, three essential features are highlighted: *the immediacy of responses, closeness and spontaneity of expression.*

> 1:153 On social networks you ask a question and it is answered immediately, you get a notice on Facebook that such a person has answered you, it is much faster.

> 5:38 I think there are two aspects, one of having instant information and, two, having information without being moderated by the teacher, because it's true that sometimes there are people who are more shy and don't dare or you think that maybe asking a slightly silly question like that, between quotes, is going to influence the teacher to look at you differently and not evaluate you the same way.

> 1:151 It's like writing a letter [referring to official platforms] or talking [referring to non-official spaces].

In this way, social networks are valued as scenarios of freedom, forming an alternative to the hierarchical organisation that characterises official spaces:

> 5:37 …and thinking about an alternative, it occurs to me that if there were a group moderated by the teacher, then it would be easier for all the students to be in that group, but I think that even so, the rest of the students would look for another way where the teacher is not, without moderating (they laugh). So, I think it's something universal.

The feeling of comfort comes from the use of these networks; they are configured as a safer and friendlier space where relationships between "acquaintances" are interwoven against the anonymity of the official platforms:

> 1:169 [in] Facebook is a person, however... aLF is very... I sometimes look at it, if someone says a comment very out of place, I look at it to understand where the comment comes from

In addition to these questions of content and form of communication, technological aspects are also relevant in the choice of networks versus official platforms, which are often considered obsolete, complexly organised and not very intuitive.

> 1:155 the forums are not functional; it is not easy to search for things because even the search tool does not work.

The communication articulated in forums is static in front of the dynamism of the networks. Although its use is extensive for the reasons we have explained, it is also

interesting to note certain risks and limitations that students identify: over-saturation and the possibility of finding incorrect information:

> 2:77 ...a teacher told us the other day that she had found some nonsense in an exam and it was because someone had put it in some notes. We all studied with the same notes, sometimes there are people who don't even look at their books.
>
> 2:37 Awful. I am in three groups of Whatsapp of statistics, all three are full, 257 people in each […], they don't even read the three messages above. You answer one question and after ten minutes they answer the same thing again.

5 Discussion

The use of non-formal virtual spaces by UNED students seems to be fulfilling various functions, as we have seen in the previous section. Our initial question (where are the students), which emerged when we did not find the expected activity on the official virtual platform, is answered by the contributions to the questionnaire and the focus groups: they are self-organising their learning in virtual social networks, such as Facebook, and instant messaging applications, such as Whatsapp. This self-organisation of learning involves the use of these other spaces, which are mainly focused on consulting colleagues and exchanging materials, coinciding with similar research [11].

In addition, it seems that the lack of a social dimension in the official UNED courses [5] is compensated for by the creation of and participation in spaces where the feeling of "companionship" and "belonging" is reinforced by increasing the number of social interactions and doing so in a more fluid, close and relaxed tone, coinciding with other researchs on the instructional incorporation of Facebook [4] and on the educational use of instant messaging applications [6 and 7]. Moreover, immediacy, intuitive use and dynamism are characteristics of these non-formal spaces that we should consider to make the teaching-learning processes in university teaching more flexible [10].

On the other hand, the absence of teachers generates a more relaxed communicative use of these spaces, although sometimes they end up becoming -especially in the case of instant messaging applications- overloaded exchanges in which the same questions and answers are constantly repeated, presenting limitations that could be solved -for example- with student moderation, thus also mitigating other communicative problems that seem to occur in extensive and complex conversations, linked to collaborative tasks, through Whatsapp and similar [8].

6 Conclusions and recommendations

The results of this exploratory research on non-formal virtual spaces used by students at UNED, and their reasons for doing so, invite us to reflect on a series of aspects to take into account to improve teaching-learning processes in contexts of distance higher education. Results and reflections have been communicated to the Vice-rectorate for Digitalisation and Innovation as a starting point for redesigning policies and guidelines that can improve our teaching practice in the current context.

Among other issues, it will be important to recognize the potential of learning that occurred in non-formal virtual spaces and, in addition, to assess the introduction of some of its characteristics into official didactic models. We are not talking about necessarily incorporating the use of virtual social networks to teaching, but about partially replicating the advantages of these tools for distance education. To do this, it will be useful to ask how to generate more accessible and intuitive and dynamic virtual platforms, compatible with various devices (not just computers) to facilitate their use at different times and scenarios of the students' daily lives. It will also be interesting that students can create profiles in which they will include the information they consider offering, as occurs in certain social networks.

Furthermore, it could be important to make an effort to avoid the image of a “chat box” teacher, betting on more fluid and close styles that generate the confidence and climate necessary for interactions and pedagogical debates to emerge with fewer corsets (certain unnecessary formalities inherited from the academic authority) in official spaces. In this sense, it may also be useful to diversify the communication channels and formats as much as possible by combining text and audio-visual interaction.

On the other hand, since it is not our objective that students stop using non-formal virtual spaces, and taking into account that *there* they continue to encounter certain conditions that we cannot incorporate into institutional virtual platforms (e.g., absence of teachers in the chats), we consider that it will be appropriate to offer some guidance from the teaching teams to the students to prevent some of the problems and limitations that seem to occur in instant messaging applications and social networks. Among others: Incorporating the figure of the mediator in unofficial spaces to avoid oversaturation of messages; Clearly report what plagiarism is and what it means academically; The need to contrast the notes of other colleagues with the book or material provided from the tutorials, or even choose to collectively prepare notes.

Non-formal virtual spaces have clearly made the self-management capacity of students visible in the teaching-learning process. Recognizing the interest of learning in non-formal contexts and incorporating the voice of the student in the design of the subjects

makes it easier for us to rethink the teaching methodology beyond the limits of academic praxis in higher education.

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The concept of competence in higher education university teachers: case study

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Abstract. Competence based models (CBM) in university higher education have been in use for at least two decades in Peru. The efforts for implementation are enormous. Despite this, teachers and academic authorities do not necessarily have a conception of competence that is articulated with the most innovative trends on these approaches. This paper is the result of a research carried out as part of the thesis for the Doctorate in Education Sciences at the Pontificia Universidad Católica del Perú; its purpose is to give an account of the conceptions of competence that teachers of two private universities in Peru have, in which a CBM has been implemented. It has been worked with a qualitative approach and a case study. The results allow us to affirm that teachers and academic authorities have very different conceptions about the notion of competence and that this can become an obstacle for the implementation of CBM.

Keywords: competence, higher education, competence based models, teachers

1 Introduction

Competence based models (CBM) in higher education have their origin in a field other than education, their sources are rather in the field of work [1]. Due to this, many academics have expressed and continue to express their mistrust regarding its real usefulness for the training of university professionals. In Peru, its relevance or incorporation into university educational models began to be discussed in the mid-1990s, in the context of the appearance of a large number of new private universities, as a result of the law for investment in education. Due to this law, in Peru the number of universities went from 51 in 1990 to 143 in 2018, 92 of which are private. [2] [3]

Since then, many universities in the country have begun to declare a set of general and specific competences as part of their training offer responding to different types of demands: demands of the business world, massification of higher education, need for greater curricular coordination, demands and expansion of accreditation systems, demands for a more comprehensive and interdisciplinary training and demands of the knowledge society. [4] Competences are usually found on institutional web pages and also in institutional documents of universities, such as their educational models or their strategic plans.

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General competences are those that are needed in the exercise of any discipline or career (verbal and written communication, analytical and systemic thinking, problem solving, creativity and others). The specific competences are related to the practices and knowledge of a certain discipline. [5] [6]

In this context, the universities have deployed a series of actions and have invested an important set of resources to design their study plans aimed at developing these competences. Actions include, for example, the creation of support bodies for programs and teachers to train them in skills-oriented training, hiring expert consultants, creating resources and materials, adapting work spaces in classrooms, among others. In addition to this, processes of evaluation and measurement of competences have been generated, both in students and graduates.

The main responsible for completing the processes of implementation of competence-oriented curricular designs are the academic authorities and teachers. Academic authorities must lead the process in their programs to give guidelines to teachers. Teachers, for their part, are the ones who must take the proposal to the classroom and to the teaching and learning processes in a concrete way, through instructional designs specially conceived to develop and evaluate competences.

However, these actors have not necessarily incorporated, adapted or adopted a concept of competence that is aligned with the proposal of their institutions or with the most innovative trends on the subject. This is not free because the very concept of competence is complex and requires an intense work of analysis and socialization.

1.1 Competence based models (CBM)

As has been pointed out, the very concept of competence entails difficulties and is not exempt from criticism, but these criticisms not only point to the concept of competence but also to CBMs. As Díaz Barriga affirms, many institutions have implemented CBMs (that is, an educational model aimed at developing competences) driven by various motivations, but some questions remain: Has the change really been achieved? Have teachers incorporated the approach? Have pedagogical and evaluation practices really been transformed? Among others [7]. In addition to this, some critics suggest that CBM has a simplistic or reductionist nature, as stated by González, Herrera and Zurita: "Los opositores visualizan el movimiento hacia sistemas basados en competencias, especialmente en áreas de formación general, como reduccionista y prescriptivo." [8, p. 21][1]

In addition to this, some other criticisms of the CBM focus on an approach to training oriented on disciplinary and specialized knowledge that should be privileged, as stated by Corvalán: "En general, las resistencias a nivel universitario vienen de la tradición positivista, racionalista y disciplinaria imperante que cristaliza en una enseñanza que refleja la segmentación del conocimiento y la especialización en solo una parte del

[1] Opponents view the movement toward competency-based systems, especially in general training areas, as reductionist and prescriptive. (Author´s translation)

mismo." [9, p. 26][2]. This idea would imply that for some academics the transmission of specialized, objective knowledge is more important.

Another criticism that is often raised against CBMs is that they have a strong dependence on the demands of the workplace, rather than on a need for comprehensive training. This is what Villarroel and Bruna suggest, when they argue that CBMs are questioned because they would be subordinate to profitability, market demands and short-term social policies [1]. On the other hand, there are also criticisms of CBM from methodological perspectives, as suggested by McNeil, Scicluna, Boyle, Grimm, Gibson and Jones, since there would be the opinion that competences as a concept do not have real credibility or practical value for curriculum design in universities. The reason for this would be that the contextual specificity of disciplines or fields of practice means that capacities can only be developed within these specific contexts and that this cannot be achieved within the educational sphere of the university itself, but outside of it. [10]

In addition to the different critical perspectives on CBMs, the very notion of competence also faces questions. As LeBoterf points out, the concept is a problem because it is a term in common use that does not cause problems in everyday language, but it is problematic that it has a special meaning in the educational field [11]. And indeed, the term competence is not an exclusive technical term of educational terminology.

On the other hand, various authors affirm that there is not yet a theory about competences that can be used for curricular purposes, which is alarming when considering that the current reforms are already underway [12], that the concept of competences is not free from more or less well-founded debates and controversies, that there is no scientific conceptualization of the notion of competence and there is no consensual theory [13] or that there are different perspectives on the notion of competence itself [14].

Some of the criticisms about the concept of competence focus on the fact that the concept is used confusing it with others: as a procedure or sequence of actions; as a resource for another competence; competence so defined that it includes several families of situations [15]. Another aspect that is questioned, according to Cuba Esquivel, is the translation from English of two terms that are different: competence (specific competence) and competency (generic competence) [16].

1.2 The concept of competence

To frame the evolution of the concept of competence, it is relevant to take into consideration what De Ketele raised, regarding the changes in pedagogical proposals in higher education and what he calls the great movements in relation to how knowledge should be understood. The first movement considers that knowledge consists of mastering classical texts; this first movement would be found in antiquity, the Middle Ages and the Renaissance, times in which the intellectual was the one who had control of the founding texts of civilization. In the second movement, it is understood that

[2] In general, resistance at the university level comes from the prevailing positivist, rationalist and disciplinary tradition that crystallizes in teaching that reflects the segmentation of knowledge and specialization in only part of it. (Author´s translation)

knowing is assimilating the results of scientific and technological discoveries; this movement coincides in its beginnings with the emergence of modern science and with the development of the specialization of the sciences, it can be located until the second half of the 20th century. In the third movement, we start from the idea that knowing is to demonstrate mastery of objectives translated into observable behaviors; this coincides with the implantation of Taylorism (efficient mass manufacturing) and behaviorism, both inspired education through the well-known goal-based pedagogy. In the fourth movement, it is assumed that knowing is demonstrating competence, it coincides with great economic and social changes; this can be located from the seventies in the twentieth century. It is precisely in this last movement that the appearance of the concept of competence can be located [17].

However, the first notions of competence were still closely linked to goal-based pedagogy and behaviorism. But, as Corvalán affirms: "A nivel procedimental, la antigua competencia enfatizaba la ejecución de operaciones y tareas, mientras que hoy se demanda poner en funcionamiento acciones y reaccionar prontamente a los eventos no previstos." [9, p. 17][3]

Considering what is proposed by this author, in the current context, in which an attempt has been made to overcome the initial criticisms of the notion of competence and the CBM, the conceptualization of competence must be located beyond behaviorism and goal-based pedagogy to be in socio-constructivism. For his part, Gonzci, as early as 1994, considered that in a third stage or focus on competences, the aim is to combine the general attributes approach with the context in which these attributes will be used. This approach analyzes the complex combinations of attributes (knowledge, attitudes, values and skills) that are used to understand and function within the particular situation in which professionals find themselves [18].

One of the great psychological theories that dominated research during the first half of the 20th century is behaviorism, which led to goal-based pedagogy. But with the decline of behaviorism, cognocitivist theories appear, which implied a change in the conception of learning. This, according to Cognitive Psychology, does not refer to behavioral responses, but rather to what students know and how they acquire it. The cognitive revolution first enlisted neobehaviorists, who posited a role for the mind, but relegated it to the "black box" state because they could not understand it. The revolution concluded not only by recognizing the mind, but also by studying its functions and processes. The mind is the agent of learning, so it is appropriate and necessary to study it from a mentalistic perspective, according to cognitive theorists. Unlike behaviorists, who were only concerned with what students do, cognitive psychologists are interested in what students know and how they come to acquire that knowledge [19].

There are, however, limitations in this perspective. As Jonassen affirms, cognitivism remains within the mind-body duality, as long as it is assumed that the role of mental activities is to represent the real world. But contemporary theorists wonder if the mind is really just a real-world reference tool or if the mind produces its own conception of events or objects that is based on individual conceptions of reality [19]. In the context of the shift from an objectivist conception of knowledge and learning towards a

[3] At a procedural level, the old competence concept emphasized the execution of operations and tasks, while today it is required to put actions into operation and react promptly to unforeseen events. (Author´s translation)

perspective that does consider mental processes as fundamental referents to explain learning, constructivism arises. As a learning theory, it opposes the idea that we learn by simple transmission. It starts from the idea that when we learn we reconstruct knowledge: we do not learn by photocopying what the teacher communicates, but rather we reorganize and, therefore, we reconstruct that knowledge to accommodate it in our own mental structures. From constructivism, didactic implications arise: the teacher is not a transmitter, but must create the situations for which the apprentice builds his knowledge [13].

Vigotsky adds the emphasis on the role of the social world in this construction [15]. This leads to one of the aspects of constructivism, which is precisely socio-constructivism. This is an epistemological paradigm of the elaboration of knowledge. From this perspective, knowledge is placed in context; situations are the source and criterion of knowledge [20].

For Vygotsky, learning must be equated in a certain way to the developmental level of the child. There are at least two evolutionary levels. The first could be called the actual evolutionary level. The other level is the zone of proximal development: the distance between the actual level of development that is determined by the ability to solve a problem independently and the level of potential development that is determined by solving a problem under the guidance of an adult or in collaboration with another more capable partner [21]. Thus, for him, learning would be constituted by reaching the zone of proximal development, which can only be reached by interaction with others.

These ideas are strongly associated with those of situated cognition. Situated cognition is a perspective that emerged in the mid-1980s and that establishes the importance of social activity and context in learning. From this perspective, the teaching process should be oriented to acculturate students through authentic practices: daily, meaningful, relevant in their culture, through processes of social interaction similar to those that take place in real situations [22].

According to what has been said so far, situated cognition would be the most appropriate perspective for the construction of a notion of competence. However, as Corvalán states: "(...) no existe una visión unívoca del enfoque por competencias. Cada autor enfatiza un aspecto, una parte, un componente, un enfoque de enseñanza o un tipo particular de competencia asociada a un determinado nivel de rendimiento esperado de su aplicación." [9, p. 17][4]

Some of the most pertinent definitions are those that consider not only know-how or the set of information, knowledge, skills, attitudes and other components, but those that consider performance and context: "(…) actuación eficaz en situaciones complejas, movilizando recursos internos (saberes, actitudes o destreza) y externos." [23, p. 13][5]; "(…) el buen desempeño en contextos diversos y auténticos basado en la integración y activación de conocimientos, normas, técnicas, procedimientos, habilidades y

[4] There is no univocal vision of the competence approach. Each author emphasizes an aspect, a part, a component, a teaching approach or a particular type of competence associated with a certain level of expected performance of their application. (Author´s translation)

[5] Effective action in complex situations, mobilizing internal resources (knowledge, attitudes or skills) and external. (Author´s translation)

destrezas, actitudes y valores." [24, pp. 23, 24][6]; "(…) poder de actuar eficazmente en una clase de situaciones, movilizando y combinando en tiempo real y de forma pertinente recursos intelectuales y emocionales." [13, p. 57][7].

In short, an adequate conceptualization of competence for the current context, framed in the knowledge society and in the need for training in an interdisciplinary and integrative way, must be situated in a socio-constructivist perspective and from situated cognition, and must imply going beyond the know how to do. Competences, therefore, should be understood as knowing how to act in context, mobilizing diverse resources, both internal and external.

2 Methodology

This article is partly the result of research conducted for the doctorate in Educational Sciences at the Pontificia Universidad Católica del Perú. This research was designed as a qualitative study and a case study. The reason a qualitative approach was chosen is that its purpose is to understand in depth how stakeholders perceive the processes of implementing a CBM. This article reports a small part of the results of that investigation, which covers more aspects than those reported here. The focus of this article is fundamentally to present the way in which the actors of two institutions understand the notion of competence.

The selected cases were two private universities in Peru. The criteria for selecting the cases were as follows: the institution must have received the institutional licensing required by Peruvian law; the institution is already implementing a CBM; the institution has a set of general and specific competences declared in its institutional documents; these declared general competences coincide with the list of competences established by the Latin America Tuning Project; the institutions agree that the study can be carried out and give their authorization.

Each selected case corresponds to an institution with particular characteristics. Case 1 (C1) corresponds to a young university, with less than 30 years of experience, in which the professional careers it offers are mainly applied (Engineering, Health Sciences, Business Sciences, among others). Case 2 (C2) corresponds to a university with a long history, in which the professional careers it offers are more diverse (Engineering, Social Sciences, Humanities, Arts, among others).

The instruments used to collect the information were two: in-depth interviews with the academic authorities of each institution and a questionnaire with closed and open questions to the teachers who agreed to participate in the study. For both types of actors, their acceptance was requested and informed consent was given. The interviews were conducted both in person and online, in both cases they were recorded and then transcribed for later analysis. In case 1, the authorities interviewed were nine; in case 2, it was eight. Likewise, in case 1, the teachers who agreed to answer the questionnaire

[6] Good performance in diverse and authentic contexts based on the integration and activation of knowledge, standards, techniques, procedures, abilities and skills, attitudes and values. (Author´s translation)

[7] Power to act effectively in a class of situations, mobilizing and combining intellectual and emotional resources in real time and in a relevant way. (Author´s translation)

were 103; in case 2, there were 67 teachers who answered the questionnaire. Information was collected between December 2018 and May 2019.

The questionnaire was self-administered through a Google form; the information from the open questions was categorized and organized for the analysis. The information from the closed questions was used to identify referential response percentages, since the purpose is not to make statistical analysis or generalizations, as it is a qualitative study.

3 Results

To find out the perception of academic authorities on how they understand the notion of competence, they were asked directly during the interview how they understand this notion. Some of the responses offered by the actors in the two cases analyzed were those shown in table 1. The responses have been selected based on their similarity to others, so that they represent all the authorities interviewed.

Table 1. Conception of competence in academic authorities

Case 1	Case 2
C1-I2: set of knowledge, abilities, skills and attitudes that a student must develop or demonstrate throughout their career	C2-I10: what they need to do, a theoretical practical relationship
C1-I3: set beyond knowledge (...) ability to do things	C2-I11: what student will be able to do
C1-I6: know how to solve problems in your field	C2-I14: competence must be seen in the student, not in the teacher
C1-I8: the union of doing, knowing, being.	C2-I16: to know how to act in different situations

As can be seen, some of the academic authorities consulted in the two cases analyzed focus their notion of competence on the following aspects: set of knowledge, skills, attitudes; aspects that go beyond purely knowledge; ability to do; solve problems. Only one of the interviewees raises a definition that has important differences with respect to the others and that includes knowing how to act in context or situation.

The teachers consulted, for their part, raised approaches to the notion of competences with more nuances. To collect their perception of the notion of competence, in the questionnaire they were asked a direct question: How would you define being competent? Faced with this question, the answers have been grouped into eight different categories, which are the following: know-how or skill; ability to solve problems; mobilize resources to respond to specific situations or contexts; possess or apply knowledge, skills, attitudes; have a solid training or master knowledge; demonstrate excellent or efficient performance; link theory and practice; others (this category corresponds to different answers from each other). The percentages of

responses offered by the teachers of the two cases analyzed are shown in the following figure.

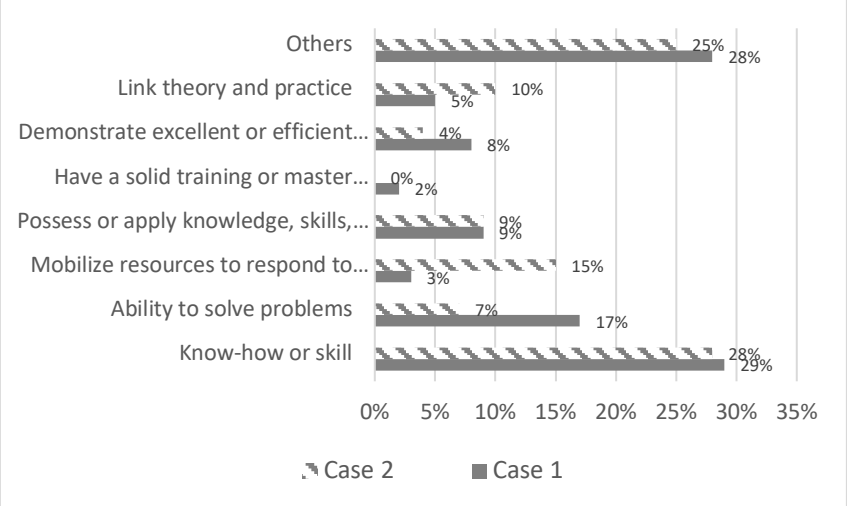


Figure 1. Conception of competence of teachers. Response percentages by category

As can be seen in Fig. 1, in some of the categories the teachers of the two institutions have very similar response percentages. This occurs for the know-how or skill categories; possess or apply knowledge, skills, attitudes; others. For the other categories, the percentages of responses differ by 4%, 5% or more.

It is striking that in the two cases analyzed, the category with the highest percentage of responses is know-how or skill, in addition to the others category, which groups together a diversity of responses. Among these are, for example, adaptability, meeting objectives, responding to results, learning and not memorizing, analyzing information, aptitude, performing according to the employer's expectations, motivation to perform a task, among others.

4 Discussion

From the information presented in the preceding section, it can be seen that the notion of competence of the academic authorities consulted is quite focused on know-how, on the need to go beyond just knowledge, in the set of knowledge, skills and attitudes. Emphasis is placed on practical know-how, which implies application of knowledge. All these approaches to the notion of competence are closely linked to a conception far removed from the socio-constructivist approach or situated cognition. They could even be related to a goal-based pedagogy or to the third movement proposed by De Ketele as it was pointed out in the introduction [17]. Only one of the actors raises a conception that is linked to situated cognition.

In the case of teachers, despite the fact that the conceptions have more variations, it can also be affirmed that in very few cases their approaches are aligned with situated cognition and knowing how to act in context. Only 15% of the teachers in case 2 (22) consider the relevance of the context in the notion of competence and only 3% of teachers in case 1 (3) do so. On the other hand, 28% and 29% consider that being competent consists of knowing how to do or having a developed skill.

Thus, for both academic authorities and teachers, the situated cognition approach or a socio-constructivist approach would not be present in their approaches to the notion of competence, except in very few cases. This could mean that the most recent notion of competence –acting effectively in different situations, mobilizing and combining intellectual and emotional resources [13]– is not rooted in the actors of the two case studies and that their conceptions are rather out of date in most of the actors.

5 Conclusions

From the information presented, it can be inferred that in the two cases analyzed, most of the actors responsible for implementing the CBM would not be handling a notion of competence aligned with the most pertinent conceptualizations to overcome the disadvantages of goal-based pedagogy. Instead, their conceptions of competence would be aligned with a perhaps constructivist conception, insofar as they not only focus on the acquisition or transmission of knowledge, but not socio-constructivist. To a lesser extent they would still have a focus on situated cognition.

Based on this, it is possible that the processes of implementation of the CBM in both institutions are having difficulties to really leave the paradigm of know-how, to move to a paradigm that involves the context and learning in situation.

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The effectiveness of an Executive Functions Program on Reducing Sociolinguistic communicative disorders in Children with Autism

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Abstract. Autism is a common developmental disorder that leads to Sociolinguistic communicative disorders among autistic children. This study aimed to reduce Sociolinguistic communicative disorders in a sample of autistic children by using an executive functions program. The sample consisted of 10 children with autism spectrum disorders whose ages range between 6-9 years, divided into two groups of 5 children each (an experimental group and a control group). For data collection, the researcher utilized the Stanford-Binet intelligence scale 5th edition, the autistic child scale, the Sociolinguistic communicative disorders scale, and the executive functions program (by the researcher). The results of the study revealed that there were differences between the means of degrees ranks of the experimental group before and after applying for the executive functions program in reducing Sociolinguistic communicative disorders in favor of the post-application, there were differences between the means of degrees ranks of two groups after applying for the executive functions program in reducing Sociolinguistic communicative disorders in favor of the experimental group, and there were no differences between the means of degrees ranks of the experimental group in the post and follow-up application in reducing Sociolinguistic communicative disorders. it was concluded that Sociolinguistic communication is a key to reduce many symptoms of autism.

Keywords: Executive Functions, Sociolinguistic Communicative Disorders, Autism Disorder.

1 Introduction

Autism is a pervasive, complex, and a neurological developmental disorder that a child is exposed to by the age of three associated with him throughout his life and negatively affects his developmental aspects [1]. Mainly, it appears in the form of difficulties in interaction and social communication and is accompanied by stereotyped and repetitive behaviors and interests [2]. It may be associated with attention deficit disorder [3]. Different definitions of autism can be found in the literature. DSM-V (2013) defined it as a developmental disorder that affects the children in early childhood before the age of eight with symptoms appear only in two areas, namely social communication disorder and stereotypical repetitive behaviors [4].

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The deficits of children with autism extend to include social communication disorders, which affect social skills, verbal and non-verbal communication skills (for example, eye contact and facial expressions, as well as difficulty making new friends. One of the most prominent symptoms of autism is that the autistic child characterizes by quantitative and qualitative deficits in the social communication process, a tendency towards isolation, and joining others is only under insistence. This child also has a deficiency in verbal and non-verbal communication, difficulty in understanding emotions, insistence on routine, and resistance to any change in the surrounding environment, and he suffers from challenges in language development [5]. Numerous studies agreed upon the correlative relationship between language development and executive functions, especially in meta-representations and syntactic awareness aspects among children with autism [6].

ASD More recently, autism and autistic children have become like the iceberg idea, that we only see the tip of it although the underneath is hidden. In this context, most literature confirmed their social failure, their inability to speak in general, and that they practice stereotyped behaviors and many other things, but we always differ in perspectives when talking about the causes that lead to autism disorder as illustrated by [7] study. [8] defined Sociolinguistic as the communicative verbal language usage and other expressive ways of communication such as non-verbal linguistic modalities as facial expressions in a specific context.

A child with autism spectrum disorder lacks the features of the typical child, and suffers from primary deficits that distinguish him from others as autism affects many different developmental aspects, and thus lead him to withdraw and introversion, as he refuses any external contact and connection with others [9]. Edwards & Crocker demonstrated that this is because this child lacks the ability to communicate and interact with others; as positive social interactions and good communications with others include the ability to understand the emotions and feelings of others and the reactions expected of them in different situations [10]. [11] explained that most autistic children suffer from late verbal communication in one or more aspect, and at least one-third of them will remain with this verbal deficit throughout his life, speaking few or no words. Certainly, such linguistic challenges will affect their life areas negatively as socialization, academies, independent life, and employment.

The deficiency in social skills represents the main problem for children with autism that refers to a lack of verbal and nonverbal communication skills and social understanding. Moreover, children with autism face problems in learning social interactions, in the initiation and in achieving reciprocal social interactions, therefore the researcher's idea of treatment with executive functions will positively affect their skills [12]. Many theories attempt to explain the symptoms and causes of autism. For example, [13] believe that autism is not the result of a single cause, but it is due to a combination of different factors. In general, it is usually challenging and impossible to have a single reason responsible for a specific disorder. One of the well-documented theories in this field is the executive dysfunction theory, which asserts that executive dysfunction can be recognized to underlie many of the fundamental characteristics of autism, whether in the social or non-social domains [14] and which indicates that the complex behavioral manifestations of autism are consequences of weak executive processes [15].

Consequently, executive functioning represents a useful approach to develop social communication skills. Thus, it is necessary to assess executive function skills in young children with autism [16]. The term executive functioning was used for the first time in the mid-twentieth century to describe functions associated with the frontal cortex. The executive functions (EF) refer to a group of high-level cognitive processes, emotional and motivational skills, mediated by the prefrontal cortex of the brain [17]. Besides, they are skills that begin to develop in childhood [16]. Executive functions are functions that affect primary abilities such as memory, attention, and motor skills. For example, a person who has a deficiency in some executive function is unable to find animal names and simple words [18].

Executive functions are considered as a general goal for all adjustment essential skills, goal-oriented behavior, which are necessary skills for success in performing daily life tasks, solving problems, assessing the situation, and adapting to unexpected situations and daily pressures [19]. It also helps the individual in organizing his behavior and controlling his emotions and feelings to complete the task and act flexibly according to the current circumstances in order to achieve the goal. Besides, it makes the individual think about the consequences of his behavior before conducting it [20]. From this standpoint, executive functions consist of a set of skills, including working memory skills, cognitive flexibility, and inhibitory control skill [21].

The executive functions skills that can affect children with autism are defined clearly in literature as follows: Working memory skill refers to the ability to keep the mental representation of information in mind while simultaneously engaging in other mental processes [20]. Cognitive flexibility skill refers to the ability to move smoothly between situations and activities according to the requirements of the situation and the sequence of events [14], [16]. Inhibitory control skill refers to the ability to stop the dominant response in favor of a more adaptive response [21]. Planning skill refers to the ability to anticipate future events for a set of objectives, establish a sequence of task execution steps promptly, and prepare information and reorganize it [14]. Initiation skill refers to the ability to initiate dialogue, participation, interaction, a conversation, the ability to assist, and the ability to initiate a request or ask questions [22]. Response inhibition skill refers to the ability to intentionally prevent and automatically control past responses from interfering with responses to the new situation, and not to interfere in the performance of other unrelated tasks [15].

Therefore, executive functioning is widely used for children with autism. In this regard, previous studies indicated the significant associations between executive functioning, Sociolinguistic communicative disorders, and restrictive and repetitive behaviors among children with autism [15], [23]. The impaired executive function may be one of the hypothesized factors limiting the development of the theory of mind, which causes difficulties in the social functioning of autistic children [24]. In addition, executive function is a better indicator of Sociolinguistic communicative problems in children with autism [25].

2 Methods

2.1 Participants

The sample of the pilot study consisted of 30 children with autism registered in some private centers for treating autism. Parents were contacted individually through special education centers, where their children were diagnosed with autism by licensed professionals, to ensure the psychometric competence of the study tools, and this sample was excluded from the basic study sample.

The basic study sample consisted of 10 children with autism disorder, divided into two groups, an experimental group and a control group of 5 children with autism spectrum disorder for each. The experimental group was exposed to the program and the control group was not exposed to the application.

Table 1. Participant characteristics (N = 10) 5 Control+ 5 Experimental.

	M	SD	Range
Age	7.8	0.894	6.4 -9
IQ	91.9	5.3	85 -100
Sociolinguistic communicative disorders	103.7	12.37	81 -114

The researcher homogenized the characteristics of the two groups in terms of age, intelligence, and Sociolinguistic communicative disorders using the Mann-Whitney Test as shown in table 2.

Table 2. Mann-Whitney Test Results for the Experimental and Control Group.

Pretest	Group	N	Mean Rank	Sum Ranks	U	Z	P
Age	Control	5	5.6	28	12	0.106	0.916
	Experimental	5	5.4	27			
Intelligence	Control	5	5.7	28.5	11.5	0.211	0.833
	Experimental	5	5.4	26.5			
SCD	Control	5	5	25	10	0.530	0.596
	Experimental	5	6	30			

The results of Table 2 indicate that there are no statistically significant differences between the mean scores of the experimental and control groups in age, intelligence, and Sociolinguistic communicative disorders, thereby guaranteeing the homogeneity of the sample.

2.2 Research methodology

This study used the experimental approach of the two-group experimental design (the experimental group and the control group) for its relevance to the characteristics of the study sample "children with autism". In this regard, the researcher utilized the pre and

post-measurement for the experimental and control groups and then the follow-up measurement for the experimental group only.

2.3 Measures

Stanford-Binet Scale 5th Edition (Prepared by [26]): It is used to measure the individual's cognitive abilities and intelligence from the age of two to 85 years old. The well-known use of the Stanford-Binet scale includes the diagnosis of various cases of cognitive delay in young children, mental retardation, learning difficulties, and mental giftedness Sample.

The Autistic Child Scale (Prepared by [27]): This scale consists of 28 items to which the specialist or parents answer with (yes) or (no). These items manifest the symptoms of autism.

Sociolinguistic communicative disorders Scale (Prepared by the Researcher): The scale consists of 39 items, distributed on three sub-dimensions, which are: the social skills disorder 12 items, verbal Language skills disorders 14 items, and Non-verbal Language 13 items, participants have to choose one answer from three alternatives according to Likert's three points scale method always 3 scores, sometimes 2 scores, rarely 1 score. All statements are negative expressions, and thus the children's scores on the scale ranged from 39:117. A higher score on the scale indicates an increased presence of Sociolinguistic communicative disorders in children with autism, and a low score indicates a lower presence of Sociolinguistic communicative disorders for them. the researcher calculated the Alpha Cronbach coefficient that was 0.854 for the social skills disorder dimension, 0.706 for the verbal Language disorders dimension, and 0.784 for the Non-verbal Language, where all values were statistically significant at the 0.01 significance level, thus the scale is reliable. Besides, the researcher verified scale validity through inter-rater validity and internal consistency. Therefore, the scale of Sociolinguistic communicative disorders as a whole has internal validity.

The Executive Functions program for children with autism (prepared by the researcher): The executive functions program relies on brain functions to regulate other functions of the child with autism disorder, and the ability to manage his life activities through a set of higher cognitive processes, emotional and motivational skills that mediate the prefrontal cortex of the brain that aims to direct the child's behavior to achieve the goal and regulate his behavior in order to achieve a great deal of meaningful social communication [19]. The current program aims to Sociolinguistic communicative disorders in children with autism by using an executive function program and monitoring the extent to which individuals participating are retaining training gains after the program ends. The number of sessions consisted of 39 sessions, and the duration of each session was 45 minutes in which a set of techniques was used, including positive reinforcement, role-playing, modeling, prompting, shaping, repetition, organization, and homework.

3 Results

Table 3. The Wilcoxon signed-rank test of the two correlated samples (Pre-test & post-test)

Variables	Scale	N	Mean-R	Sum-R	Z	P
Social Skills Disorder	Negative rank	5	3	15	2.04	0.041**
	Positive rank	0	0	0		
	Equal	0				
Verbal Language	Negative rank	5	3	15	0.03	0.042**
	Positive rank	0	0	0		
	Equal	0				
Non-verbal Lang	Negative rank	5	5	25	0.02	0.043**
	Positive rank	0	0	0		
	Equal	0				

** $p<0.05$.

Results demonstrated that there were statistically significant differences between the pre-post measurement application scores of the experimental group in favor of the post-application in social skills disorder ($z= 2.04$; $p<.05$), verbal Language disorder ($z= 2.03$; $p<.05$), Non-verbal Language ($z= 2.02$; $p<.05$) indicating the strong effect of the program used in the current study in reducing the level of Sociolinguistic communicative disorders among children with autism- the sample under study.

Table 4. The results of the Wilcoxon Signed-Rank test of the two correlated samples (Posttest-3wks after)

Variables	Scale	N	Mean- R	Sum-R	Z	P
Social Skills Disorder	Negative rank	1	1.5	1.5	-0.82	0.414
	Positive rank	2	2.25	4.5		
	Equal	2				
Verbal Language	Negative rank	1	2	2	0.45	0.655
	Positive rank	1	1	1		
	Equal	3				
Non-verbal Lang	Negative rank	1	2.5	2.5	0.27	0.785
	Positive rank	2	1.75	3.5		
	Equal	2				

Besides, results revealed that there are no differences between the experimental group post and follow-up measurement application (after three weeks) in the social skills disorder ($z= -, 816$; $p>0.05$), verbal Language ($z= -, 447$; $p>0.05$), Non-verbal Language ($z= -.272$; $p>0.05$). This indicated the stability of the program's effect for a period of time among children with autism- the sample under study.

Table 5. The results of The Mann-Whitney test of two independent samples (Posttest)

Variables	Scale	N	Mean- R	Sum-R	U	Z	P
Social Skills Disorder	Control	5	8	40	0.00	-2.65	0.008*
	Experimental	5	3	15			
Verbal Language	Control	5	8	40	0.00	-2.63	0.009*
	Experimental	5	3	15			
Non-verbal Language	Control	5	5	40	0.00	-2.64	0.008*
	Experimental	5	3	15			

*p<0.01.

Moreover, results illustrated there were differences between the means of scores of the experimental and control group post measurement in the social skills disorder (z= -, 2.652; p<.01), verbal Language (z= -2.627; p<.01), Non-verbal Language (z= -2.635; p<.01), indicating the stability of the program's effect for a period of time among children with autism- the sample under study.

4 Discussion

The purpose of this study was to investigate the effectiveness of an executive functions program in reducing Sociolinguistic communicative disorders in children with autism. Previous studies have shown that executive functions can be used with children with autism to improve a set of practices or to reduce a group of disorders, especially Sociolinguistic communicative disorders using effective training of executive functions. Numerous studies agreed upon the correlative relationship between language development and executive functions, especially in meta-representations and syntactic awareness aspects among children with autism [6], [13], [28].

Analyzing results revealed that there were differences between the experimental group in the pre and post-scale application in favor of the post-application and that there were statistically significant differences between the experimental and control group in the post-scale application in favor of the experimental group, indicating that the program applied in this study that is based on using the executive functions has contributed significantly to reduce Sociolinguistic communicative disorders among children with autism in the experimental group compared with those in the control group. These results are inconsistent with the results of many previous studies [29-30].

In this regard, previous studies showed that children who suffer from behavioral symptoms have executive functions impairment than their peers because they are unable to direct their behaviors to achieve a specific purpose, and they do not have any initiation to plan, organize, and develop strategies to solve a problem, this was confirmed by many studies as [31]. While there executive functioning is broadly related to ASD, few studies expecting the relationship between executive functioning and autism. In this regard [15] revealed a significant relationship between executive functioning and restricted and repetitive behaviors. Besides, they asserted the relationship between the two variables especially, in the social domain in children and adolescents with and

without ASD. Other researchers concluded that EF dysfunctions are associated with language deficits [32].

In the current study, the program sessions were conducted over a period of 15 weeks. The results indicated that executive functions helped in reducing three main areas of Sociolinguistic communicative disorders (social skills disorder, verbal Language and Non-verbal Language), compared to the control group whose Sociolinguistic communicative disorders remained without a decrease. The researcher attributes these results for different reasons. Firstly, children of the experimental group received effective training on executive function strategies that are characterized by modernity in their approach and application and based on the scientific and methodological basis in reducing communication disorders among people with autism. The effect of this program was evident in the experimental group, and in contrast, the control group received regular training without targeting their behavior and social skills. Secondly, executive functions are considered as one of the most important strategies used nowadays all over the world to modify the behaviors of children with autism in particular and those with special needs in general in integrated classrooms, or in behavior modification rooms and centers. That this program is based on scientific foundations and theories, which asserted in the importance of taking into consideration individual differences through learning more about their abilities, learning styles, and intelligence preferences. This is consistent with the scientific method and the psychological logic as asserted in the findings of [25], [33] studies.

The researcher attributes the improvement in Sociolinguistic communicative disorders among the children of the experimental group to the content of the training program on the executive functions that were selected, starting with the techniques that were used such as the technique of reinforcement, shaping, sequencing, modeling, prompting, gradual exclusion, task analysis, feedback, and the role-playing. In addition to the set of skills targeted in the current program such as the skill of positive communication with others through the methods of visual communication with others via activities and play, the skill of attention, the skill of developing response inhabitation that was done by reducing the child's movement, developing his awareness of the desired behavior, and replacing the unwanted behavior to a desirable one. The program targeted also the skill of initiation such as initiation of greeting others, initiation of a request to play with others, the initiation of daily life activities, and the initiation to help others, all of which are behaviors that develop Sociolinguistic communicative, the ability to make new friends and increase verbal and non-verbal communication skills.

Moreover, the researcher utilized the cognitive flexibility skills such as accepting others in play and place, and classification skills such as classifying types of food and similar shapes, the planning skills such as arranging steps for brushing teeth, and working memory skills such as remembering the places of things and remembering the names of games. Undoubtedly, all these skills and experiences provide an opportunity for the trainees to arouse their strengths and try to develop their weaknesses as training differed from one child to another and from one executive function to another. This result id logical and consistent with study results [24].

The results also confirmed that there were no statistically significant differences between the post and follow-up measures of the experimental group in Sociolinguistic

communicative disorders, and this indicates that the experimental group had received training in Sociolinguistic communicative disorders such as social skills, verbal Language of Non-verbal Language with others for children with autism. This result demonstrated the effectiveness of the program in improving the personal, social, and performance aspects of children with autism. We find that the development of Sociolinguistic communicative that has become acquired and trained in it increased assistance, compassion, obedience, and responsibility towards others and this was a treat for many behavioral and social disorders, including social communication disorder that these children suffer from. These results were consistent with study results [34] confirming that there were no differences between the post and follow-up application of the experimental group in Sociolinguistic communicative disorders for children with autism disorder.

5 Conclusions

From the above-mentioned, the results of the current study supported training through executive functions in improving the Sociolinguistic communicative skills of children with autism and developing their academic, personal, social, and interactive capabilities which are closely related to their progress in behavioral skills and result in the use of positive behavioral skills in interaction with life situations. Communication, attention, response, initiation, cognitive flexibility, classification, planning, and working memory skills should be developed because they are essential skills for these children with autism disorder that helps to improve communication between the child and his surroundings. Besides, the use of techniques must be diversified with these children so that the child does not become bored. So, the researcher suggests the application of the executive functions training program used in this study on other groups such as the mentally handicapped, Asperger's, the hearing impaired ... etc., and measuring tools must be developed to identify and diagnose Sociolinguistic communicative disorders for children of preschool age so that these disorders do not worsen in the future.

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Typical Behaviors Related to Corruption in University Students in Puno, Peru

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Abstract. Corruption is an emerging issue in the scientific field that has seldom been studied in Peru from the perspective of university students. The aim of this study is to identify the typical behaviors related to corruption among students of a public university in the Peruvian Andes (Puno). This is an exploratory study as it represents one of the first approaches to the phenomenon of corruption in the Puno region. The corruption normalization scale was applied to show the typical behaviors related to corruption. A total of 615 students from the Professional School of Administration participated, ranging from 18 to 22 years old. The results show that the typical behaviors related to corruption in the academic field among these students were the following: (i) recognizing to have given a false excuse to their parents to justify where they were (75.8%), (ii) admitting to acquire pirated products (74.3%), (iii) having given a false excuse to a teacher to justify their absence in class (52.9%) and, (iv) having kept something borrowed even though they knew they had to return it (40.8%). These findings identify the dynamics related to typical corrupt behaviors that merit being broken down if the aim is to prevent these behaviors that deviate from the norm from becoming natural, visualizing and addressing them when they have already been accomplished.

Keywords: Corruption, Higher Education, Moral, Values, Puno, Peru.

1 Introduction

Factors affecting higher education (universities), such as corruption, are common to all countries [1, 2]. Corruption is an emerging issue in the scientific field that has seldom been studied in Peru from the perspective of university students. Corruption is an increasingly important political and business problem among nations and in international

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organizations, which has been part of society throughout history [3, 4]. The word corruption comes from Latin *corrumpere* which means to destroy, spoil, or break [5]. Similarly, *corruptio* expresses moral decay, perverse behavior, putrefaction, and rottenness [6]. The concept of corruption is generally used to refer to the misuse of a public office or the most prevalent abuses of public power for private gain, that is, actions and behaviors that constitute bribery, embezzlement, favoritism, and more [4, 7, 8].

Corruption is a vice that creates countless problems such as undermining citizens' trust in government, limiting economic growth, hindering investments, creating political instability [5, 9]. In fact, 46% of Peruvians indicate corruption as one of the country's main problems [10], along with crime and insecurity among citizens, violence against women, drug use, poverty, and unemployment [11]. Of all the countries in the region, Peru is the most concerned about corruption, primarily regarding the level of political and financial corruption [12, 13]. Moreover, 80% of Peruvians think corruption harms them in their daily lives because they are perceived as potential victims of abuse by the authorities, bribery, and extortion [14].

Despite the reported figures on corruption cases and their related concerns, the State's actions in preventing and eradicating it have certain passivity. Legal actions are taken only after the events have occurred; moreover, it seems that society waits for political scandals to occur to confirm the existence of corruption, without considering that the problem develops over time. This is where education plays an important role, from preschool to higher education. Study programs show that the values begin working in primary education, which are made more flexible until reaching higher education. The National Curriculum of Primary Education in Peru prioritizes the values and citizenship education of students who, upon finishing their education, will be prepared to pursue higher education, as well as to function successfully as citizens in a world that is constantly and profoundly changing [15]. For this reason, and with the aim of acting on the findings both in the school and university stages, it is important to identify the typical behaviors related to corruption among students of a public university in the Peruvian Andes (Puno).

2 Research Context

This study was conducted in the geographic context of the Puno region in Peru. The participants comprised students from the Professional School of Administration at a national university in Puno, capital of the Puno Andean region, located in southeastern Peru [16, 17].

The results of the latest census conducted in 2017 show that the total population of the department of Puno in urban centers is 630,648 (53.8%) inhabitants. In rural areas, the number of inhabitants is 542,049 (46.2%) [17]. Despite the economic growth, Peru maintains 21.8% of poverty and 4.1% of extreme poverty; meanwhile Puno maintains 34.6% of poverty and 6.5% of extreme poverty [18]. In Puno, 70.4% of students between 17 and 18 years old complete high school, but only 14% of them attend postsecondary education [17]. The percentage of people with secondary and postsecondary education increased in 2017 compared to the 2007 census [17].

Of the 47 native languages that exist in Peru, Quechua and Aymara are spoken in the department of Puno, with Quechua being the first language that 42.86% of the population over 5 years old learned to speak in childhood, followed by 28.04% of the population who stated that they learned Spanish and 27.04% Aymara [16, 17]. Aymara is a current native language within scope for the department because it is spoken in almost the entire department of Puno [16].

The national university involved in this study is one of the oldest and most important public education institutions in the Puno region, with more than 160 years of history in this city. As part of its mission, it considers the scientific, technological, and humanistic training of its students with cultural identity and social responsibility to contribute to the region and country's sustainable development [23]. In its vision, it highlights an appreciation of its culture, as well as recognizing its rights and responsibilities [23].

3 Methodology

This is an exploratory study [19] because it represents one of the first approaches to the typical behaviors related to corruption in the Puno region and its use among university students, as well as the frequency with which they occur. The *corruption normalization scale* developed by Freundt-Thurne and Tomás-Rojas [20] was applied to show the typical behaviors related to corruption. This scale is one-dimensional and is composed of 19-Likert items with five response options, where 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Always. The study was conducted between March and June 2020, in the midst of the COVID-19 pandemic.

The sample consisted of 615 students enrolled in the 2019-II academic term at the Professional School of Administration. For convenience, the sampling was nonprobabilistic, where the students were selected given their willingness and availability to participate in the study [21]. The participants were students from the I to X academic grade in the 2020-I term. A total of 64.1% of students were female, coming from families with a medium to low socioeconomic status. Their age ranged from 18 to 22 years old; all spoke Spanish as their first language, along with Quechua and/or Aymara in some cases depending on where they were from.

The study was coordinated with the teachers in charge of the courses. They asked their students to enter an online platform that contained the survey's form. All participants were asked for their respective informed consent [22], which explained the purpose of the study, ensuring anonymity and confidentiality of the data; moreover, they were told that their answers would not affect their grades [23].

4 Results and Discussions

For the purpose of the results and discussion, of the 19 items included in the initial research, only 11 items that were closely related to the typical behaviors linked to corruption in the academic field were analyzed. The remaining eight items (considered extra-curricular) will be considered in a future publication.

A total of 86.4% of the university students surveyed stated that they had "never" requested academic benefits (enrollment, payments, requirements, withdrawals, etc.,) with false and/or incomplete reasons, while 13.6% indicated that they had done so "at least once." Within the Andean moral code, three moral and ethical obligations are exercised that synthesize society's moral premises and lay the foundations of punishment in three principles: *Ama sua* (Do not steal), *Ama llulla* (Do not lie), and *Ama quella* (Do not be lazy) [24], effective as moral values for the modern world [25]. When analyzing potential differences between genders, the percentages of university men and women who "never" requested academic benefits with false and/or incomplete reasons did not significantly vary. There is evidence of behavior that seems to continue to be present in the dynamics of more than 84% of the students surveyed (Male: 84.7% and Female: 86.2%). However, only 13.8% of female university students specified "rarely" having requested academic benefits with false and/or incomplete reasons, while only 7.1% of male university students said that they had done so, with the categories of "sometimes" at 5.9%, "often" at 1.2%, and "always" 1.2% appearing among men as opposed to women.

Only 30.1% of the university students surveyed acknowledged "never" having cheated on an exam, while 69.9% agreed to having done it "at least once." Notably, 40.8% of the university students surveyed indicated "rarely cheating on an exam," while 1.5% of university students admitted that they "often" cheated on an exam. The results obtained by gender show that although the percentage of female university students who acknowledged "never" having cheated on an exam was lower (26.3%) than the percentage of men who acknowledged it (35.3%); it is consistent that with the following item, 73.8% of university women admitted to having cheated on "an exam," compared with only 64.7% of men. According to Ramos et al. [26, p. 35], the causes that lead a student to commit plagiarism are "saving time," "personal confidence," "the ease of doing so with the Internet," "the habit of doing things at the last minute," "getting better grades," "imitating when doing what others do without consequences," "lack of policies and institutional tools to detect and manage this dishonest act," among others. All of the above confirms what sociologist Javier Díaz-Albertini mentions, "the majority in Peru think that our norms suffer from an 'unbearable ease,' referring to the 'culture of transgression' (anything goes) that normalizes a lack of respect for rules" [27].

Similarly, although 82.5% indicated that they "never" submitted other people's work as their own, 17.5% acknowledged that they had done it "at least once," while 14.6% acknowledged that they had submitted other people's work as their own. These results showed that the percentage of university students who stated that they had never sent their university assignments to be done by others is lower (79.1%) than those who indicated that they "never" (82.5%) submitted other people's work as their own. Notably, the university students surveyed agreed to have their work done by others at least once (20.9%), and 1% said they always did it. Approximately 17% said that they "rarely" sent their university homework to others to complete. In accordance with Díaz-Albertini, the data presented above show the reappearance of a weak relationship with the rules, which, according to him, "is explained on the basis of cultural, structural, and socio-political factors" [27]. Díaz-Albertini indicates the sociopolitical aspect as one of

his main reasons when mentioning the weak Peruvian citizenship; while Tanaka [28] refers to the "lack of civility" and the ability to "get around" the rules, etc. If it is based on gender differences, 86.2% of university women indicated "never" having submitted other people's work as if it were their own, while a lower percentage (75.3%) of men admitted to "never" having done it. Additionally, 20% of men said they "rarely" submitted other people's work as their own, while only 12.5% of university women acknowledged doing so.

In relation to falsifying information in a document, 87.4% indicated that they had never done it, while 12.6% said that they had done it "at least once." In the matter of having kept something borrowed even though they knew they had to return it, 59.2% of the university students surveyed acknowledged "never" having done so, while 40.8% acknowledged that they had done so "at least once." It should be noted that while 88.5% of the female university students acknowledged "never" having done so, a slightly lower percentage of men (85.2%) indicated this. However, it was done "at least once" by 11.5% of women and 14.7% of male university students. It is noteworthy that in university classrooms, knowledge of politics and morals are taught, citing the phrase "The end justifies the means" in The Prince of Machiavelli [29], as well as: "Borrowed books: lost or damaged" [29, p. 127]. These are statements that are repeated and readily accepted among university students. In Andean cultures, especially in Aymara communities, taking others' belongings without their consent is a weakness that deserves punishment [31]. Male students show more typical behaviors contrary to the rules than women. When it comes to the type of answers, women tend to give much more categorical answers, for better or for worse.

Furthermore, while 47.1% of the university students interviewed stated "never" having given a false excuse to a teacher to justify their absence in class, 24.3% of the same university students surveyed stated "never" having given a false excuse to their parents to justify where they were. In fact, 52.9% of the students indicated that they had given a false excuse to a teacher to justify their absence in class "at least once," while 0.5% said that they "always" gave false excuse as justification. In Andean society, a liar is considered a social blight whose actions are usually punished by the community during weekly gatherings, generally held on Sundays [32]. Considering the "at least once" response, it is concerning that 75.8% of university students indicated having given a false excuse to their parents to justify where they were. Moreover, 1% responded that they "always" gave a false excuse to their parents to justify where they were. Only 20.6% of female university students acknowledged "never" having given their parents a false excuse to justify where they were, while the percentage rose to 30.7% among men. A total of 79.4% of female university students admitted to having done so "at least once," while it was 62.7% among men. The answer could be based on the difference in the type of control that parents exercise over sons compared to daughters, control that could be triggering inappropriate behavior by those who are afraid to reveal the whole truth, and they choose not to admit it. The value of sincerity appears as an aspect linked to the credibility of students, which was previously studied among a group of students from the same university, by Flores, Garcia, Calsina, and Tapachura [33]. As the authors recognize, it is a value that promotes trust among people, which also becomes the

starting point for building, reaching, and maintaining "positive," lasting, and "productive" relationships. According to Western thought, the path to progress is taken in finding the truth, while for Andean oral communities and cultures, people learn by seeing, doing, and listening [34, 35]. The important part is coexistence with family and the community [34]. Family relationships are "a process of mutual and evolutionary influence that includes verbal and non-verbal messages, perceptions, feelings, and cognitions from members of the family group" [32, p. 154]. Students are social beings and it is in the family, the first social group where they share opinions, beliefs, thoughts, norms, values, knowledge, and expectations; therefore, parents are the first models of social and affective behavior [33, 34, 40].

The fragility of our institutions is also reflected in the percentage found among the interviewees when asked if they had used contacts in any institution to obtain preferential treatment compared to others. While 66.5% of those surveyed indicated that they had never used contacts in any institution to obtain preferential treatment over others, 33.5% explained that they had used contacts in an institution to obtain preferential treatment compared to others at least once. No one admitted to having done it "always." It should be noted that 69.7% of university students indicated that they had "never" used contacts in any institution to obtain preferential treatment, while 58.8% of male university students indicated that they had never done so. The difference between the percentage of men and women respondents who indicated they "often" used contacts in an institution to obtain preferential treatment is striking. While 7.1% of men admitted to having done so, only 1.3% of women did.

The results of two items showed the operational weakness of many institutions in Peru, institutions supposedly "in charge of ensuring, monitoring, and sanctioning lack of compliance with the legal system" [27]. These were bribing some authority and purchasing pirated products. According to the responses from the university students surveyed, 92.2% had "never" bribed any authority (police, professor, etc.,) while 1% admitted that they have "often" done so. While 93.4% of university women admitted that they had "never" bribed any authority, 87.1% of men acknowledged they had. Either women recognized it more easily or there were more men who would have "bribed an authority such as policemen and teachers." Therefore, it may be appropriate to rethink that, considering Tanaka's [28] indication that it is useful to "look at behaviors and their relationship with the institutional environments in which they operate," which insists on changing environments than changing mindsets. "If people disregard the rules often, it is because they do not have better options and because the cost of non-compliance is very low, given the State's limited capacity or lack of willingness to enforce the law." In a sociocultural space such as Peru, it is no longer surprising that 74.3% admitted to having acquired pirated products (movies, music, software, etc.,) "at least once." While 3.4% acknowledged doing it "always," only 25.7% indicated that they had "never" acquired any. When it comes to gender, 75.5% of female university students acknowledged having done it "at least once," while the percentage of male university students was 72%. However, given the options of "often" and "always," the percentage of male university students is nearly double (20%) than that of university women (10.5%). This behavior is not strange, considering that any pirated product sold in a market responds to the same rules (supply and demand) as any other product. Therefore, if there was no

demand for this type of product, its supply would be irrelevant [36]. High rates of piracy are common in different regions of developing countries such as Puno where only 7.5% of households have Internet access [11]. Although at the national level, one of the main problems affecting the economy is piracy (software, movies, music, toys, the publishing industry, tobacco, textiles, shoes, food, alcohol, etc.,) behavior in the Puno region is no different. In contrast, because it is near the border with Bolivia, some of these products easily enter and are sold in the region due to a lack of police control [37]. Through this region, "40.77% of the contraband that is trafficked in Peru" enters [34, p. 7]. Additionally, the country ranks 30th out of 53 countries evaluated in the Intellectual Property policies world ranking [38].

5 Conclusions

In line with the aim of this study, the typical behaviors related to corruption in the academic field among students of a public university in Puno were the following: (i) recognizing to have given a false excuse to their parents to justify where they were (75.8%), (ii) admitting to acquire pirated products (74.3%), (iii) having given a false excuse to a teacher to justify their absence in class (52.9%) and, (iv) having kept something borrowed even though they knew they had to return it (40.8%).

Responses to the 11 items from the academic field that are part of the corruption normalization scale [20] only serve to highlight the dynamics related to typical corrupt behavior that merit being broken down if the aim is to prevent these behaviors that deviate from the norm from becoming natural, visualizing and addressing them when they have already been accomplished. The idea is to correct them while they are in the process of developing. The family is the social nucleus where students learn the morals and ethics inherited from the *Tawantinsuyo*, as well as admirable precepts (*Ama sua*, *Ama llulla*, and *Ama quella*) that have been in operation since the time of the Inca Empire, achieving efficient and effective results. In the perspective of Andean families, wisdom and knowledge result in a continual experience and sharing in other settings, as these are practices still prevalent in the communities. Parents instill in their children ideas of reciprocity that start within the family nucleus and extend to the community.

After family, the university is a space called on to become the preferred environment to reflect, review, and share ideas about certain habitual behaviors that deviate from the norm, as well as behaviors that do not build citizenship or relationships of trust. All are of great importance when it comes to building firm institutions. When thinking about an educational institution, norms, rules, and ways of acting in accordance with the university's institutional mission and vision generally come to mind, which was the purpose of this study. It is precisely the mission, as well as the vision sought, that are the characteristic points of departure and arrival that must help the typical behaviors that constructively contribute to citizens and social dynamics in the region and the country.

For future studies, working on two important points is recommended: understanding the reasons behind this type of behavior by students through qualitative studies, as well as reviewing the curricular structures of the various schools, to add courses and/or or units in which daily challenges can be worked on, and to reflect on the impact of typical

behaviors outside the norm. As Puno is a border area, which implies a high level of human traffic, it becomes an attractive region for legal and illegal business opportunities (e.g., smuggling), which is also an important focus of migration. This phenomenon makes the Puno population vulnerable to behavior outside the law, which is quickly imitated due to its beneficial results, especially when it is not duly or timely punished pursuant to law. Therefore, to prevent many of the behaviors outside the law from being incorporated into the daily dynamics of students from rural areas, it is essential to insist on dual control: first, from families and their communities, which is strongest in the first stage of life; and second, monitoring and control assumed by educational institutions, whether it be primary, secondary, or university.

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Usability experience in the calculation of pharmacokinetic parameters with software: Phenytoin case

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ABSTRACT: The objective of this research was to evaluate how the use of mathematical models that simulate the drug´s pharmacokinetic, can influence the calculation of pharmacokinetic parameters, being the human-computer-interaction an useful tool to simplify them. For it, we study the effect of P-gp inhibitors on the pharmacokinetics of the anticonvulsant, phenytoin; we co-administered the drugs to a group of rats and then measured the plasma concentrations of phenytoin, from which we calculated the pharmacokinetic parameters, manually and using the WinNonlin software. P-gp inhibitors caused a change in the pharmacokinetics of phenytoin, moving from the open-one compartment model to the open-two-compartment model, this was demonstrated with a better fit of data (r = 0.9871) in the two compartments model. Since complex mathematical models are necessary, the software will be useful, but it is the pharmacokinetic specialists who evaluate and define the model to be used, which demonstrates the importance of HCI.

KEY WORDS: Pharmacokinetic parameters, HCI, compartmental models, Phenytoin, P-glycoprotein inhibitors, WinNonlin software.

1 Introduction

There are numerous definitions of the term pharmacokinetics (PK), Dost, Wagner and Gibaldi [1, 2] describe pharmacokinetics as "the processes of speed change in drug concentrations in the human or animal body", or "the study of speed change of drug concentrations and their metabolites in biological fluids, tissues and excretions, as well as the pharmacological response and construction of appropriate models for the interpretation of such data" and finally "the study of the temporal evolution of drug levels and their metabolites in the different fluids, tissues and emunctories of the organism and the mathematical relations necessary to develop the appropriate models to interpret such data".

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The main objective of pharmacokinetics is to clarify the relationships between the pharmacological or toxicological response and the levels of the drug or its metabolites in different body fluids and offers a way to improve and optimize the individual treatment of patients, being Clinical Pharmacokinetics a fundamental tool in the achievement of this objective and key to establish appropriate dosing regimens [2, 3].

The pharmacokinetic parameters (P.P.) of drugs are unique and specific, depending on the active ingredient (A.I.), and the pharmaceutical dosage form. Thus, each drug is described by its pharmacokinetic parameters such as absorption (Ka) and elimination (K) constants, half-life time ($t_{1/2}$), apparent distribution volume (Vd), systemic clearance (Cls), metabolization constant (km), unchanged drug excretion constant in urine (ke), liver clearance, bioavailability factor (F), among others, or the so-called bioavailability parameters, namely the area under the plasma concentration curve vs. time (AUC), the maximum plasma concentration and maximum time [4 - 7].

If it is considered that each fluid, cell, tissue, organ and system have different physical-chemical characteristics and different degrees of affinity for drugs, the human organism has multiple compartments, in which each of them would act as an individual compartment [3, 4, 6]. Drugs move between compartments and their distribution are complex; these events occur simultaneously, requiring mathematical and statistical models to estimate drug doses and drug's efficacy over the time for a given dose. A model is a hypothesis, which uses mathematical terms to describe quantitative relationships. The predictive capacity of a model is based on the appropriate selection and development of the mathematical function that parameterizes the essential factors governing the kinetic process [7]. Consequently, specialized software which facilitate mathematical modeling for the calculation of P.P. are a very useful tool, where the interaction of the expert in clinical pharmacokinetics with the software, is crucial.

Hefley in 1992 defined the Human-Computer Interaction (HCI) as "the discipline that design, evaluate and implement interactive computer systems for human use; and to the study of the most significant related phenomena" [8].

The difficulty in mathematical modeling of pharmacokinetics and the calculations is relevant to many researchers, for example, Ping Wang et. al. in 2019, developed a TCM-ADMEpred method, which implies a novel strategy for the prediction of pharmacokinetics in traditional Chinese Medicine (TCM*)*; the method was used to predict the AUC of 3 alkaloids in Yuanhu Zhitong (YZP) and 2 coumarins [9].

Another recent study by Zhaomin Dong et. al. presents a web-based application, pkweb (https://pkweb.hhra.net), with an easy-to-use interface and a range of functions for analyzing PK data. Capabilities include PK data simulation, which integrates 27 modules (e.g., intravenous bolus (IV) injection, IV infusion and extravascular administration) and models the suitability of the PK data [10]. Buffington D.E. et al. and Leader W.G. et al., developed pharmacokinetic software programs for clinical decision making, which were designed to assist the physician in the analysis, prediction, interpretation and reporting of serum concentration of several drugs using Bayesian and non-Bayesian methods [11].

Consequently, the use of specialized software nowadays is a fundamental aid for the calculation of P.P.; and it is a clear example of HCI, where the computer programs are specially designed to provide solutions such as [12 - 14]:

1. Adequacy of drug concentration vs. time data to a series of pharmacokinetic models and the choice of the best one in the statistical description of the data.

2. Adequacy of data within a user-defined PK or pharmacodynamic (PD) model
3. Simulation: Since simulation processes involve a numerical solution of the equation with predefined precision.
4. Experimental design: Allowing the description of the curve and the model.
5. Applications in Clinical Pharmacokinetics: some software are available for the clinical monitoring of drugs with a narrow therapeutic index.
6. Computer programs for teaching.

In the teaching-learning methodology, it is very helpful to apply the theories of constructivism and cognitivism. Constructivism is a theory about learning and not a teaching strategy or method. It states that students must actively construct their own knowledge, making them believe and respond to their own hypotheses, increasing the student's confidence in their own critical thinking skills. Students must build their own compartmental and mathematical models, making the transit of drugs in the body fit them. Cognitivism and constructivism can be applied to curricular design and choice of educational methods. David Kolb's theory of experiential learning has many potential applications related to constructivist. In this theory, learners enter a cyclical process of taking part in a concrete experience, reflecting on this experience to formulate an abstract conceptualization of the process, which is then tested through active experimentation [16], which is the nature of pharmacokinetic evaluations.

2 Calculation methodology

The starting point for a pharmacokinetic study, is to define the type of samples to be analyzed; in the animal organism there is access, mainly, to two important fluids in which the distribution of drugs can be investigated: blood and urine. The complexity of the mathematical model designed to find the interrelationship will depend on the number of systems in which it is proposed that the drug is distributed [1, 17]. However, a simple and useful pharmacokinetic tool is based on Compartmental Models; in this analysis based on linear pharmacokinetics, there is a direct proportionality of transfer rates between different compartments and concentrations will depend primarily on the route of administration, we can have the following cases [7, 18]:

1. Intravenous administration, either rapid (bolus) or slow intravenous infusion
2. Extravascular administration (referred to any other route with absorption)

If, for example, we consider an IV administration to the organism and assume a homogeneous distribution throughout the body, we speak of an open one compartment model (MA1C). In pharmacokinetics, it is considered that P.P. are constant for a given A.I. and the Vd and the K can be estimated from plasmatic concentrations vs. time data [7, 17, 18]. It is also important to consider the kinetics that the A.I. follows within the organism; in most cases, it is assumed that the drugs follow first-order kinetics, that is, dependent on the amount of A.I.; furthermore, it is considered a unidirectional sense of the drug's transit, which is why we speak of open models [3, 17]. Within the variants of compartmental analysis (Fig. 1) we have the following possibilities [7, 17]:

1. Open model of one compartment (MA1C), where a homogeneous distribution of A.I. is assumed, with a single central compartment (Fig. 1 - A).
2. Open model of two compartments (MA2C), where the body tissues are classified into two categories: those that are instantly balanced and those that require some time to reach equilibrium (peripheral compartment) (Fig. 1 - B).
3. Multi-compartmental models, where the drug reaches the central compartment, but with a different speed towards other peripheral compartments.

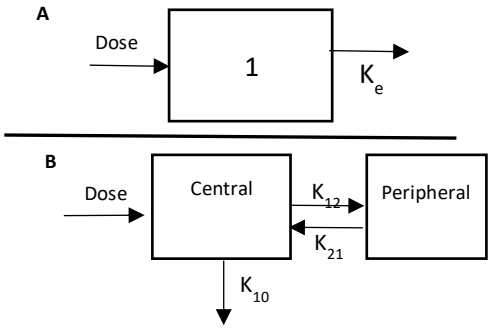


Fig. 1 Compartment Models after IV bolus administration of a drug MA1C (A) and MA2C (B) [20].

It is possible that many drugs may follow non-linear pharmacokinetics and the kinetic process is governed by the magnitude of the dose [1, 7, 17]; other drugs give rise to dose-dependent kinetics and are governed by the Michaelis-Menten equation [1, 7].

Numerous linear differential equations are involved in pharmacokinetic calculations. Although these differential equations are integrated by conventional methods, these often require much time and are impractical; it is common to use the Laplace transformation, a methodology that consists of replacing the independent variable (time) by the Laplace operator [1, 7].

In summary, the calculation of the P.P. must take into account the following considerations [1, 7, 17]:

1. Fluid in which the study will be carried out.
2. To define if the concentrations of the A.I. or the metabolites are quantified.
3. Route of administration of the drug.
4. Type and kinetic order that follows the A.I. contained in the drug.
5. Model of compartments to which the A.I., MA1C, MA2C or others are most suitable.
6. General and specific method to be used for the calculation, based on slopes or mass balance.

Among the most used software programs, we have the following: PCNonlin, WinNonlin, SAS, RSTRIP, PKAnalyst for Windows, DIFFEQ Pharmacokinetics Library, P-STAT, STELLA, NONMEM, MKMODEL, ADAPT II [7, 12 - 14].

In these decisions a series of mathematical equations are usually used, that will later be operated by the software; here we propose some equations solved after the integration of differential equations, and that will serve us as a tool to demonstrate how the decision of the human specialized in clinical pharmacokinetics will define the appropriate use of the software for the calculation of P.P. [1, 3]:

$$Cp_t = \frac{Do}{Vd} e^{-Kt} \quad (1)$$

Equation (1) allows us to calculate pharmacokinetic parameters from plasma concentration data (Cp) after administration of a drug trough IV bolus; the model assumed is an MA1C [1, 5, 7].

$$Cp_t = A e^{-\alpha t} + B e^{-\beta t}$$
$$A = \frac{Qo\ (\alpha - k_{21})}{Vc\ (\alpha - \beta)} \quad (2, 3)$$

$$B = \frac{Qo\ (k_{21} - \beta)}{Vc\ (\alpha - \beta)} \quad (4)$$

When an MA2C is assumed, the time it takes for the drug to reach equilibrium depends on the degree of affinity for the tissue or tissues that make up the peripheral compartment; if the log of Cp is plotted as a function of time, we obtain a biexponential curve with two clearly defined slopes; this curve is defined by equation (2), where the values of A and B are expressed by the relationships of equations (3) and (4), where Vc is the volume of distribution of the central compartment [1, 7].

$$Cp_t = \frac{ko\,F\,Do}{Vd\,(ka - K)}(e^{-Kt} - e^{-Ka\,t}) \quad (5)$$

Equation (5) allows the calculation of the Cp of a drug from Cp data, after its extravascular administration, using the method of the residuals (Feathered) [1 - 3, 6, 7].

$$C_{av}^{\infty} = \frac{1{,}44\,Do\,t_{1/2}\,F}{Vd\,\tau} \quad (6)$$

Equation (6) allows us to calculate the individualized dosage regimen (Do / τ) for a patient, where τ is the dosage interval when the effective plasma concentration (Cav) to be achieved within the therapeutic range is known [1, 2, 9].

3 Results and discussion

The aim of this work was to demonstrate numerically how the error in the definition of the mathematical model to be used, can induce errors in the calculation of the P.P. and determine that wrong dosage regimens are established, especially in risk patients.

Our research group studied the impact of the administration of P-glycoprotein (P-gp) inhibitors, an efflux pump expressed in several organs and barriers of the body, on the pharmacokinetics of the anticonvulsant, phenytoin. The study was carried out on

male Sprague-Dawley rats, weighing between 250 and 280 grams. In the design of the study, three experimental groups were used, one of which was given phenytoin and the other two phenytoin with different doses of P-gp inhibitors.

The pharmacokinetic calculations were made manually and we compared them with the data obtained with the Phoenix WinNonlin Software - Phoenix 64 version 8.1.0.3535, which works with Windows and is used in PK, PD and NCA [21]. For the processing of the obtained experimental data we use the modules shown in Fig. 2.



Fig. 2. Modules of the WinNonlin software used in the computational calculation of P.F. [22].

The results presented are referred to individuals of the group of male Sprague-Dawley rats, to which the anticonvulsant phenytoin was administered by IV, at a dose of 15 mg/kg of weight, plus the P-gp inhibitor, at a dose of 2 mg/kg of weight (Treatment 1), obtaining the following results:

Table 1. Plasma phenytoin concentrations after IV administration of the association phenytoin (15 mg/kg) and P-gp inhibitor (2 mg/kg) in male Sprague-Dawley rats (n = 2).

Treatment 1		
Time (minutes)	Rat-1 (R-1) Cp (µg/mL)	Rat-2 (R-2) Cp (µg/mL)
5	36.13	36.13
15	31.55	31.56
30	19.22	19.22
45	11.68	11.68
60	9.86	9.88
180	2.31	2.62
360	1.36	1.22
480	0.83	1.01
600	0.77	0.82
720	0.71	0.66

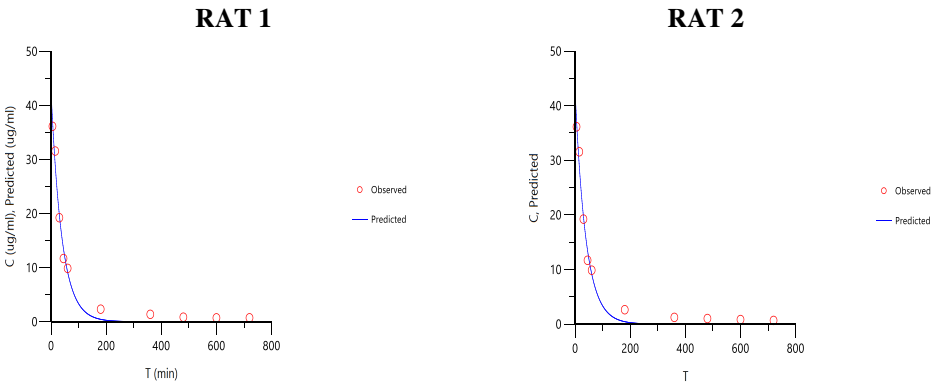


Fig. 3. Plasma concentration profiles vs. time after IV administration of the association phenytoin (15 mg/kg) + P-gp inhibitor (2 mg/kg) in male Sprague-Dawley rats.

The experimental data in Table 1 were used to calculate the P.P., using WinNonlin software; a good fit is appreciated when comparing the observed values, shown in red in the graphs in Fig. 3, with those predicted from the model fit using a MA1C (in blue); furthermore, if we compare the P.P values calculated for the two rats shown in Table 2, we observe no significant statistical differences in terms of AUC, K, $t_{1/2}$, maximum concentration (Cmax), Vd and Cls.

Table 2. Pharmacokinetic parameters of phenytoin administered by IV with P-gp inhibitor in male Sprague-Dawley rats, calculated using WinNonlin software for a MA1C (n = 2)

	R-1			R-2		
Parameter	Estimate	S.E.	C.V. (%)	Estimate	S.E.	C.V. (%)
AUC (ug/ml)*min	1663.38	94.60	5.69	1664.96	98.03	5.89
Ke (min^{-1})	0.0255	0.0021	8.08	0.0255	0.0021	8.37
$t_{1/2}$ (min)	27.14	2.19	8.08	27.19	2.27	8.36
Cmax (ug/ml)	42.47	1.82	4.29	42.45	1.88	4.44
Vd (ml/kg)	353.19	0.0053	4.29	353.36	0.0055	4.44
Cl_s (ml/min/ kg)	9.01	0.0002	5.90	9.01	0.0002	5.89

Calculations with the same data were made manually, using the logarithmic version of equation (1) for a MA1C and first order kinetics, observing that the linear correlation of plasma concentration vs. time in both experimental animals is not very high, with a value of r = 0.9248 for R1 and r = 0.9309 for R2, which leaves some doubts as to whether the kinetics of phenytoin co-administered with the P-gp inhibitor follows a MA1C. The pharmacokinetic parameters calculated manually are shown in table 3, compared with those found with the WINNONLIN software.

We can appreciate similarity in the P.P. calculated for the two experimental animals by the same method, but between methods there are very significant statistical differences, which demonstrates that the MA1C model used is not the most adequate and that the software only processes the mathematical calculations indicated, while it is the

specialist in pharmacokinetics who observe, analyze and evaluate the situation in order to choose the best model, as is deduced from the work of Zhaomin Dong et. al [10].

Table 3. Pharmacokinetic parameters of phenytoin administered by IV with P-gp inhibitor in male Sprague-Dawley rats, calculated manually for a MA1C and compared with WINNONLIN.

	Treatment 1			
Parameter	Manual Rat 1	Manual Rat 2	WINNONLIN R1	WINNONLIN R2
AUC (ug/ml) *min	2868.74	2724.91	1663.38	1664.96
K (min^{-1})	0.0055	0.0055	0.0255	0.0255
$t_{1/2}$ (min)	126.46	126.79	27.14	27.19
Cmax (ug/ml)	17.77	18.06	42.47	42.45
Vd (ml/kg)	846.50	830.67	353.19	353.36
CL_s (ml/min / kg)	4.64	4.54	9.01	9.01

In the correct determination of P.P. using software, it is important to apply computational thinking, which has a high level of abstraction and an algorithmic approach to solve any type of problem, which involves designing systems and understanding human behavior by taking advantage of the fundamental concepts of computing. In the same way, in the teaching-learning process, the theories of constructivism and cognitivism can be applied, where the students themselves are the ones who build knowledge, making them believe and respond to their hypotheses, increasing the student's confidence in their own critical thinking skills [15, 23]; in this case, the phenytoin has a very changeable pharmacokinetics, so when it is administered with the P-gp inhibitor, it is essential to define the mathematical model to which the behavior of phenytoin is adjusted, because it will depend on it whether the calculated P.P. are corrects and whether the adjustment of the dosage regime of this anticonvulsant is appropriate, since if it is not done correctly, the patient's life may be endangered.

There is evidence of the changing pharmacokinetics of phenytoin, so drug resistance in patients with epilepsy is approximately 30%, resulting in refractory epilepsy. The pharmacokinetic hypothesis suggests that antiepileptic drugs, such as phenytoin, do not reach the target tissues in the concentrations required for therapeutic action, resulting from the active efflux of P-gp, a protein expressed in several human tissues and locally over-expressed in the blood-brain barrier (BBB). P-gp confers intrinsic resistance to normal tissues to eliminate unnecessary and toxic exogenous substances, or their metabolites outside the body and is thought to play an important role in the origin of refractory epilepsy. Studies by Ming-Liang Lai et al. suggest that genetic polymorphism of P-gp may affect the efficacy of phenytoin by decreasing absorption or increasing elimination at the central nervous system (CNS) level [24, 25].

There are also antecedents of Michaelian behavior of phenytoin; Aarons Leon and collaborators, determined the maximum metabolic rate (Vm) and the Michaelis-Menten constant (Km) of phenytoin; Zaccara, G. and collaborators carried out a retrospective study in 282 patients with epilepsy to evaluate the predictive performance of

pharmacokinetic methods for individualized dose of phenytoin, using the linearized method of Michaelis-Menten [26, 27].

Consequently, it is clear that the administration of a P-gp inhibitor with phenytoin, makes its pharmacokinetics change, which clearly evidences the need for the expert in pharmacokinetics to interact with the computer, and to be able to define the mathematical models to be used.

When adjusting the average data of the two rats according to a MA2C using the same software, we appreciate an almost perfect adjustment between the observed and predicted data (Fig. 4), obtaining a value of r = 0.9871 in the distribution phase.

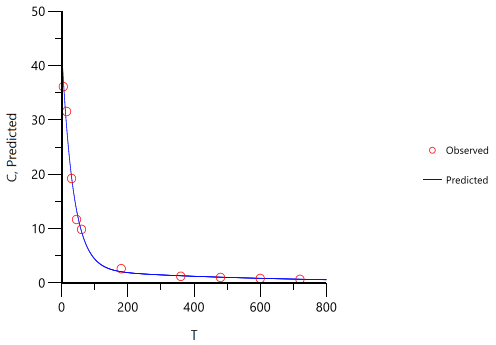


Fig. 4. Plasma concentration profile vs. time of average data, after IV administration of the association phenytoin (15 mg/kg) + P-gp inhibitor (2 mg/kg) in male Sprague-Dawley rats.

We perform the calculations of P.P. for phenytoin following an MA2C, manually (residual method) and using WinNonlin software, with average data, which can be seen in table 4.

Using the MA2C, a greater similarity between the parameters calculated manually and by the WinNonlin software can be clearly seen. This in vivo change in phenytoin pharmacokinetics is due to the joint administration of the P-gp inhibitor, which blocks the action of the P-gp as an efflux pump at the CNS level.

In order to realize the magnitude of the error that can be induced by the use of an erroneous mathematical model, we calculated the dosage regime of phenytoin as a function of the maximum Cp and the average Cp (equation 6), using the P.P. calculated for an MA1C, obtaining a Do = 7.06 mg/kg every 8 hours and with those obtained for an MA2C, which has a better adjustment, the Do = 31.14 mg/kg every 8 hours. The role of usability and the theories of constructivism and cognitivism can be applied, however, in order for these new technologies to be more effective; the contributions from the field of HCI will be critical. [28].

Table 4. Pharmacokinetic parameters of phenytoin administered by IV with P-gp inhibitor in male Sprague-Dawley rats, calculated manually and using WinNonlin software (MA2C).

	Rx	
Parameter	Estimate with WinNonlin	Estimate Manually
AUC (ug/ml) *min	2802.0263	3013.61
A (intercepto)	40.49	42.37
B (intercepto)	2.55	3.09
α (min^{-1})	0.0288	0.0257
β (min^{-1})	0.0018	0.0023
K (min^{-1})	0.0154	0.0151
$t_{1/2}$ (min)	45.12	45.93
$t_{1/2\ \alpha}$ (min)	24.08	26.92
$t_{1/2\ \beta}$ (min)	378.92	306.32
Cmax (ug/ml)	43.04	45.47
K_{12} (min^{-1})	0.0118	0.0091
K_{21}(min^{-1})	0.0034	0.0039
Vc (ml/kg)	348.51	329.92
V_{ss} (ml/kg)	1558.04	1104.04
V_b (ml/kg)	2981.70	2200.12

Index:
α: distribution phase speed constant
β: disposition phase speed constant
$t_{1/2}$ **α:** average distribution half life time
$t_{1/2}$ **β:** average disposal half life time
A: distribution phase intercept
B: phase disposition intercept
Cmax: maximum plasma concentration
Vb: volume of distribution in the body
Vss: volume of distribution in the steady state
Vc: apparent volume of distribution of the central compartment
K12: transfer speed constant from central to peripheral compartment
K21: transfer speed constant from peripheral to central compartment

Thus, in the study of pharmacokinetics, a software is an important tool to help in many of the theoretical and practical aspects. The aim of this article is to provide a computational approach in the field of pharmacokinetics, making it clear that a software only processes information mechanically, the one who decides which pharmacokinetic and mathematical model to use is the expert in clinical pharmacokinetics, so the HCI is a very important tool to help.

4 Conclusions

The concomitant administration of phenytoin with P-gp inhibitors causes significant changes on phenytoin pharmacokinetics as a result of the inhibition of the active efflux of P-gp. This leads to vatiations on the calculated pharmacokinetic parameters of phenytoin depending on the compartment model used. In this study it was demonstrated that the adjustment of the data to an MA1C is relatively good, with an average value of

r = 0.9272, which could lead to calculation errors, but when the MA2C was applied, the data adjusted much better, with a value of r = 0.9871 in the distribution phase. This is why the differences in the P.P. calculated manually and using WinNonlin software show significant differences for an MA1C, while there are no significant differences when the correct model, the MA2C, is used. This allows us to conclude that the usability of specialized software facilitates the calculation of the P.P., however, it is the expert in pharmacokinetics who must decide which model to use, demonstrating thus the importance of human-computer interaction.

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IdBookstore : An Innovation Digital Book Design Using User Experience with Ubiquity Smart Reader

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Abstract. Idbookstore apps as a user experience design for autonomy learning resources interactive digital book (cyberbook) based on user ubiquity smart readers. The product will use for students and teachers at the State University of Malang. Through innovative design mixed by a component of creativity, technology, and business. Also, this service to access the application consist of e-book software and Book Market Place. Furthermore, Evaluation technical apply based on the general ebook, a teacher (or lectures) assign the user I and the students (pupils) assign the user II. The result of evaluation based on 3 criteria that is the first is layout and design, the second is content and functionalities, and finally is device, format, and distribution. The results of idbookstore have the potential to be a viable digital book with service capability for comfortable smart reader users by a rate of user validation average 92% of good criteria.

Keywords: Digital Book, Innovation Learning, User Experience, Multimedia Content, Ubiquity Smart Reader

1 Introduction

Innovation design for digital book by multiple access resources need requires the creativity and technology of digital media to be interactive, easy to understand with natural language, time and cost effective. Many digital books have been created freely accessible, but not least the book has the interaction that educates and does not ambiguous understanding for readers. Also a display of books just using a PDF style only. In recenly, using e-pub apps for increasing motivation to read book on smartphone [4]. But packaged in the form of an application that allows readers for access has not been contained in the context of user friendly. Observing that the advancement of digital technology has the capability of services through the performance and display of digital books. It is providing an interesting interaction

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between readers and multimedia content digital such as 3D animation, augmented reality, holograms and audio video [11].

Iindicators of reading engagement included motivation for independent reading and comprehension as measured by standardized tests on the print book and both ebooks [5]. And the development of digital book through SIGIL application in cookies and candys lessons was motivated by the lack of the interactive learning media for students [9].

The use of natural language with the NLP (Natural Language Processing) program added to digital books certainly has a positive impact on the character building of readers both in ethics and interpersonal attitudes. For example, applying the correct language usage. In terms of optimizing the use of interactive digital books that are more natural in standard language, the resulting books have a function as learning media for the 21st century.

The importance of using digital books as the right solution for readers in the digital age through the latest digital book media and applications. With features that provide personalized services for readers' wants or needs based on ubiquity smart reader technology in measuring the emotional level and level of understanding of the reader's content according [7].

In particular the implementation of digital book with a smart features and easy to access will consider to using user experience design and innovation. In this case, we should be integrated an infrastucture IT technology and a new curriculum which have develop on site State Univeristy of Malang,

In addition, the innovation digital books targetting is improving learning performance more efficient for accessing resources in real-time condition. This challenge of media connections to help reader activities. Not only the application provide a service of digital book easy to access, but also using ubiquity smart reader will be find a good user respons to increase a quality of book and the duration reader shortly to understanding of one book. As a performace evaluation of digital book will try to find a satisfaction of user who read a book online by a good services. Furthermore, the intercation on digital book will be increase a quality of digital book when appear on market place digital book.

1.1 The Goal

(1). Provides a digital book with innovation user experience design; (2). Developing interactive and interaction user on the digital book products based on ubiquity smart reader ; (3). Evalution criteria user experience design especially for validation design, functionality and access distribution for smart readers

1.2 The Contribution

The development of autonomy learning resources with interactive digital book has the advantage of providing an outsourcing of digital based means through multiple resource sharing on smart education environment. Opportunities to develop an innovation excellent learning product using multimedia digital content. The services

focus for improving capabilities of students and lecturers at State University of Malang. This product hope to available and support a life-based learning project. Also the main contribution is a driven the multi-disciplinary research on site to provide an interactive digital book product by other department includes information sain, design and art, language, and also smart devices system.

1.3 Related Work

Development of smart education concept as the foundation of digital book making as independent learning source monitored with smart ubiquitous activity. According to the concept developed [8]. The essence of smart education is to create an intelligent environment using smart system and technology devices. Also smart pedagogy can be facilitated to provide personalized learning services and empower learners, and thus the talent of wisdom who have better value orientation, higher quality of thinking, and stronger behavior and ability can be nurtured. Based on this concept, the proposed digital book development has a research framework (Fig. 1). This framework illustrates three important elements of smart education: smart environment, smart pedagogy, and smart learners.

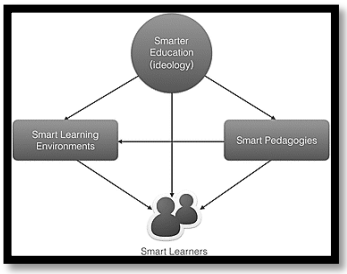


Fig. 1. Smart Education Framework

Smart education emphasizes ideology to pursue a better education and is therefore better credited as a smarter education, which meets the need for smart pedagogy as a learning environment and technological modern, and advances educational goals to grow and find smart learners. The smart environment can be strongly influenced by intelligent pedagogy. Smart pedagogy and smart environment support student development.

While research developed [6] which used monitoring system of e-book reader concentration in the classroom with artificial intelligent sensor. They have monitors various physiological signals when students read learning materials. Digital learning materials can provide reading concentration information to help tutors understand the learners' learning status in providing appropriate teaching strategies based on the level of concentration of digital reading. The assisted teaching features to fit the concept of tools in the smart classroom. Of course, facilities and infrastructure multi-access of digital books can not be separated from the conditions of use of digital divide in education. Refers to [9] campuses and communities where access to Internet devices and connectivity is unavailable or unreachable. One good reference is the

modernization of the E-rate program available to provide high-speed wireless access in schools across the country. But new digital differences and differences between students who use technology to create, design, build, explore, and collaborate and those who use technology to passively consume media. By itself, access to connectivity and devices does not guarantee access to quality educational or educational experience. Without careful intervention and attention to the way technology is used for learning, the sharing of digital usage can grow and even increase access to technology in schools/colleges.

2 Method

This research uses Design Thinking is a design methodology that provides a solution-based approach to solving problems [13]. The five stages of Design Thinking, are as follows: Empathise, Define (the problem), Ideate, Prototype, and Test as Fig. 2 below.

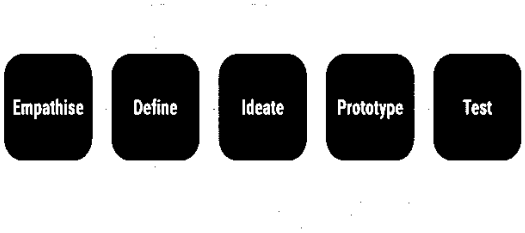


Fig. 2. DTP Methodology

- The first stage of the Design Thinking process is to gain an empathic understanding of the problem you are trying to solve. Empathy allows design thinkers to set aside his or her own assumptions about the world in order to gain insight into users and their needs.
- The Define stage will help the designers in your team gather great ideas to establish features, functions, and any other elements that will allow them to solve the problems or, at the very least, allow users to resolve issues themselves with the minimum of difficulty.
- Ideation techniques such as Brainstorm, idea sessions are typically used to stimulate free thinking and to expand the problem space. It is important to get as many ideas or problem solutions as possible at the beginning of the Ideation phase.
- Prototypes may be shared and tested within the team itself, in other departments, or on a small group of people outside the design team. This is an experimental phase, and the aim is to identify the best possible solution for each of the problems identified during the first three stages.
- The results generated during the testing phase are often used to redefine one or more problems and inform the understanding of the users, the conditions of use, how people think, behave, and feel, and to empathise.

2.1 Overview Research Development

Development of independent learning resources within the state univeristy of malang. An environment testing based user experience design to creating an autonomous learning system as show Fig. 3. So to find an user conditions show smart activity by a smart multimedia content to improve focus for smart readers. The materials or digital book products have learning standards and materials suitable for use in Life Based Learning programs.

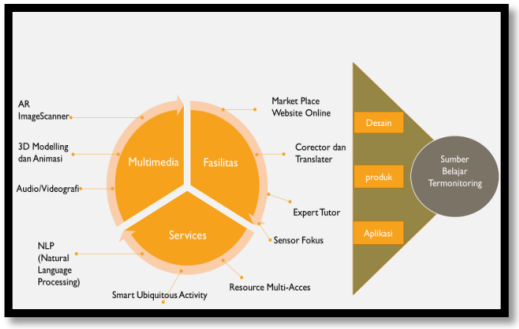


Fig. 3. Research Sceme and Target

3 Result and Discussion

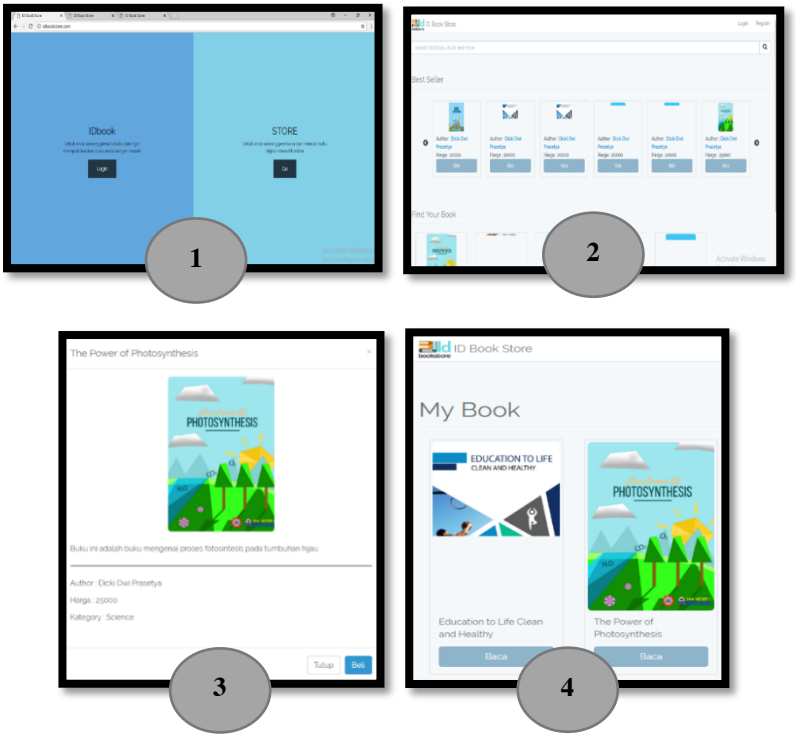




Fig. 4. User Experience Design Idbookstore

We introduce the result design and features based on user experience design as show on the diagram of application display with numbering from 1 to 9. Follow the

describe of functionality of idbookstore application will be arrange such as table 1 dan Fig. 4.

Table 1. Display user experience design Idbookstore apps

Number	Function
1	Main application consist of 2 services(Digital Book and Market Place)
2	Display of books based on categories
3	Display candidate book for buy user
4	Reading book interaction by a user from my book feature
5	Display multimedia content with direct interactive reading
6	Display dasboard and input data author
7	Upload book processing
8	Display list of book
9	Forum and chatting user to admin

In addition, we show a sample of Multimedia Content based AR media for interaction and interactive smart reader. We apply a regulary picture to understanding content of book using AR vizualization. As show in figure 5. The red circle indicate how object (man) do sport such as run exercise. The user can interact as direction speed control from low to high level. And then automatically object to be run more faster. This intercation can use the reader to understanding regulary sport for health activity by time duration related short time than no interaction AR on the content book manually or other digital book display.

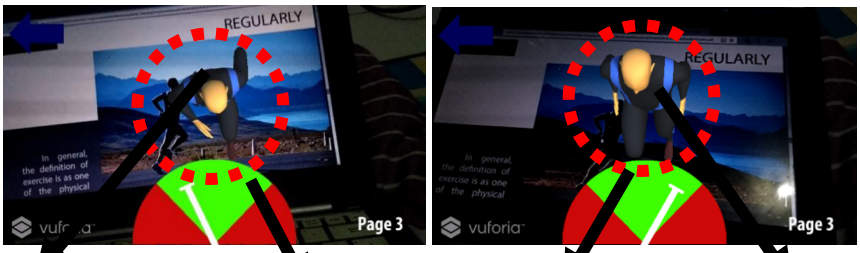


Fig. 5. Interactive and Interaction Reader with a Idbookstore Application

3.1 Evaluation criteria

In accordance with the characteristics idbookstore evaluated in accordance with the design for authors, electronic publishers, and developers of hardware and software. The evaluation criterion uses a review concept [1],[2] with HyperTextBook project. Both focus on developing a recommendation system on book design that visualizes

aspects of electronic book making electronically. While the evaluation criteria also consider the process of delivery of digital book to user by [3]. The limitations of learning media features cause visual communication to be difficult, so that the explanation of the material is less easy to understand, especially in relation to illustrations, sketches, diagram, and modeling. Therefore, a flexible learning media solution that can be used together is needed [10].

The following evaluation results are illustrated in table 1-3 with criteria on 3 aspects namely; (1). Layout and Design, (2), Content and Functionalities, (3). Device, Format, and Distribution. The evaluation was performed in accordance with the average user idlocked checklist with user 1 and 2. User 1 is a number of lecturers and teachers (25 people) and User 2 is a number of students and pupils (50 people).

Table 2. Layout and Design Evaluation

Number	Criteria	User I		User II	
		Yes	No	Yes	No
1	Does the layout of the idbookstore mimic the paper book or is it a cyberbook publication?	23	2	47	3
2	Does the idboostrore contain an informative cover, featuring the name of author, the title, the date of publication, and the publisher's details	25	0	49	1
3	Does it have a clearly defined or user-friendly layout (sections, chapters)?	22	3	45	5
4	Is it accompanied by a table of contents which provides an introduction to the content as well as the layout?	23	2	46	4
5	Is the content laid out on pages or within scrollable areas?	24	1	47	3
6	Are particular sections of the content (e.g. pages) labelled clearly through page numbering or any other system?	22	3	48	2
7	Does the interface feature other navigation clues which make particular elements of content accessible?	22	3	47	3
8	Are colour schemes used to aid searching?	24	1	48	2
9	Are the fonts visible?	23	2	47	3
10	Is the content indexed, so that necessary details, e.g. names or terminology, can be easily accessed?	21	4	46	4

Table 3. Content and Functionalities

Number	Criteria	User I		User II	
		Yes	No	Yes	No
1	Is the content delivered in manageable chunks, given the format of the idbookstore and the functionalities of the e-reading device?	25	0	48	2
2	Are related elements of the content hyperlinked?	23	2	47	3
3	Are multimedia/hypermedia part of the idbookstore	24	1	49	1
4	Do the multimedia/hypermedia enhance the content and constitute added value?	24	1	48	2
5	Is the idbookstore equipped with an advanced search	23	2	47	3

	tool which permits the reader to take a variety of search routes and use a range of search queries?				
6	Can the reader customise elements of the idbookstore to his own liking/needs?	24	1	48	2
7	Are bookmarking and annotation tools available to the reader?	21	4	45	5
8	Is the content supplemented with extra online materials, e.g. multimedia or companion websites?	25	0	50	0
9	Does the idbookstore feature usage data mining functionalities?	18	7	44	6
10	Can the idbookstore function as: a database, a narrative, a set of learning objects, a package of viewable resources or as imagery?	23	2	48	2

Table 4. Device, Format, and Distribution

Number	Criteria	User I		User II	
		Yes	No	Yes	No
1	Does the idbookstore require an e-reader which is relatively cheap and available?	22	3	47	3
2	Is the idbookstore file format open, i.e. will it be read by multiple brands of reading devices or a desktop computer?	24	1	48	2
3	Are reading rights restricted in any way, e.g. through a digital rights management (DRM) system?	19	6	43	7
4	Is the retail distribution of the format restricted in any way?	22	3	46	4
5	Is provide an interaction AR multimedia content ?	25	0	50	0
6	Is available micro video and streaming access?	24	1	48	2

Evaluation criteria are not all complete. Selectively selecting books with the language that best matches the material situation. The quality of content may appear a good presentation. For the thoughts of certain evaluators, a good criteria book does not necessarily meet all these criteria and the relevance of each should be assessed subjectively before the final list is compiled. Digital book evaluation should not be limited to content and software, but it should also embrace the hardware, e-readers, and the various digital formats available, which can also influence the efficacy of language-strengthened book instructions. The compilation results of the criteria show 92% of idbookstore qualify as a digital book repository that is eligible to display from data compilation table 2-4.

4 Conclusion

Evaluation of the use of digital books designed with the UI / UX concept on the website platform features interaction between readers and books with a variety of multimedia content to facilitate understanding of the subject being read. The content is arranged in accordance with the e-pub application by adjusting the visualization process such as images, videos, animation, auto-read, and illustrations. Added

interaction features with Augmented Reality media to facilitate additional book explanations and give readers interest in understanding the content visually. The design of making digital books that are included in the website platform is made to evaluate the experience of book readers that are embedded in the database system in an application called "idbookstore". The development of this digital book platform has been equipped with book category features, book recommendations, popular books, and digital book types. The results of book testing with the health category show the interest and ease of use of digital books through 3 test criteria, namely layout design, content and functionality, and the average distribution of the results of the usability platform evaluation is above 85 percent. In the future, the development of a recommendation system with a deep learning method will be used to find out which books readers need in the future according to the categories and preferences of books by readers. In addition, the text summarization process still needs to be developed to facilitate the synopsis of books that will be read by users.

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Evaluation of the index of similarity detected by Turnitin® in research projects of a master's degree in Higher Education

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Abstract. The objective of this study is to compile samples of errors extracted from research papers that illustrate the different conflicts in the theoretical sections after the application of the Turnitin® software. To do this, 28 theoretical sections were selected, drawn from research projects written by students of a master's degree in Higher Education at a private university in southern Peru in 2020. The design is non-experimental, cross-sectional with a quantitative approach. Descriptive statistics were used to analyze the data. The results show that with regard to the level of similarity found the documents analyzed are at level IV (50-74%), while the types of plagiarism with the greatest presence are "copy and paste" and "search and replace". Among the sources with a high coincidence index are theses and articles from scientific journals, while the section with the highest percentage of similarity and the highest number of cases of plagiarism is the theoretical framework. In this sense, the Turnitin software® is suitable for reporting the degree of similarity in research papers as it helps to detect signs of possible cases of plagiarism.

Keywords: Plagiarism, academic writing, originality, Turnitin**.**

1. Introduction

Intellectual work is an activity that must be done honestly and fairly, accepting the consequences of our actions at all times. One of its pillars is respect for intellectual property through compliance with rules and principles that encourage this action. However, acts that go against this principle have been on the increase, endangering the intellectual activity embodied in research works such as theses and scientific articles [1]. It is common that both teachers and students, regardless of the level or degree of studies, voluntarily or involuntarily omit to give credit to the authors from whom

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information is taken, which hinders the intellectual and professional development of whoever commits it [2].

The above describes what is understood as plagiarism, an act that is not always assumed as dishonest behavior but as a normal activity in the university [3]. The internet has contributed to reinforcing this idea since it offers the possibility of accessing a large amount of information, thus making thin the line that separates the legal from the illegal. This means that in the field of "downloadable", anything goes, there are no limits and everything can benefit whoever uses it. The original goes into the background and the field of reproduction is entered without giving credit to those who deserve it. This is a problem whose solution is not only to punish or punish whoever commits it, but also to educate and correct the offenders. This responsibility falls not only on teachers but also on the institutions affected by plagiarism in their prestige and the quality of their processes.

Beyond understanding plagiarism as an infringement of copyright, its practice is a reflection of the absence of academic writing skills that are not always promoted by universities. Writing at the university allows the acquisition and communication of the contents that are studied in the career and thus account for the learning and passing of courses [4], that is, it fulfills an epistemic, rhetorical and enabling function [5].

The use of tools to detect cases of plagiarism has become an ally in the fight against academic malpractices at all educational levels. Turnitin is a commercial product that was launched in 1997 to compare files uploaded by users with those on the Internet, with student documents that are stored in its repository and with indexed databases. Its objective is to ensure academic integrity, and since its creation it has been implementing various services that respond to the academic needs of the institutions that acquire it. Its use helps to detect and prevent possible cases of plagiarism by performing a match search and establishing a similarity index [6] [7] [8]. However, it is not enough to detect--universities need to educate. Detecting cases of dishonesty in time will help to detect the problem and correct it for the future.

1.1 Literature review

Over the years, the need to identify cases of plagiarism in writing processes in the university environment [9] has been increasing. Likewise, the thesis genre is one of those that has aroused the greatest interest among researchers in the areas of linguistics and education, given its role in the academic training of students. This document (thesis) allows, at the most advanced level, to take solid steps to enter the scientific community [10, 11]. This concern has led various authors to focus on proposing preventive and educational measures [12]. Of these, those that focus on the use of tools to detect cases of plagiarism as well as to verify the author's contribution on the subject (originality) stand out. Although there are various systems in the environment that allow evaluating the level of originality of the work carried out by students, Turnitin is one of the most popular and well-known given the alternatives it offers both students and teachers to maintain academic integrity in their scholarly activities [13].

By the same token, the studies that focus on analyzing the effectiveness of Turnitin as a resource to detect plagiarism [14], its impact on laboratory reports and argumentative

essays [15, 16], its use as a resource to support academic integrity to a higher level [17] [18], and its use to evaluate the practices of graduate students in the handling of sources [19]. Likewise, among the studies that have focused on analyzing plagiarism in undergraduate and graduate students, the one by Marsden et al. [20] on dishonest academic behaviors in Australian students, the study by Duff et al. [21] in students of a master's degree in engineering, and the study by Gilmore et al. [22] who conducted a comparative study between master's and doctoral students stand out. Lack of originality and plagiarism are the result of the lack of skills in academic writing, a problem that is sometimes not confronted by universities given the fact that few activities that promote the proper use of authorship recognition are organized. For this reason, software like Turnitin is used rather as a punitive mechanism than a training tool.

2. Method

A non-experimental, cross-sectional study with a quantitative approach was carried out. 28 research projects written by students of a master's degree in Higher Education from a private university in southern Peru in 2020 were selected. The projects were developed in the Research Workshop I course. For the analysis, only the theoretical sections of the projects (Statement of the problem, Justification and Theoretical framework) were analyzed since these allow to clearly distinguish the works of others with their own research [11], as well as to recognize and assess the writing skills (summarize and criticize) applied by the students to build the makeup of their work [23]. The projects were presented at the end of the course. It should be noted that, among the contents developed are those related to the essential aspects of the search and systematization of information as well as the process for the construction of the theoretical and methodological bases of the research, the process to reference the sources of consultation, and the importance of avoiding plagiarism and promoting academic integrity.

The Initial Similarity Index (ISI) report issued by the Turnitin software was used to determine the level of similarity and the type of plagiarism. The ISI can be found on the originality report issued by the software once the documents are uploaded. This report suggests an overall percentage of the student's text that matches the sources in their database and indicates the level of match with a colored (see Fig. 1). To determine the type of plagiarism, the researchers carried out a qualitative evaluation of the document in order to find the cases in which the student did not carry out the corresponding citation process. The cases in which the student correctly applied the process of registration and credit of the source (citation and reference) were excluded from the study. Once the cases of plagiarism had been detected, their quantification and classification ensue with the help of a matrix prepared in Excel and with registration and analysis sheets created for the study on the basis of the categories established by the software (see Table 1).

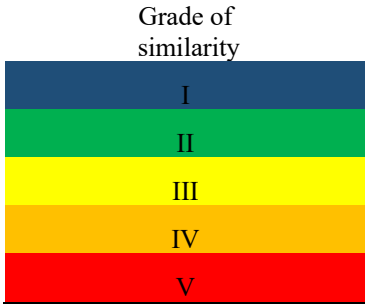


Fig. 1. Degrees of similarity used by the Turnitin software.

Table 1. Modalities of plagiarism

Modality	**Form in which it is presented**
Cloning	Presenting someone else's work as his/her own, reproduced verbatim.
Copy and paste	Including ample text passages from a single source without modifying them.
Search and replace	Changing keywords and expressions without altering the essential content of the sources.
Remix	Mixing paraphrased text extracted from multiple sources.
Recycling	Taking ample passages from a previous work of one's own without proper quotation.
Hybrid	Combining perfectly quoted sources with unquoted fragments or passages.
Mosaic	Material copied from multiple sources that fit well.
Error 404	Citing non-existent sources or including inaccurate information on sources.
Source RSS	Correct quoting of sources, but almost without including paragraphs created by the autor.
Reuse	Correct quoting of sources making too much use of the original text structure and/or words.

Note: Information taken from "10 unoriginal work modalities", by Turnitin, 2020. Retrieved from https://www.turnitin.com/static/plagiarism-spectrum/

3. Results

Percentage of similarity

The similarity index allows the reviewer to determine the student's contribution. Although logic leads to consider that the similarity index must be below the originality index (the latter understood as the content that the student contributes to the theoretical context of the study), various specialists have ventured to determine a permissible

standard percentage of similarity that can be between 15 and 20% without further technical support. The truth is that, whatever the percentage of similarity shown by the software, a qualitative analysis must be carried out to determine whether or not this percentage corresponds to duly cited information. Indicating a standard percentage can lead to create in the student a "false sense of security" [17] that in the long run can generate justifications for committing plagiarism or tolerance towards it. Regarding the level of similarity obtained by the works analyzed in this study, of the 28 projects evaluated, a maximum of 90% and a minimum of 7% were obtained as descriptive value.

The average value was 56.11% with a standard deviation of 22.63%. These results partially coincide with what was found by Tran et al. [13] who determined an average of 42.6% similarity in works carried out by Vietnamese university students, also with the results obtained by Bautista et al. [24] who, after analyzing the master's theses in social sciences, determined a level of plagiarism of 62%, and with the results obtained by Saldaña et al. [25] who investigated plagiarism in theses and in their advisers from the medical career of a public university in Peru, determining that, of 33 theses, 27 (82%) had evidence of plagiarism. Table 2 shows the degrees of similarity obtained.

Table 2. Degrees of similarity

Categories	fi	%
I (0%)	0	0
II (less than 25%)	0	0
III (25% to 49%)	8	28,6
IV (50% to 74%)	14	50,0
V (more than 74%)	6	21,4
Total	28	100,0

As can be seen, 50% of the jobs are at Level IV, a fact that is worrying. Although these results are already indications of possible plagiarism, when the students were notified, many of them argued that what had been presented "was a first version and that this would be corrected already in the thesis." Others, for their part, indicated that given the urgency to present the works "they had taken information from the sources without stopping to cite or reference the sources." These arguments support the idea that the theoretical component is complex since it implies the search and systematization of information, an action that few students claimed to have done.

Types of plagiarism

Regarding the types of plagiarism, these can be seen in Table 3. Plagiarism by "copy and paste" is presented as the type with the highest frequency. This result is repeated at other levels as in the case of high school students [12]. Likewise, the "search and replace" type (27.08%) is the second most frequent. These results are striking given that they are evidence of how little effort the students had put into creating their own theoretical content. The fact of copying entire fragments (including the quote) shows a rush to complete the task, and if searching and replacing information could mean a

slight effort to adapt the information, both types show an intention to plagiarize. When consulting the students about these cases, the arguments they provided were on the side of including the citation, that is, that it is not plagiarism because it was cited, despite the fact that the similarity report indicates that the entire component (text and abbreviated reference) had been taken from sources that the software accurately recognized. Although the software shows a possible case of plagiarism, it is important to point out that the differences between direct and indirect quotes were addressed during the sessions. One of the indications given in classes was that, if a text fragment is included, it is necessary for the author of the work to attach the fragment and add to the abbreviated reference, in addition to author and year, the page or pages, as this would provide a solution to the problem in a formal way.

Table 3. Types of plagiarism found

Type	Fi	%
Cloning	1	2.08
Copy and paste	25	52.08
Search and replace	13	27.08
Remix	2	4.17
Recycling	0	0.00
Hybrid	0	0.00
Mosaic	7	14.58
Error 404	0	0.00
Source RSS	0	0.00
Reuse	0	0.00
Total	48	100.00

Sources with the highest percentage of similarity

One of the options offered by Turnitin is to show the source whose information matches the one that appears in the theoretical section of the work. Turnitin compares the information with three databases or repositories: resources taken from the internet, student work stored in the system repository, and indexed academic scientific content. This option is relevant since it allows the institution to verify the origin of the content taken by the student and go, if need be, to the source itself. Another important aspect is that, as part of the contents of the Research Workshop I course, contents such as the search for information in academic databases and activities are included in which students must present a preliminary list of the scientific literature that will serve them as the basis for writing his/her thesis project. When evaluating which of the sources of origin of the information taken has the greatest presence, theses are placed first as one of the genres most consulted by students, followed by scientific journals (see Fig. 2).

Likewise, web pages and Wikipedia rank last with lower percentages. These data are positive, especially if one takes into account that the use of Internet resources is common not only in students in the training process but also in professionals from various specialties who prefer these sources because they are of immediate consultation, especially in the case from Wikipedia [26, 27, 28] and others such as Blogspot, Prezi and Scribd [24].

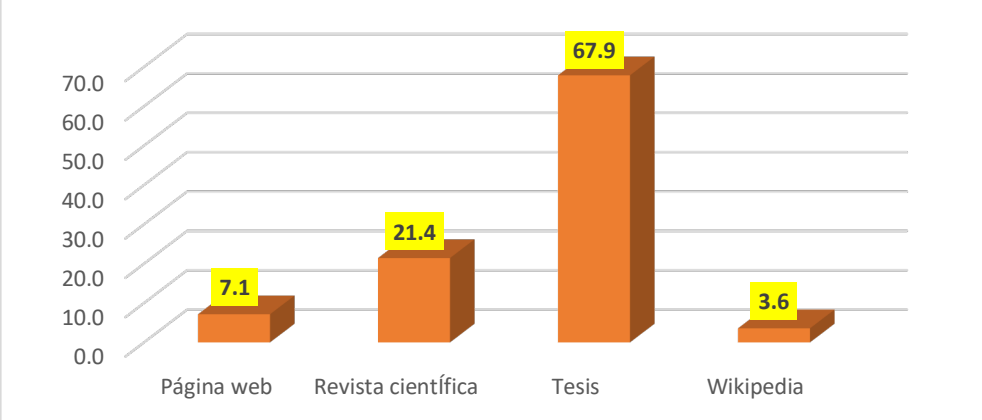


Fig. 2. Source type with higher percentage of similarity.

Theoretical sections

The purpose of the theoretical section of a thesis is to present the theoretical panorama of the chosen topic as well as the information gaps and justification for carrying out the study [29]. Authors such as Paltridge and Starfield [23] highlight how complicated it is to elaborate this section since its development requires, in addition to searching for information, reading it in order to prepare summaries, comments and critical analysis of the contents. Of the three components that were analyzed in the present study, the one that presented the greatest complications was the Theoretical framework, since this requires the use of one's own sources and external sources of information, which, in the words of Phillips and Pugh [30], allow the reader to recognize that the author has a command of the subject and the knowledge of the discipline in which the study belongs. In that sense, this section is the most vulnerable to plagiarism. This fact is demonstrated in the present study, where the theoretical frameworks concentrate the highest percentage of similarity (86.7%), as can be seen in Table 4.

Table 4. Sections with the greatest presence of similarity

Section	fi	%
Problem exposition	3	10.0
Justification	1	3.3
Theoretical framework	26	86.7

4. Conclusions

Any proposal that seeks to counteract dishonest behavior in the university must focus, above all, on understanding the phenomenon, which is not an easy task. Understanding the nature and facets of dishonest acts will help make better decisions at the institution level [20]. A cultural component underlies the way in which people perceive acts of academic dishonesty such as plagiarism, that is, the promotion and practice of certain habits that are dragged from high school to university and even at higher levels such as postgraduate [twenty-one]. Although it could be considered that, due to the years of student life in university, graduate students may have greater awareness of the norms and conventions for the avoidance of acts such as plagiarism, this is not always true, which leads teachers to insist on influencing the procedures for writing and referencing consultation sources [22].

The objective of this study was to collect samples of errors extracted from research papers that allow to illustrate the different conflicts in the theoretical sections after the application of the Turnitin software among posgraduate students. Regarding the level of similarity found, the analyzed documents are at level IV (50-74%), a result that shows possible cases of plagiarism as well as barely a small contribution from the student to the theoretical construction of the project. Regarding the type of plagiarism, “copy and paste” and “search and replace” are presented as the types most frequently resorted to. These results could be overcome by applying a correct handling and interpretation of the similarity index: reducing the tendency to easy things and developing sufficient skills for the construction of the theoretical section of the thesis project [31]. Among the sources with the highest rate of coincidence are theses (first place) and articles from scientific journals (second place), whereas sources such as web pages and Wikipedia are in the last place. The section that concentrates the highest percentage of similarity and the highest number of cases of plagiarism are the thesis’ theoretical bases, a foreseeable section since it is in this section where the author must combine his/her speech with that of others in order to give theoretical support to his/her proposal.

The evidence allows us to conclude that there are serious shortfalls in the management of sources, in the citation process and in the management of strategies and skills in the writing of academic texts by students. Although the process of searching and processing

scientific information is part of the course content, it is necessary to implement as a rule the feedback on the use of the software and on the implications of committing acts of plagiarism, which will lead students to apply and foster the principles of academic honesty, which will help promote originality in academic writing. Finally, it is recommended, to avoid cases of academic fraud such as plagiarism, to establish mechanisms for regulation, monitoring, detection and training from the early years in university. These mechanisms must be included in the regulations and academic guidelines as part of the academic integrity policies of the university. Likewise, it is advisable, as a preventive measure, to promote and regulate the use of plagiarism detection software, developing regulations for use consistent with the practice of academic writing with the help of digital resources such as plagiarism detection software, also training teachers, researchers and consultants of thesis on the use of these tools not only in the classroom but also in research activities. Taking this into consideration, the results of this study are important since they allow us to have evidence of a phenomenon that is not exclusive to the academic field but also to others, such as politics, advertising and communications.

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Strengthening capacities of an academic network of digital fabrication laboratories and the role of international collaboration in times of COVID-19

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Abstract. Technologies based on 3D printing are revolutionizing academia and public health. The objective of the article is to describe the activities of the Academic Network of Digital Fabrication Laboratories (Fab Lab) at Universidad Continental (Peru) in the context of COVID-19 pandemic. During period April-June 2020 more than 500 kits that included face shields were developed and distributed to public and private institutions nationwide. In addition, 3D-printed respirator valves for respirators were donated to public hospitals in Peru in order to keep COVID-19 patients who required oxygen alive. Moreover, Universidad Continental implemented seven multidisciplinary virtual learning courses on digital fabrication during the first semester of 2020. 91 students were trained on digital fabrication concepts and developed 13 research projects related to tackling the COVID-19 pandemic. Finally, the role of international academic collaborative networks to share resources and lessons learned is discussed during the COVID-19 crisis.

Keywords: Education, University, Digital Fabrication, Peru, Spain, SARS-CoV-2, COVID-19.

1 Introduction

The COVID-19 pandemic was a challenge for higher education worldwide. Social distancing and other control measures established during the COVID-19 pandemic generated a sudden change in the provision of education for students in higher education institutions worldwide [1,2]. Asian countries and Eastern Europe, being the first affected, had a short adaptation time to switch to digital learning education; while in Hong Kong the universities adapted well due to a previous history of implementing virtual classrooms [3]. However, many universities, especially in resource-constraint settings around the world, had serious problems due to lack of technological resources, infrastructure and sociocultural issues, so those countries took a long time to adapt to digital learning education [4,5]. A significant challenge for many low- and middle-income countries that university digital fabrication labs were lockdown [6] yet the

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gradual adoption of digital education with its wide range of digital resources and stimulation self-learning enabled them to overcome these challenges [7,8].

Due to the critical shortage or lack of personal protective equipment (PPE) in the context of the COVID-19 pandemic, digital fabrication laboratories around the world used their technological capacity to massively manufacture personal protective equipment and supplies necessary for the containment of the COVID-19 pandemic [9,10]. In Peru, the Fab Lab National Network (Fab Lab Peru) called for a collaboration of all the digital fabrication laboratories in the country to be able to produce face shields for healthcare workers during the pandemic [11,12]. This article describes the activities of the Academic Network of Digital Fabrication Laboratories (Fab Lab) at Universidad Continental (Peru) in the context of the COVID-19 pandemic. In addition, the role of the national and international academic collaborative networks to share lessons learned is discussed during the COVID-19 crisis.

2 Activities of the Academic Network of Digital Fabrication Laboratories (Fab Lab) at Universidad Continental (Peru) in the context of the COVID-19 pandemic

Peru, as many countries in the world, suffered from a critical shortage or lack of PPE for healthcare workers and people that provided services to the citizens, specially at the beginning of the pandemic [13] The Academic Network of Digital Fabrication Laboratories (Fab Lab) at Universidad Continental in Peru is comprised of four digital fabrication laboratories located in the following campuses: Huancayo, Lima, Arequipa and Cuzco. In the context of COVID-19, this effort was initiated during the last week of March 2020 after it was realized that digital fabrication could have a significant role to the PPE shortage for healthcare frontline workers [14].

Face shields production kits. Since April 2020, Universidad Continental began to manufacture protective face shields and three stages were developed: 1). Acquisition of 3D files; 2) Validation and adjustment of parameters; and 3) 3D printing.

For the 3D file acquisition stage, a file entitled "Easy 3D printed face shield"(15) was downloaded from the "Thingiverse" website in STL file, which loads the geometry of the three-dimensional file. Regarding 3D modeling for size validation and parameter adjustment, different specialized graphic computer programs, such as Inventor and Autocad, were tested to redesign the 3D modeling of the protective visor for adaptation to the Peruvian biotype. In addition, the Ultimaker Cura program was used for the validation of the 3D printing parameters and export them in Standard Triangle Language (STL) files. Regarding the 3D printing stage, it was decided initially to produce the face shields with the printers: Colido X3045 and Ultimaker 2+. The face shields took initially about 2 hours 30 minutes to manufacture. However, it was later decided to develop kiwi-type face shields using transparent polycarbonate sheets manufactured with laser cutters, since they were produced in less time (compared to 3D printing) and due to the feasibility of mass production.

During April to June 2020, more than 500 face shields production kit donations were made, which included a face shield, a disinfection manual and a zero-contact clamp, which were distributed from the four laboratories of the Network of Digital Fabrication Laboratories at Universidad Continental to diverse public and private institutions in Peru, including: Regional Medical College of Physicians of Junin, Continental Clinic in Huancayo, Regional Medical College of Physicians of Arequipa, Ate Vitarte Emergency Hospital, and Condorcanqui District Municipality. Face shields were evaluated before their production by medical doctors who worked in hospitals in Lima (José Casimiro Ulloa Emergency Hospital, Ate Vitarte Emergency Hospital) and Ramiro Prialé Hospital in Huancayo.

3D-printed respirator valves for respirators. The team made the following 3D printed respirator for respirators: Charlotte and PEEP (positive end-expiratory pressure) [16]. Those valves were used for non-invasive ventilation systems and were donated to public hospitals in Huancayo (Junin) in order to keep COVID-19 patients who required oxygen alive.

2.1 Strengthening capacities through Fab Lab multidisciplinary virtual learning courses

On August 2019, the Academic Network of Digital Fabrication Laboratories (Fab Lab) at Universidad Continental (available at: https://fablab.ucontinental.edu.pe/) began the design of an academic curriculum with a multidisciplinary faculty group that incorporates digital fabrication technologies in academic programs. On September 2019, our proposal was piloted in the following three in-person courses at the Arequipa campus: Design of Mechanical Systems, Architectural Projects IV and Design of Industrial Plants.

Module 1 provided: the basic concepts on digital fabrication, information retrieval (searching databases such as: SCOPUS, Web of Science and SciELO, web page design using the following resources: Nicepage and Github platform. Finally, students were instructed to use 2D Design and 3D Freeware online tools to start designing their projects.

Module 2 provided the basics of laser cutter, 3D printing, CNC machining, vinyl cutting plotter. Project deliverables included: web page, reports, infographics and videos.

Module 3 provided the following topics: project repositories related to courses, rapid prototyping tools, project management. During the field testing, the prototype interacts with clients and/or end users. All three modules were developed throughout weeks 1 to 15 (Table 1).
In general, 85% satisfaction rate was rated among students in the three courses involving 50 students.

Table 1. Modules of the Digital Fabrication Curriculum at Universidad Continental.

Module 1 (Week 1 - 5)	Module 2 (Week 6 - 10)	Module 3 (Week 11 – 15)
Introduction to Fabrication Digital	Laser Cutter	Project Repositories
Databases and Information Retrieval: SCOPUS, Web of Science SciELO	3D Printing	Rapid Prototyping Tools
Management Project	CNC Machining	Field Testing
Web Page Design	Vinyl Cutting plotter	Project Deliverable
2D / 3D Design		

2.2 Digital Fabrication Curriculum during the COVID-19 Pandemic

In March 2020, due to the COVID-19 pandemic, seven multidisciplinary virtual learning courses on digital fabrication were adapted and implemented (Table 2). 91 students from there campus (Huancayo, Lima, Arequipa) were trained on digital fabrication concepts and developed 13 research projects related to tackling the COVID-19 pandemic.

Table 2. List of virtual learning courses on digital fabrication (March-July 2020)

Courses	Academic program	Semester	N° Students
Mechanical Systems Design	Mechanical Engineering	VIII	17
Biomechanics, Ergonomics and Occupational Health	Medical Technology	VI	21
Innovation and Technological Management	Industrial Engineering	VIII	24
Industrial Design	Industrial Engineering	VII	13
Digital Representation I	Architecture	III	1
Architectural Projects III	Architecture	III	1
Architectural Projects IV	Architecture	IV	14
Total			91

2.3 Satisfaction survey

The following four criteria for the satisfaction survey were considered: Support for the prototyping phase, where one member of the technical team (Fabber Tech) printed the student design and then, the prototype was delivered to students home address in order to complete their final projects; Teaching materials (included: presentations, guidelines and multimedia resources), the methodology during virtual classes (flipped classroom, and problem based learning); and finally the Fabber Tech who provided support to the students (Table 3). An overall satisfaction rate of 87.57% were achieved among students.

	Mechanical Systems Design	Biomechanics, Ergonomics and Occupational Health	Innovation and Technological Management	Industrial Design	Digital Representation I	Architectural Projects III	Architectural Projects IV
Support for the prototyping phase	90 %	90 %	78.88 %	74.81 %	100 %	100 %	80.90 %
Teaching materials	84 %	88 %	80.83 %	70.37 %	73.3 %	73.3 %	81.90 %
Methodology	87 %	85 %	83.61 %	68.14 %	100 %	100 %	81.90 %
Fabber Tech	95 %	93 %	84.41 %	81.41 %	100 %	100 %	80.95 %
General	87 %	89 %	81.93 %	73.68 %	100 %	100 %	81.41 %

Table 3. Result of period 2020-10 satisfaction survey.

2.4 IX Engineering Project Fair (July 2020)

Engineering students had the opportunity to present their digital fabrication projects at the IX Engineering Project Fair (July 2020) entitled: "Towards finding engineering solutions to tackle COVID-19", held on July 24, 2020. The keynote lecture was given by one of the authors (CL) who shared the experience of digital fabrication applied to architecture and engineering at the Fab Lab Madrid CEU (Spain).

3 The role of international academic collaborative networks to share resources and lessons learned during the COVID-19 crisis.

Among the most outstanding international academic initiatives among Fab Labs globally, it is worth highlighting the work developed by the Center for Bits and Atoms (CBA) of the Massachusetts Institute of Technology (MIT) [17] focused not only on the design and manufacture of equipment and devices to support the fight against COVID-19, but also to support the Fab Labs community, fostering collaboration, sharing through their institutional repository standards related to materials, protocols, among other resources [18].

Also, it is important to point out the collaboration between the Fab Labs of Stanford University, Brown University and the University of Utah that involved more than 120 students in the design and manufacture of a respirator [19] that is in phase of validation in India, Kenya and Nepal, where they will be manufactured on a large scale. Those universities have incorporated simulation tools in their classes so that students can view their models (Cornell Tech's Maker Lab), others have used augmented reality technologies (Fab Lab Madrid CEU), some broadcasted their classes by videoconference using Go-pro cameras, which allowed students to visualize the operation of the machines by the lab instructor (Rice University's Oshman Engineering Design Kitchen). Other universities decided to mail kits of electronics materials and tools to their students (UCLA Samueli Makerspace Engineering School) and some even chose to design machines and provide students with materials so that they could manufacture them in their homes (IAAC, Fab Lab Barcelona).

A report prepared by the Fab Foundation [20] based on information collected from more than sixty Fab Labs distributed around the world and carried out in May 2020 reveals the impact that Fab Labs have had on their local communities during the crisis due to the COVID-19 pandemic. The conclusions of the Fab Foundation report show that, although the lockdown, 61.9% of the Fab Labs that responded to the survey, found a way to remain open or partially opened and got involved in the manufacture and distribution of PPE and medical devices for healthcare personnel distributed locally to hospitals, health centers, and those who needed the most, and most of which were donated for free, sharing the designs based on open source licenses.

It should be noted that local initiatives were developed in the United States, such as the one that joined the Chicago Fab Lab (The Wanger Family Fab Lab) [21] with the city's Makerspaces network to create a virtual community, the Illinois PPE Network (22), organizing the production and distribution of 6,500 daily face screens that were distributed for free to more than 100 hospitals in the Chicago area.

In Europe, the collaboration between Fab Lab Madrid CEU and the Coronavirus Makers Madrid [23], produced more than 300,000 PPE (Fig. 1) that were distributed among hospitals and health centers. With more than 20,000 volunteers throughout the country, the Coronavirus Makers initiative [24] managed to manufacture more than 1.5 million personal protective equipment nationwide.



Figure 1. Personal protective equipment manufactured at Fab Lab Madrid CEU (left) and Coronavirus Makers face screen model validated by the authorities (right).
Image source: Covadonga Lorenzo.

In Italy, the Fab Lab Western Sicily, in collaboration with the Italian maker network, focused on the manufacture of thousands of Ventury and Charlotte valves for respirators, which were in short supply during the early phases of the pandemic, which made possible to connect diving masks with a respirator, to help the most seriously ill patients [25].

On the African continent, Fab Lab Rwanda [26] and Fab Lab Nairobi [27] worked in collaboration with the Fab Lab Network and local authorities in the design, manufacture and validation of respirators, oximeters and protective equipment for local hospitals.

Finally, in Asia, it is worth highlighting the work of laboratories such as Fab Lab DhakaFab Lab Vigyan Ashram or BSDU Fab Lab, which manufactured masks, facial protection screens and other medical equipment since the beginning of the pandemic, and were manufactured only in India, more than 2 million open source equipment's [28,29].

4 Final remarks

The crisis caused by the COVID-19 pandemic has demonstrated the important role for digital fabrication regarding the design, prototyping and validation processes of prototypes when manufacturing medical devices and PPE using 3D printing and laser cutter technologies, and even on a large scale when working collaboratively with local communities [10,30]. Local and international collaboration have been a key issue for digital fabrication, as well as for other topics such as digital health [31,32]. In addition, we presented the case of Universidad Continental that implemented seven multidisciplinary virtual learning courses on digital fabrication during the first semester of 2020. We continue currently accompanying 211 students are participating in 07 multidisciplinary courses on digital fabrication. Therefore, more than 300 students were trained on digital fabrication concepts and developed innovative research projects related to tackling the COVID-19 pandemic during 2020.

We also present the important role of collaboration to establish links between laboratories, universities, companies and local institutions, in order to support the communities most in need during the toughest phases of the pandemic. This paper shows the potential of fabrication digital technologies and the importance as live spaces that promote co-creation, but also as spaces for social innovation and to build capacity for a next generation of interdisciplinary students.

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Measuring Students' Competencies with ShareLook as a Digital Portfolio

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Abstract. The growing need for STEAM Education is a key indicating emphasis of the importance of competencies and skills. This new paradigm shift is playing a crucial role for jobseekers in a world soon to be dominated by polarization. One of the main objectives of Tsing Hua STEAM School is to explore the feasibility of measuring learners' competencies in STEAM Education with the use of a digital portfolio, to ensure the employability of graduating students in Taiwan. For this paper, we will be partnering with ShareLook to explore how critical thinking is being developed in the learners.

Keywords: STEAM Education, Tsing Hua STEAM School, Critical Thinking, ShareLook

1 Introduction

The composition of jobs and skills demanded by employers have changed dramatically due to technological advancements [1]; whereby mid-skill jobs disappear because of increased mechanization and digitization of routine tasks. This phenomenon is termed job polarization [2]. To ensure workers stay employed in the new industry, America is advocating STEM Education strongly [3]. To combat the same challenges in Taiwan, the revised Curriculum Guidelines of the 12-Year Basic Education [4] placed a greater emphasis on achievement of competencies. Tsing Hua STEAM School [5] was started in 2018 with an intention to help teachers leverage on DDMT Model [6] in relooking lessons design. The biggest differentiator is that competencies are 'soft skills' and should not be measured using the traditional 'pen & paper' test. Many academics and research in recent times have pointed to the use of a digital portfolio [7] in tracking the progress of the learners as they display competencies such as critical thinking, communication and problem-solving. The aim

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of this paper was to suggest how the Technology Acceptance Model increases user motivation of a digital portfolio; and how ShareLook can seek to capture the communication and critical thinking process of the learners.

2 Related Work

2.1 Technology Acceptance Model

The growing technology needs brought about by Industry 4.0 has resulted in many providers jumping on the bandwagons to provide new systems for adoption, this has also accounted for increasing failures of system adoptions in organizations; thus predicting system usage is paramount for system adoption to happen [8]. For this study, I will be using Technology Acceptance Model (TAM) to predict user motivation of ShareLook.

Technology Acceptance Model was first proposed by Davis in 1985; where system use is a response that can be explained or predicted by user motivation which is influenced by external stimulus consisting of the system's features and capabilities [9]. In his model, users' motivation can be explained by three factors: Perceived Ease of Use, Perceived Usefulness and Attitude Toward Using the system. According to Davis [10], the definitions for Perceived Ease of Use and Perceived Usefulness are:

> "Perceived usefulness: the degree to which an individual believes that using a particular system would enhance his or her job performance.
> Perceived ease of use: The degree to which an individual believes that using a particular system would be free of physical and mental effort."

Davis et al. further suggested in 1989 that 'attitude towards using the system' be revised to 'behavioral intention' as individuals will use the system without forming any attitude if system is useful. Venkatesh [11] identified two main groups of antecedents for perceived ease of use in 2000: anchors and adjustments. Please find below a graphical representation of extending TAM to include determinants for perceived ease of use in Fig. 1.

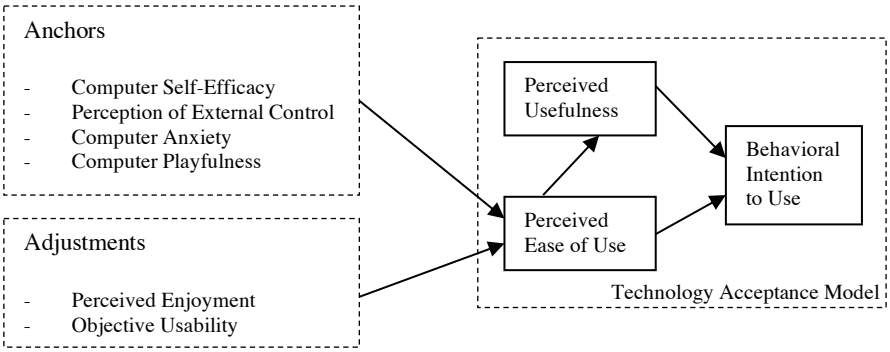


Fig 1 Extending TAM to include determinants for perceived ease of use

2.2 ShareLook

ShareLook is a pioneer in multimedia-based E-learning and mobile learning founded by Raanan Nedivi. Previously enrolled as a doctoral student in Biochemistry, he envisioned a growing demand for demand for multimedia-based education due to the onset of technology and made a switch to producing online interactive training videos industry and academic institutions. Headquartered in Singapore, Raanan has assembled a team of learning designers and programmers from Kenya, Thailand, and Nepal with a global vision of refining and preparing ShareLook for international usage. ShareLook as a platform checks many of the boxes by Venkatesh's extended model of Extending TAM (Figure)to include determinants for perceived ease of use. For example, ShareLook has integrated live webinars and text-to-speech features under its 'Live Events'. In addition, a transcript can be generated 30 minutes after the event has concluded, making it easy to replicate and translate to another language with ease. To encourage 'Anytime, Anywhere Learning' [12], concluded webinars can then be found in the Marketplace for learners to access at their own convenience.

A second feature is ShareLook's ability to connect learners internationally. As an online system that has undergone rigorous penetration testing, grouping international students is enticing for educators eager to develop students' competencies in a safe environment. Finally educators with a low level of self-efficacy in computers will feel confident to create content and assessments upon internalization of the DDMT Model [5], which is contributing factor of 'Perceived Usefulness'. The next stage of development is to integrate Artificial Intelligence into the digital portfolio segment; where students will be guided to address other areas of competencies based on rubrics developed by educators.

3 Participants and Settings

AnXing Elementary School in Hsinchu County was established on 1st August 2016 and officially began to enroll 1st grade students the same year. Every year, one grade level is added to the enrolment of the school. By 2020, it has enrolled approximately 1500 students, distributed within 52 classes from Grades 1-5. Through the joint efforts of the teachers, students, and Parents Support Group (PSG), the school's vision of 21st century global literacy has finally been integrated into the school curriculum. In addition to teaching the 12 Year Basic Education curriculum set by the state, teachers have an added responsibility of developing a customized curriculum for Chinese Art and Science subjects. We believe that the 21st Century is an era of increased collaboration between citizens from countries around the world. To achieve this heighten level of collaboration, apart from a strong literary foundation provided by our 12 Year Basic Education, providing our students with additional depth in language and science can enable them to have higher and further aspirations. The cultivation of art and literature can also enable students to develop values such as respect, inclusiveness and appreciation for global perspectives.

A total of 28 students will be participating in this research study. Their ages span between 9 and 11, or Grade 3 to 5 students. A big driving force for these students are the influences of their parents. Majority of the parents are involved in occupations at the nearby Science Park, a place similar to Silicon Valley for technology services. Another driving factor from working in the Science Park is the emphasis on globalization and skills necessary in Industry 4.0.

For this research, 28 students will be further grouped into 4 groups, each group led by a different instructor as they are guided to provide a solution for a problem around their lives based on the DDMT Model; Design, Discover, Model & Modelling and transfer. This study takes place over 30 hours (3 hours per session) as the students document their weekly progress using ShareLook.

4 Results

The following problem statements are crafted by the elementary students based on the DDMT Model [5]. They are:

- Building a safe and healthy schoolbag for elementary students
- Protecting the beauty of flora
- Creating a smoke-free environment
- Eradicating killer litter

Each problem statement is crafted by the students within the group as a problem that is critical to the students. As each group of 7 students are led through the four phases of 'Discover', 'Define', 'Model & Modelling' and 'Transfer', their learning progression were captured using ShareLook which the trainers had to create a course matching an assignment to each phase prior to the activities. For this study, a total of 4 assignments was created, one for each phase. Please refer to Fig. 2 and 3, depicting how courses can be created on ShareLook.

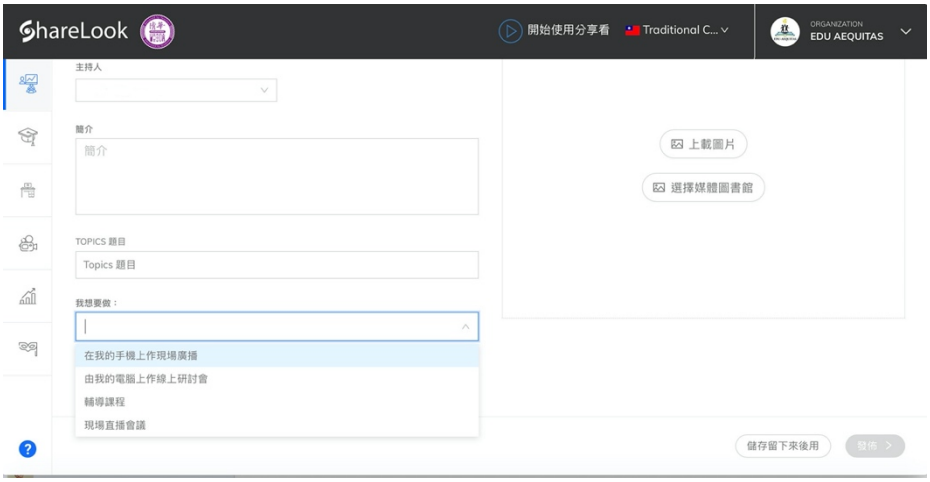


Fig 2 Creating a course in ShareLook

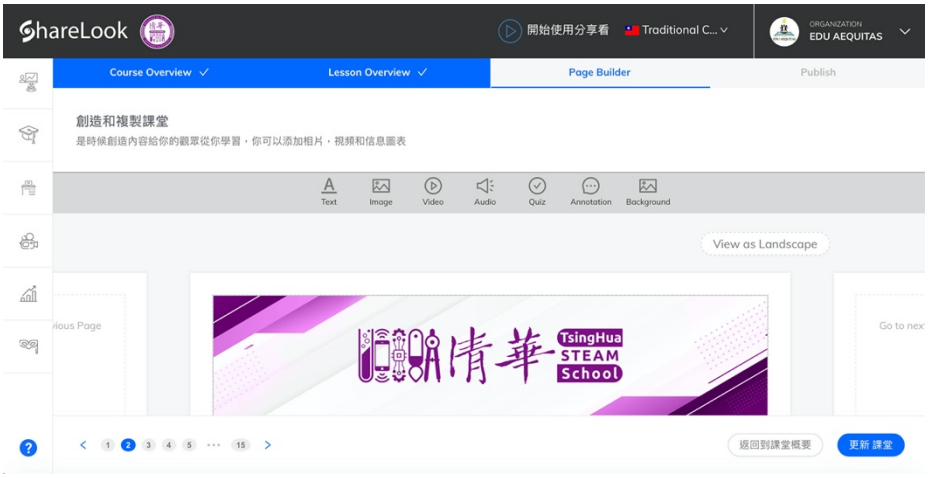


Fig. 3 A created course on ShareLook

A powerful feature highlighted by the trainers in the creation process is the ability to toggle between languages. This highly aligns to an important objective listed in the 12 Year Basic Education [4] of grooming a global citizen. It also falls nicely under the 'Perceived Usefulness' column of the TAM model, thereby enhancing the motivation for users. On the other hand, because the system is structured clearly with instructions, students can upload their work easily and timely through their mobile devices, allowing a more accurate reflection of their thinking and competencies at selected intervals. This is in line to the idea of a digital portfolio for measuring competencies [7].

5 Further Considerations

Although the research has proven adequate the use of a digital portfolio to document critical thinking, improvements could be applied to further strengthen the study. Firstly, I would like to insert one more assignment into each phase of the DDMT Model to have a pre and post comparison between each phase. This would imply that the trainer needs to re-define the learning outcomes for each phase very clearly in order to draw out the desired outcomes. Secondly, I would want to take the proposed and completed solution for trial in another area to demonstrate the understanding of the 'Transfer' phase. It would also be good for the system to capture any modifications made to their solutions in the new environment.

6 Conclusions

The use of a digital portfolio serves as a powerful indicator of following the learners' thoughts through the learning process. In this study, through the capturing of assignments at different junctions, the digital portfolio captures the multiple perspectives provided by the students in their attempt to solve their problem statement. Learning to solve a problem in different perspectives is a good indicator of critical thinking abilities [13]. It is also important to note that while TAM has shown evidence to increase trainers and students' motivation to use ShareLook, the organization, 'Tsing Hua STEAM School' does play a part in selecting ShareLook as the platform. The real success of this study would be evident if educators from AnXing Elementary School adopt ShareLook in the long run.

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- Jenny Liao, Student Trainer, National Tsing Hua University
- Stephen Hsu, Student Trainer, National Tsing Hua University

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Use of music to enable the social inclusion of deaf children using robotics and recreational activities

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Abstract. This project demonstrates challenges encountered in the inclusion of children with hearing impairment in music learning and presents how society sees these children, seeks to know how deaf people see music, presents reports of deaf people who have had contact with music and how it has helped them in society and seeks to evaluate visual elements combined with robotics in the practical teaching performed with deaf children. It is envisioned with this work to present how technology can be a differential in the practice of music teaching and an aid to generate social inclusion of deaf children, allowing their contact with hearing people in all places with audible events.

Keywords: hearing impaired children, deaf community and culture, colorful musical elements, deaf aid technology applications, robotics in music.

1 Introduction

At different moments in history and school policy in Brazil, music education was present in the context, always marked by difficulties, the process of building music teaching was marked by document elaborations and actions that were the result of struggles to insert it in schools. Thus, higher education institutions created undergraduate courses in Artistic Education by legal determination, thus working the teaching of visual, performing, and musical arts. On the other hand, the use of these different languages as consequence generated the weakening of music education in schools, and over time was replaced by only fine arts, which contributed to the disappearance of music as cited [1].

In view of this [2] believes that music should not only be worked as a discipline, but be worked in a thorough way by professionals with solid knowledge of it to pass a solid knowledge to those who study it, she says this because it analyzes that teachers without musical training summarize in practical musical foundations only activities such as singing or musical listening with basic information. Thus it is difficult to imagine that teachers with the ability to teach early beings would have conception of music teaching equally to a teacher prepared and licensed for the teaching of music, because they obtained in their curriculum, the theoretical, practical way, the expressive form of music teaching, and finally one of the most relevant items, acquired techniques to be able to teach the mastery of musical instruments to children

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as mentioned [3], the self still defends how important music is being taught in schools for better cognitive development of children.
The author [3] also proposed some questions to be analyzed in this world of music education in schools, one of them is to analyze the fact that a teacher not licensed in music guiding children, the error inserted in this medium also, of teachers not graduated in music, teach this specific subject in schools. Another factor that is also relevant is the consideration of equality between teachers with musical training or not according to law 11,769 in 2008. Thus, it is intended to seek new alternatives that can help meet these needs in schools in the musical sphere, for this it is necessary to explore the technological means to be as an aid of music learning in schools, in addition there are cases of children with very specific needs, such as hearing impairment, which would be another case study factor for music teaching.
Currently in Brazil there are different types of deficiencies, and it can be auditory that is the theme, or visual, motor, with its degrees of severity. In the case of auditory, according to census data, it reached the third position, lagging the visual, and motor impairment, which occupies the first general position [3].
This research sought to delimit the theme, comprising a search for bibliographic references in relation to the theme, thus we were aware of several articles and books among which we highlight an article of [4] with the name "Deafness and Music: is this a paradox?" where this same author also has a doctoral thesis with the theme "Teaching Music to deaf students: perspectives for inclusive pedagogical action", among the various books analyzed we find the book "The musicality of the deaf: representation and stigma" of the researcher Nadir Haguiara-Cervellini, we had other articles and books used as a theoretical basis, but all the others were musical currents and others pointed to libras learning.
The formation of deaf individuals has broken many paradigms that until a few years ago represented unique models, and has allowed deaf people to have new opportunities, such as going to a cinema, to a park, to school and being able to interact simply, and being able to learn music and feel it like other people.

2 Use of colors in music to aid deaf people

For several years, researchers tried to relate musical notes with colors and even in the old east these relationships were made between these two [5]. We will show below a table where the relationship made by several researchers during the centuries that sought to idealize this relationship between music and colors is presented in Fig. 1:

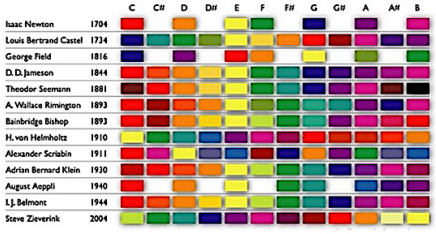


Fig 1. Three centuries of color scales

It is possible to analyze in this table that the relationships do not follow the same pattern between colors and intervals of musical notes, because there were many personal perceptions among the researchers, which means that there was only meaning for those who defined them. For this reason, there is a need for a standardization between music and colors, so that the learning process can be carried out through audiovisuality and show efficiency.
[6] is also used for a relationship between colors and musical notes with purpose in the frequencies of sounds and frequency of colors. With this thought of analyzing the low colors (430x1012) which in this case represents the red with darker tint and making use of the concept of tuning (There 440 Hertz), the researcher noticed that the tone that has the closest relationship would be the SUN that is below the A 392 Hertz. The comparison is perfect, but it is concluded that it is not all frequencies that are equivalent in tones due to the temperate nature of the tuning in the west.
In Fig. 2 we show the Law of the Octaves/Periodic Law, which deal with the underlying ratio of the vibration scale and thus, therefore, is the basis for all theories that relate to the relationships between colors and musical notes (the repetition of the notes on the board means the sharp "#") [6].

Color frequency	*Color name*	*Frequency 40 octaves below*	*note name*	*Freand note quorum*	*Difference*
430 (x 1012)	Red	391,3	Sun	392	0,7
460 (x 1012)	Red / Orange	418,6	Sun	415	3,6
490 (x 1012)	Orange	445,9	There	440	5,9
520 (x 1012)	Yellow	473,2	There	466	7,2
550 (x 1012)	Lemon	500,5	You	494	6,5
580 (x 1012)	Green	527,8	C	524	3,8
610 (x 1012)	Turquoise	555,1	C	555	0,1
640 (x 1012)	Blue	582,3	Defendant	588	5,7
680 (x 1012)	Indigo	618,7	Defendant	623	4,3
720 (x 1012)	Dark Violet	655,1	Mi	669	13,9
760 (x 1012)	Violet Lighter	691,5	Make	700	8,5
800 (x 1012)	Ultraviolet	727,9	Make	742	14,1

Fig. 2. Sound and Color Frequencies

This research becomes interesting because of the musical notes and colors in the music are constituted of frequencies, but there is a problem that the musical note is always a single color or vice versa, so the relationship that the musical note has with a color would have a lot of variation, and every moment would have other colors.
A researcher in the Arts department of PUC-RJ made a relationship between music and colors, in the case of Celso Braga Wilmer (1948). The same has training in visual communication, mathematics, and music, of which were the researcher developed a project to facilitate the learning of reading sheet music as quoted [6].
Wilmer developed a work focused on the musical pedagogical form, focused on the understanding of music through sheet music, so he named his work "Rainbow Score". The aim of this study was to adapt traditional cores to provide a form of ease to music students with established musical symbols, where Wilmer saw themes [7]. abstracts.
Based on the levels of abstraction of learning of Jean Piaget (1896-1980), the project sought to insert the score already existing within a presentation of the chromatic

model that he himself adopted, applying the scales and shades the largest and smallest in its duration, harmonic and melodic, etc. Thus, after the application of Wilmer's project are the degrees of the musical scales that receive the colors and cease to be the tones, as a kind of figure on a background [6]. You can see below how this relationship works in the Fig. 3.

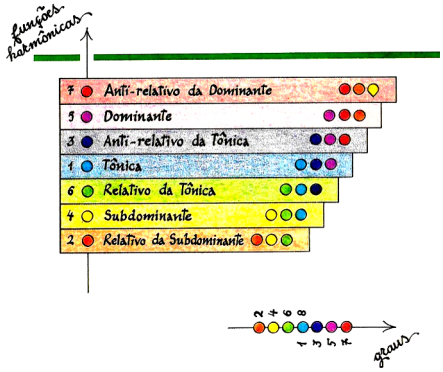


Fig. 3. Harmonic functions with colors.

Still dealing with harmonic functions, the researcher Wilmer made a relationship between musical intervals and colors very different from previous researchers, and so many others of today, the work proposed by the same is somewhat effective, and this can be seen as a great principle for analyzing music using colors, is considered relational character what notes and colors can have in a given music.

Another project that deserves to be mentioned is the "CO. Diesis" which was conceived by the Balearic Islands University in Spain, where it was developed thinking of blind people and works the relationship of colors with sound, where color becomes sound[7]. This work was a pathway for the software "CromoTMusic" that also stands out in this concept.

The principle of work is to transform sounds into colors for blind people, already in the background one has the idea of working on the transformation of musical notes into colors to help deaf people in contact with music. At the point of view of audiovisuality the circumstance cited is very important because we speak of two deficiencies (hearing and vision) that are treated in audiovisuality one of them deafness can be compensated through colors, in the case of contact with music.

3 Methodology

In this project we present to the child's deaf fundamentals of music, such as musical notes, rhythms and tempo of the compass, coming out of the traditional way that makes use only of a book, a blackboard or any other medium other than with the use of technology, in this way will be made the use of the following materials:

- *Mbot robot adapted with a single LED that supports 7 colors / bluetooth.*

- *USB vibratory bracelet could not find a bluetooth bracelet.*
- *Grand piano Roland,*
- *iPad-Pro,*
- *Python language to configure the robot.*
- *Editom for demonstration (SOL clave).*

To achieve the goal in the experiments we will work with a robot integrated with Scratch that is a programming language composed of blocks created by Papert in 2008, and more specifically use it adapted in a version of Makeblock, so we will have the possibility to control the robot and its resources through a mobile device, this can be a mobile phone, tablet or iPad, where children will make combinations in the application.
Before starting any activity with the robot, we will teach the concepts of the project so that children can understand what each item means during the practice of recreational activities, because none of the children has musical knowledge, this in the theoretical and practical scope. In this way we will teach the combinations between colors and musical notes proposed by Wilmer, and musical concept based on BONA which is a book intended for teaching musical concepts.
After the children know the musical notes combined with colors and have a basis of what each color means in the musical pentagram we will move on to the second part of the experiments that concerns rhythmic time, we will insert the concept of musical time in the activities. The child will know the rhythmic time equivalences used in music using the robot's movements.
A group of 7 children aged between 5 and 9 years was selected to do the musical experiment using robotics and playful activities with applications. Among these children 6 have hearing problems and need interpreters to help them in communication and 1 of them listens normally and will be a model for the other children when performing the activities. Throughout the process there was consent of their guardians and we were assisted by 4 monitors who were psychologists and pedagogues who accompanied the children during the moments we met and participated in the experience as evaluators.
Table 1 shows the communication situation of each of the 7 children who participated in the experiments, where the symbol "X" indicates positive, this information was proven during the experiments.

Table 1. Communication situation of each child.

Participant and Age	Reading situation	LIBRAS Situation	Degree of Deafness		
			Moderate	Severe	Deep
Child 1 - 9 years	X				
Child 2 - 6 years					X
Child 3 - 6 years					X
Child 4 - 7 years					X
Child 5 - 7 years					X
Child 6 - 8 years	X	X			X
Child 7 - 9 years	X	X			X

The first contact with the children lasted about 4 hours, for them to become familiar with the proposed scenario and feel at ease it was necessary to do an activity to generate entertainment, so we did an activity with the use of balloons representing the colors of the musical notes that we would use in the application next. So, after the activities with balloons we set up the robot together with the kids as a mode of fun.
In the first stage of the experiments the child listener began to make the first contact with the robot and the other children followed what was done because then the other children would perform the same activity. Thus, the child listener practiced musical concepts.
In the second contact that was a following Sunday it was expected that it would be necessary to remind the children of the colors of the notes and the times that were made the movements of the robot because it had been 7 days, but it was not necessary to do this activity again because the children still remember easily what was proposed in the first activity, this was verified with a simple activity similar to that of the balloons that was performed previously, and through tests with the robot before the experiment of that day.
We started this time by the youngest child to verify that she still had the theoretical concept in mind, even because there was little time spent on the day of the first experiment and so could perform any musical activity similar to another one with little difficulty, this because she imitates the robot during the preparation of the same before the activity that day , which was proven in the participation of the child, she performed the activities without problems.
After the youngest child finished his participation it was the turn of the hearing child to take over the post and do the activities proposed on that day and again be an example for the other children, because soon after all of them they would do the same activity, as we performed in the first experiment.
In order to generate entertainment and the children could have a sense of the experiments for this stage were defined new stages of activities using the application, at that moment we made the use of the song called "Slaves of Job", where each stage of the game in the application in this experiment taught an excerpt of the music and a movement with the musical notes with colors , the steps would end at the time it was played entirely by each child. Just as in the previous activity the other children mimicked the robot's movements and raised their hands for each note presented by the robot.
For the third stage we made the use of the robot that was already used from the first stage, but unlike the other occasions the children would not command the robot via mobile device, but rather the robot would be an indicator that a musical note would be generated from a piano, in case the children pressed anote musical on the piano and the robot presented the color of the note executed on it.
As in the first two experiments the children had no contact with a physical piano, this could generate difficulty for them, so we inserted in this stage of the project a USB bracelet integrated into the robot, so when the children played a musical note on the piano it would vibrate by the fact that it was acoustic, the robot would light the LED indicating the note that was played on the piano and the bracelet would be integrated into the robot generating a vibration in the children's wrist.

We programmed the robot in advance in order to just get to the place and connect it to the piano and get satisfactory response with the notes pressed on the piano keys, so we connected the robot's USB input to the piano. At the time of the experiment of this stage the child should have his left hand on the piano, because it is the hand with the bracelet, she also felt the vibration of the piano, all this occurred in a synchronized way and we sought not to have delays, so as not to generate confusion in the children's heads.

Fig. 4 shows the final scheme of the experiment being performed by one of the children during the third experiment.

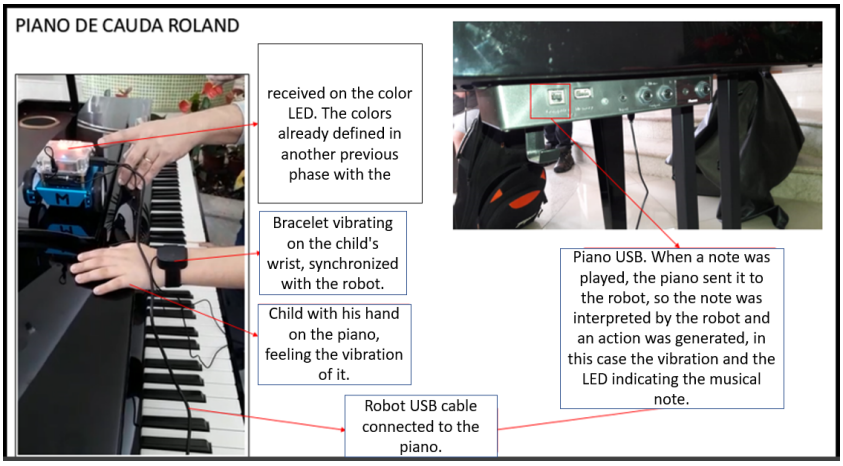


Fig 4. Child playing piano with all the built-in features.

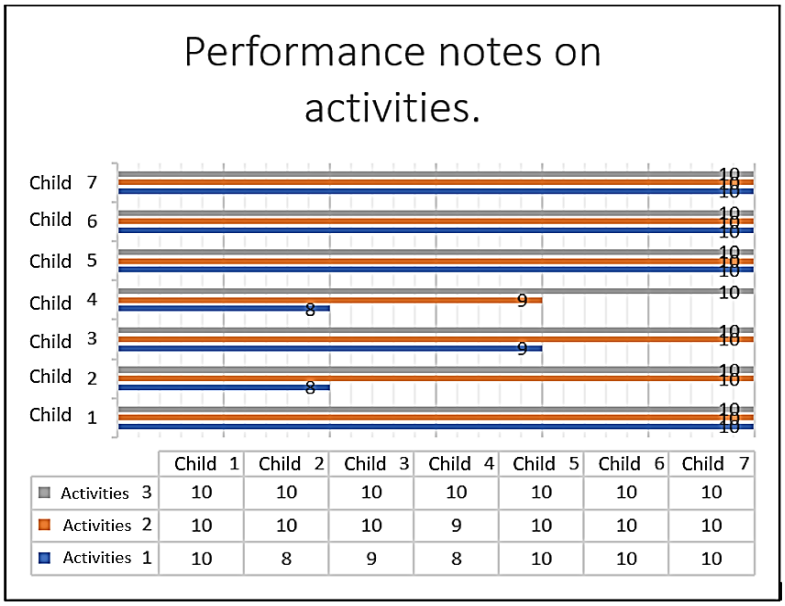
In this third stage we intended to make the children play the same music used in activity 2 when they used the digital piano on the mobile device, which occurred without difficulty. Also as was proposed earlier in the other activities children who were not in contact with the piano should imitate the movements that the robot generated on top of the piano and raise their hands when the notes were performed, an activity that all children performed several times.

All experiments were carried out with the same children, we had the first step we called as experiment 1, the second stage experiment 2 and the third stage of experiment 3.

The activities we developed at all stages explored how children would deal with the concept of colors combined with musical notes, contact with electronic devices and musical rhythm, and evaluate visual and rhythmic issues performed by children when imitating the robot.

All the children performed the same activities in the same period, so it would be possible to know what was the abstraction in relation to the period of participation of all children, knowing where each one managed to get in the application and the time it took.

At all stages the children were evaluated by monitors present at the site, one of the expected specifications would be to know if it was possible for the child to have kept in mind the concept of the activities that were performed previously, and be able to perform the musical concepts, and then know if the younger children could perform the activities more quickly because they had more examples performed before their participation in the execution.
Below is the chart showing Fig. 5 in general how was the performance in children's notes in all activities, so it is better to have a view with the general notes.



	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6	Child 7
Activities 3	10	10	10	10	10	10	10
Activities 2	10	10	10	9	10	10	10
Activities 1	10	8	9	8	10	10	10

Fig. 5. Performance overview in experiments.

According to the results presented in the experiments so far, it can be analyzed that the child was able to learn the musical concepts due to the repetitions of theory and practice, and another relevant factor was the child to see the other children practicing when on their opportunity with the devices, and also with the help of the robot to generate the movements and present the colors as an aider was a differential for the result obtained , so know that something happened while performing a musical note on the iPad.

4 Final considerations

Seeking to see beyond sound, involving different methods to help children in their interpretation of music as use of colors, we also sought to present through the literature review that there is no neurological obstacle that can compromise an individual to have a musical experience, such that the child aims to be able to make use of images and vibrations of devices , thus these items gave us a basis to be able to make a planning of how to achieve the goal allowing to insert applications and hardware in experiments with hearing impaired children.

As soon as we carried out the musical experiments with the hearing impaired children, it was possible to analyze that the architecture used allowed the children to perform the musical activity, thus assisting in the perception of the sounds that happened and that were performed with the compass, vibration and rhythms through the robot.
With this it was possible to reflect on what benefits music played in children through their attitudes in the activities, and how they gave us a positive return with their participation in the activities and also with the feedback we had of them at the end of the activities, the comments of the advisors at the time of the activities, because they were doing the evaluation all the time of the children while they were performing the activities , thus presenting the practical concept that it is possible and pleasurable to teach music to deaf children.
Based on the evaluations and opinions of the advisors who were all pedagogues, it was possible to realize in general that the use of architecture comes to be a great way to be used in the musical activities of deaf children, even for reasons of values that are accessible, and also easy to handle by people even if they are lay people in the subject, with extensive documentation on the WEB the solution used here can be replicated easily for people who wanted to accomplish the same technological context with the documentation available.
The activities performed in this research indicate that the junction that can help provide music learning for hearing impaired children. It presented potential for musical activities and can be adapted to other situations of different visions, thus being able to teach other points in music theory and children learn to have fun.
Thus, it is essential to make use of adaptive technological means in the education of deaf children, verify the effectiveness of the application and hardware, study ways and know what the real impact caused in those who participate in learning.

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Assessing the Quality of Higher Education Facing COVID-19 New Challenges

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Abstract. Since the report of the first cases of severe acute respiratory syndrome (SARS-CoV-2) in late 2019 and its declaration as a global COVID-19 pandemic in March 2020, the changes generated by containment and/or mitigation measures imposed by governments have generated important changes in the dynamics of many of the daily activities, including the preventive closure of educational institutions. Faced with this reality, higher education institutions have resorted to different modes of mediating learning through online methods as the main mechanism to continue offering their academic programs; however, the abrupt change exposes a scenario where the current evaluation mechanisms may not be sufficient to estimate the quality of education. This work reviews the scenarios, possible causes and needs for new approaches in the evaluation of the effectiveness and efficiency of higher education in times of pandemic.

Keywords: Higher Education, Quality Assessment, COVID-19, Pandemic.

1 Introduction

The first cases of severe acute respiratory syndrome (SARS-CoV-2), commonly referred as COVID-19, were reported at the end of 2019, and the rapid increase in cases and their spread in around 200 countries, made the World Health Organization (WHO), will declare a global pandemic in a few months [1].

Given this reality and in the absence of adequate treatment or vaccine, constant hygiene, social distancing, quarantine, self-confinement [2], and other control measures have been the best response to the rapid spread of infection in many countries. This situation has determined important changes in the dynamics of many of the daily activities.

The restricting to free movement and public meetings, distancing and self-confinement have caused the preventive close of educational institutions at all levels.

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It is estimated that worldwide 1.5 billion scholars and university students have been affected by this closure [3].

In response to this, higher education institutions have applied different modalities to achieve learning through online methods as the main mechanism to continue offer their academic programs, and although this has supposed a significant challenge to both teachers and students in terms of the adequacy of the teaching-learning process [4], this alternative has gained importance due to its flexibility and relative easy adoption.

However, online education presents a series of challenges involving a wide range of factors that affect learning outcomes, ranging from asymmetries in access to communication and information technologies, to proper management of instructional tools and teaching models.

Under this panorama, establishing mechanisms that allow the evaluation of the education quality are necessary to make a timely follow-up of teaching-learning process. Now, the monitoring of quality on education is a process assumed by the institutions as a self-evaluation mechanism and as a requirement of compliance with the official standards of each country; However, under the current circumstances, where the rapid change to online education models has incorporated new elements in the process, it is worth asking ourselves: are the current evaluation mechanisms relevant to achieve an adequate assessment of quality in higher education under the current reality?

This paper makes a review of conceptual and circumstantial aspects that frame the new challenges of quality assessment in higher education through a review of the literature on the subject and a global analysis of the current state of knowledge in this area, in order to illustrate the apparent need to incorporate new elements that allow a broader analysis of this dimension under the current circumstances.

2 Education and COVID-19

The pandemic declaration and the subsequent containment and / or mitigation measures imposed by many governments have led to a large number of academics, researchers, operational personnel and students having stopped or restricted their face-to-face activities in university institutions. [5].

However, the rapid and not necessarily adequate adoption of online education tools have determined conditions that, according to the perception of the actors, have impacted the quality of teaching.

A recent research has shown negative perceptions in students of the abrupt change measures to online education tools [3]. Assignments-based teaching processes, instability and costs associated with online education (internet and technology), are the main observations of students in face of the abrupt change to online learning, although paradoxically most of them consider that the measure assumed it is the most indicated as a solution to pandemic restrictions. [6].

We must be added to this, the asymmetry of access to the necessary resources to keep up with the pace of online education based on the socio-economic conditions of the students. This situation is most evident in developing countries, where although higher education institutions have adopted online strategies, and it is not clear under what conditions these measures benefit low-income and rural students [7].

Although access to communication and information technologies in many developing countries was already limited prior to the pandemic [8] [9], and the internet could even be considered as a non-essential resource for the social and labor functioning of some sectors of the population, the control measures imposed have radically turned towards virtual spaces the way we relate and maintain our social structure, just as dependence on electronic media has increased for work, commerce and education for all levels [10], which intensifies the impact of digital inequality on students.

Hasan and Bao [3], mention technological, personal, family, institutional and social limitations as the main obstacles to online education, while from a technological perspective, Beaunoyer et al [10], expose that factors associated with quality of equipment (hardware, software and quality of internet connection), autonomy of use and access, technological support and experience in the use of communication and information technologies, can determine the efficiency and effectiveness of the educational process mediated by digital tools in students .

3 Quality in Higher Education

Quality has manifested itself in recent decades as an ever-present theme in the discussion and guiding academic practices of higher education in Latin America and in the world. From a local perspective, the concepts of quality in education have been associated with different visions or perceptions [11], being able to be located among the most common:

Quality as Excellence. This conception is based on the evaluation of results, where it emphasizes the weighting of outstanding students, renowned academics and high impact of scientific productivity. Although it is applicable to our environment, it is not capable of encompassing all contexts of higher education, favoring elite institutions.

Quality as Response to Context. Its weighting is due to the successful results related to the graduates in the environment, the connection of the university with the productive means of its environment. This vision is eventually exposed to limiting itself to mere technical aspects and neglecting the nature of the university's relationship with its social environment, and it can also lead to a limitation of the global vision of knowledge.

Quality in Dependence on Declared Purposes. From this perspective, the institutions and / or the state set specific objectives for local or regional development allowing progress in jointly defined directions.

Globalization has redefined the classic concept of quality based on academic exclusivity, outstanding students and facilities, it has even restricted the weight of tradition and elitism since both have been limited by the proliferation of new institutions and ways of learning [11]. In Fig. 1 we resume some aspects that should be considered for a comprehensive and current concept of quality in higher education.

In our environment and with a global vision, the development of a concept of quality in university education must have elements that allow it to: be operational (translate into easily manageable elements within a guide, model or evaluation procedure), cover in one way or another, the substantive functions of the university (teaching, research,

extension and internationalization), implicitly carry the concept of appreciation or valuation and be linked to the social relevance of university activity.

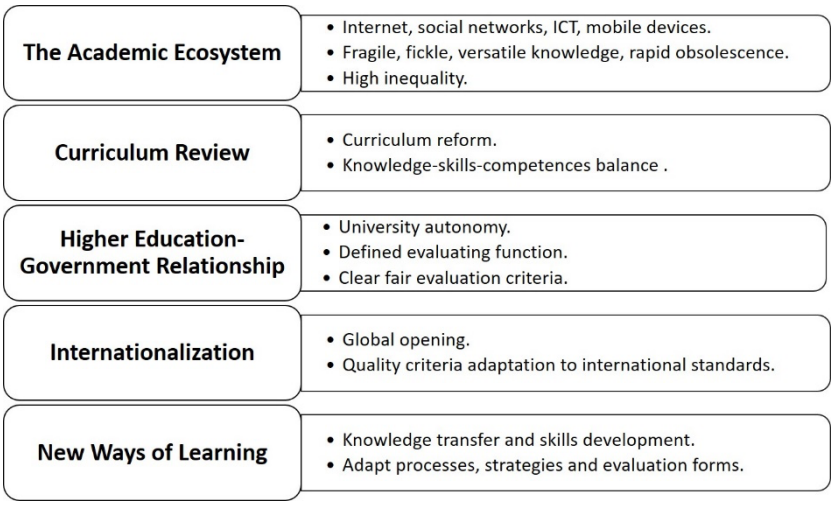


Fig 1. Aspects to consider for a concept of quality in higher education.

The educational quality evaluation processes respond to: political dimensions, sociocultural and economic dimensions of the context, institutional model, perceptions about the educational quality of institutional actors and regulations of the evaluating entity. [12]. However, current circumstances establish the need to incorporate new elements that allow a real and fair evaluation of the quality of university education.

4 Assessing Quality in Pandemic Conditions

According to the concepts and considerations set out, it is important to understand that the evaluation of quality under COVID-19 conditions make it necessary to incorporate elements of online education along with the requirements already defined to traditional face-to-face model.

4.1 Quality in Online Models

The evaluation of online education is an aspect already discussed and sufficiently developed in the academic community for more than 30 years. In this regard, Toro and Carrillo [13], review and propose the incorporation of indicators in three areas of quality:

Technical quality. This dimension requires the evaluation of indicators related to the technological platform that must guarantee that accessing and working with online content is a stable and effective experience. It is important to evaluate not only hardware and software aspects, it must also assess the operation and maintenance capabilities.

Organizational and Creative Quality. In this area, the educational platform on which the actors of the educational process develop teaching-learning activities is valued. The flexibility of handling instructional approaches (cognitive and behavioral) must be weighed, allowing the acquisition of knowledge and the development of abilities and skills, considering the different learning rates of students and allowing the combination of different didactic strategies.

Communicational Quality. Under this dimension, the capacity of the educational and instructional model to promote and maintain relationships between the actors of the teaching-learning process through synchronous and asynchronous communication is evaluated. Communicational benefits should not only be focused on merely academic aspects, they should also stimulate the creation of spaces for cultural and recreational activities that generate and strengthen relationships between members of the academic community.

4.2 New Evaluation Requirements

Impact of Changes in the Educational Model. The effectiveness and efficiency of teaching must be incorporated into the evaluation in the midst of the changes incorporated into the traditional model as an emergent measure to the limitations imposed by the pandemic.

It is important to establish rigorous mechanisms for evaluation, data monitoring and documentation of strategies that allow us to weigh the improvements in the model through evidence [5]. The main objective is to satisfy the expectations and demands of the interest groups (students, society, government, accreditation bodies, etc.), demonstrating the capacity to respond to changes [14], with the highest standards and guaranteeing the continuity of the formation of students.

Improved Capabilities in Online Education Tools. The abruptness of the changes and the initial conditions of each institution in the face of new communication and information technologies can determine particular conditions for migration to online models. But, on the other hand, the competencies of teachers and students in distance education can also have a severe impact on the learning outcome.

Teachers unequally face the need to use the available resources to develop their courses online as if they were still in the classroom, transforming face-to-face content into virtuality without making substantial changes to content or methodologies. Students, for their part, experience an accelerated overload of information through educational platforms, social networks, mobile applications and email that can induce a block or stuck feeling that will be approached with greater or lesser success from their connectivity capacities and abilities in management of technological resources, but also according to their discipline, time management and responsibility with the self-learning process. For this reason, it is important to establish awareness and training mechanisms that facilitate the processes of incorporating new teaching tools.

It is necessary to implement training programs for teachers that promote the development of skills that allow them to plan and implement courses through virtual means, as well as the design of strategies for evaluating student performance according to the new scenarios. This can also include the adaptation of programs and study plans that contribute to a successful incorporation of virtual tools [15] [16].

The implementation of awareness and empowerment programs for students on online education issues should be necessary to ensure an adequate transition and the use of content under this eventuality (which is likely to extend). Management of technological tools, use of time, discipline in assignments and ethical values must be incorporated as fundamental pieces in these programs to guarantee the best performance of students in the face of changes.

Training processes implemented in teachers and students should be a focus of quality assessment. Faced with the changes, training is a determining axis of quality in higher education, allowing the alignment of learning goals with the model of each institution [14].

Wellness and Health. Another aspect that becomes important and that must be incorporated into the quality assessment is the availability of support for the well-being and health of students through virtual means.

Some authors have called "e-Learning crack-up", the effect caused by the rapid change from the classroom experience to models based on ICT tools [3]. Causes such as the quality of the content, ease of access, technological limitations, lack of technical support and lack of interaction with colleagues, can contribute to this and create situations of psychological distress [3], and induce not necessarily valid negative perceptions about the incorporated changes [17].

Mechanisms should be established for access to medical advice, accompaniment in well-being and psychological support, as well as a constant monitoring plan that allows for early detection of problems that affect the results and participation of students. [5] [18].

It is necessary to implement measurement indicators that determine the assurance of well-being and health, particularly in the face of the socio-emotional and psychological effects induced by the conditions of isolation and virtualization of education. This aspect is particularly important in assessing the quality of education in the face of new challenges due to the pandemic.

5 Final considerations

Assessing quality involves all actors in the educational process and their environment. The quality of learning should not only be measured in quantity of knowledge, it is essential to assess the logical thinking, ability and dexterity of students in their work and social context, as well as their well-being and perception of the teaching received.

The isolation and self-confinement conditions imposed for the control of COVID-19 have forced higher education institutions to incorporate online education strategies in order to maintain their activities in the face of their closure, which has imposed new challenges and difficulties for both students and teachers, as well as significant planning and assessment challenges.

Under this new scheme, it is necessary to establish broader criteria for the evaluation of quality that incorporates both technological aspects, such as the assurance of the induction and timely training of the teaching staff, up to the constant monitoring of the results and the perception of the students. It is evident that it is necessary to incorporate

new variables that allow to visualize the true impact of the incorporated changes and their affinity with the institutional goals.

It is not the interest of this paper to propose all the necessary elements to evaluate education in times of pandemic, the primary interest is to open a discussion, exposing the need for change and proposing some elements that should be considered.

It is possible that more than a conjunctural situation, this pandemic will become an opportunity to make the traditional models of education more flexible, allowing the incorporation of new actors, new groups, new services and new tools, flattening the asymmetry of access to education and improving its resilience in times of constant change.

The current challenge is to guarantee everyone a complete education, with an effective use of university resources, aligned with current needs and with the highest quality standards.

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An Open Educational Game Based on Re-Purpose for Teaching Technical English in the Context of Computer Programming at Brazil

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Abstract. Students of Information Technology (IT)-related undergraduate courses often face barriers like insufficient prerequisites for difficult subjects and lack of motivation. The completion of abstract tasks like logical thinking, algorithm design and programming often gets harder than usual, since frequently they require basic knowledge of some foreign language, explicitly English. In the context of non-native English-speaking countries, the IT students can face a specific problem of having to write programming codes using keywords and commands mainly in English; In this sense, the goal of this paper is to present the repurposing of an open-source conventional, entertainment-driven 2D game to an educational game to teach technical English, related to programming fundamentals. An alpha version of the educational game has been delivered and a subjective experiment was carried out with a sample of 42 IT students and the results of the paper show that the repurposing was done in a straightforward way.

Keywords: Game Modding, Game Remix, Open Educational Resource, Educational Game.

1 Introduction

The portuguese empire was the first world empire in history, covering almost six centuries of existence, starting in 1415. It is noted that during most of them almost six centuries, the Portuguese language had a great influence in the world [1]. Another very important empire in the history of the world was the spanish empire, which started in the 15th century and was in operation until the beginning of the 19th century. It cannot be denied that the Spanish language also had an enormous capacity

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in the world. This helps us to understand that, during this period from the 15th to the 19th century, if people wanted to communicate globally, what would make more sense would be the communication in Portuguese or Spanish [2, 3].
Today, what they define as great powers are no longer wars over territories, ships and exploratory trips by oceans, etc., but technology, within this great area, known Information Technology is of great importance. As can be seen in [4, 5, 6] English is currently the most widespread language in the world. It is a fact that all high-level Computer Programming (CP) languages work with instructions in English, which means that the best and / or most updated information technology materials are produced and used in English and later translated into other languages, but with an inevitable delay. According to [4, 5, 6], the most important scientific research is written in English.
According to [7] studying programming is difficult for most students starting higher education courses in IT, in poorer and / or emerging countries, students do not necessarily have basic educational content and learn at a very fast pace.

2 Theoretical Fundamentals

2.1 Teaching and Learning CP and Dependence on Technical English.

According to [8], learning CP offers a set of challenges and techniques that are different from the challenges of learning Physics or Reading / Writing.
CP is one of the pillars of Computing. The teaching of CP is one of the biggest challenges that have been faced for years in Computer Science; a particular case is the teaching of CP for beginning students [9]. The student's interest in the subject is an important topic, learning programming will be boring and difficult if students are not motivated or engaged [10]. The challenge of learning and teaching CP is exacerbated by the traditional reading-based approach [9]. English is often the language of instruction in the university classroom; the best and most current books and articles are commonly published primarily in English, the job market values the command of English and most MOOCs (Massive Open Online Courses) are available in English [11].

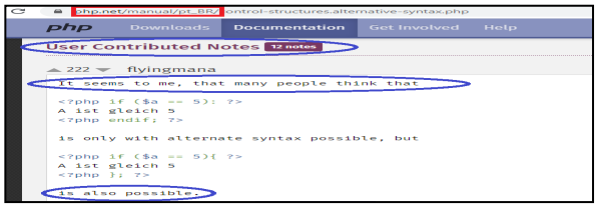


Fig. 1. PHP language documentation with English texts

The difficulties in studying programming, including difficulties in the English language, can make students unmotivated and even withdraw from the course. Fig. 1 shows the official Brazilian website for the online documentation of the PHP

programming language, it is possible to see that even though the website is Brazilian, there are explanations about the language that are documented in English.

Fig. 2 shows a text generated by the Python interpreter to explain an error generated in a program. These errors shown by IDE are presented in English. It is very common that many programming students who face this type of situation do not even try to understand what error is occurring, but ask the teacher for help immediately, often due to the great difficulty of reading and interpreting a simple text in English.

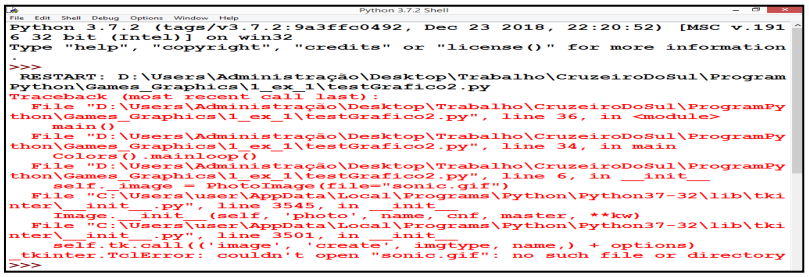


Fig. 2. Error description, in English, in the Python interpreter.

In addition to the examples of situations that the CP student needs technical English to deal with the discipline, there are other situations that even include the reserved words of the languages that also belong to the English language.

2.2 Learning and Proficiency in English in Latin American Countries

In countries that do not speak English officially, most students have poor English experience and are unable to communicate or write fluently in English [8].
According to [11] approximately 95% of the world population do not have English as their native language, which contrasts with the issue that approximately 100% of programming languages are defined in English, for example. English is the official language of many open-source software communities around the world.
As a result of Spanish colonization in the 16th century, Argentina is among the Spanish-speaking countries; with the exception of Brazil (which speaks Portuguese), all Latin American countries are Spanish-speaking [12].
Because Latin American countries do not speak English as an official or mother tongue, students lack the awareness that English allows free access to different people and places and that it is the most studied language in the world [13].
In Mexico, [14], the incorporation of technological resources in the teaching of the English language has been almost nil. In a worldwide ranking of English proficiency, among 72 countries, Mexico is in position 43 [13].
In a similar ranking, among 88 countries, Brazil was ranked 53rd; in 2017 Brazil was in 41st place, but instead of rising positions it fell to 53rd position, in that same

ranking Mexico was in 57th place, Argentina was in 27th place and Costa Rica in 36th place ; Chile ranked 46 [15, 16].
At Costa Rica, material activities for language teaching have focused on music, debates, stimulating images and fun stories, in an attempt to motivate students and immerse themselves in the language [17]
The 27th position makes Argentina the best placed country in English proficiency, among Latin American countries. According to [18] English has become ubiquitous in the daily life of Argentines and it is common to hear from young people that they are learning / training English on their own using digital games, music and other practical activities in English, this may have cooperated for the best English proficiency performance among Latin American countries.

2.3 Use of Educational Digital Games

Many studies and systems have used fun as an aspect to attract students' attention and motivate them, as examples of Educational Games and Gamification of systems [19], so these games must contain elements / characteristics of fun / entertainment. Most educational games do not contain the depth of a rich narrative that can provide engagement as commercial (entertainment) video games do, so educational games should be better developed [20]. Incorporating a rich narrative into an educational environment can support engagement and help improve student / player performance in the educational aspect [21].

The work [22] points out that the vast majority of young Brazilians use video games frequently, but it is usually for entertainment purposes only. This can be used as a motivation for using digital games in education, as many young people are already familiar with the world of digital games, and this is an interesting aspect for the use of this tool in educational assistance. The act of playing / teaching in teaching or learning aims to motivate the student, because it is a hybrid action, in which one learns and has fun, defined as a playful activity, because pleasure is present in the action [23]. There are some problems in developing educational games: developing a good digital game is expensive and time consuming [24, 25], there are very few open-source educational digital games to allow for reuse [26], it is difficult to adapt educational games to contexts distinct in order to adapt them to different disciplines [27], digital games are known to be boring, with rare exceptions, and it is difficult to define in practice what will be fun for a player, [28].

2.4 Open Digital Games and the Culture of Modding

A Digital Game is an interactive software that makes use of audiovisual resources (drawing, animation, music, script, etc.) for the purpose of entertainment. Open software (free and opensource) is software that the developer has made available the source code / project so that people (third parties) can change it and providing a license that allows this manipulation legally. Thus, an open digital game is a game

available for internal manipulation at the source code level and with a license that allows changes without copyright infringement.

There are some opensource digital games on the market, but in numbers far less expressive than commercial digital games. This is because the development of a digital game is expensive and time consuming and companies want to obtain financial return to cover the invested expenses and still generate profit (necessary to keep the company running). So, for big digital gaming companies, the open source philosophy is not interesting, at least not without another type of model that generates profit elsewhere. The Purpose is the adaptation, modification and redistribution of the game to a new context with the consequence of giving a new purpose to the software, which in practice works as a conversion. In the case of this article, the purpose is used and suggested to convert a digital entertainment game to an educational digital game. An important observation is that the Re-Purpose requires that the 5 characteristics of the Willey [29] model be previously met, otherwise the Re-Purpose is impossible.

The open digital game has already been explained, but to understand the purpose of a digital game, we need to understand the culture of modification of digital games. The culture of game modification is already established (it is a current reality) and the trend is that it will continue to grow [30]. Companies started to encourage this culture that was called Game Modding or MOD [31, 32].

3 METHODOLOGY

3.1 The Proposal: Repurpose of the Digital Game

To modify a digital entertainment game to an educational digital game, we tested four games that have open source and free license to choose the game for modification. We focus on games that are coded in Python, Java or C # and with RPG or 2D Platform styles, as they are two very popular and classic styles. The first was Stolen Crow with Python code and MIT license (https://github.com/justinmeister/The-Stolen-Crown-RPG), the second was Platformer Microgame with C # code and license from Unity Free Extension Asset (https://assetstore.unity.com/packages/templates/platformer-microgame-151055), the third was Simple Platformer (https://github.com/SteveSmith16384/SimplePlatformer) with license from MIT and the fourth JumPY Man (https://github.com/haseeb-heaven/JumPYMan-Game) with Python code and GPL3 license. The game chosen was Unity Engine's Platformer Microgame.



Fig. 3. Web Page, in English, of the Unity Free Game

Fig. 3 shows the page, on the internet, of the game Platfromer Microgame distributed free for modification by Unity Technologies, this page is completely written in English.

The educational content of the game consists of part of programming fundamentals and part of technical English to support programming. Programming content consists of: main data types and variables (int, float, bool, string), arithmetic operations (subtraction, sum, multiplication and division), operations and logical operators (And, Or, false, true, not), relational operations and operators (less, greater, equals) if / else statement, for / while statement.

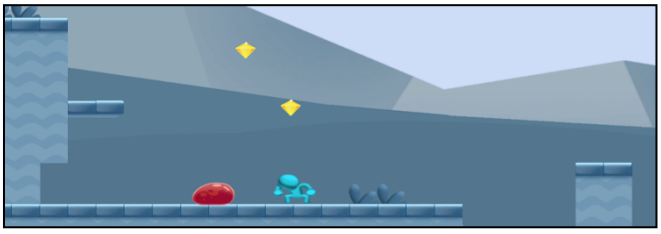


Fig. 4. Original Platform Microgame, free game by Unity Technologies.

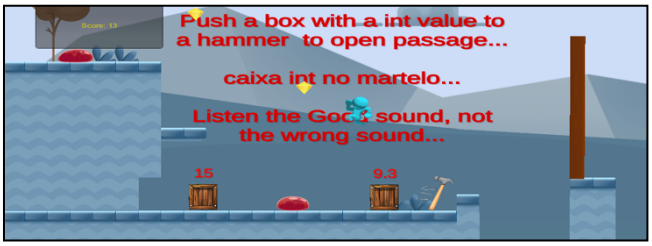


Fig. 5. Modding of Platform Microgame, free game.

Table 1 specifies the details of the game modifications. It is possible to identify in Table 1 how much each game's artifact has been modified for the possibility of the educational purpose of the game.

Table 1. Details and Quantification Of Changes To The Opensource Game

Artifacts	Little	Medium	Much
Programming			X
Art		X	
Scenario			X
Music and Sounds	X		
Narrative		X	
Level Design		X	
Mechanism	X		
Educational Content			X

As can be seen in Table 1, the most modified artifacts were: Programming (C # Script), Scenario (as already shown in Fig. 5) and Educational Content (which was created from scratch and had the narrative as support). Art, Narrative and Level Design were changed less intensely, so that Art and Level Design had a supportive relationship to the modification of the Scenario (and vice versa) and the Narrative served as a justification and explanation of the content educational inserted (so that this content would not be aggressive, too much and would not harm fun and engagement). Mechanics, Music and Sounds were slightly changed. The mechanics were little changed, because the main idea was to make the most of it, because it is a Classic Mechanics and known for its fun and success in several commercial digital games. The music itself has not been altered, but sounds have been added to make the puzzles and their solutions clearer, and these sounds were related to the music to keep the sound aesthetics pleasing.

3.2 Evaluation of the Proposed Digital Educational Game

To evaluate the Read All C # game, an intervention was carried out with 42 higher education students from the Computer Science course. As the objective was to evaluate the students' experience under a qualitative approach, we analyzed two different reference models for the evaluation process. The first was the generic ITU BT500 assessment (https://www.itu.int/rec/R-REC-BT.500) - and the other was the MEEGA + model [33]. After analyzing these two evaluation models, we opted for the second, the MEEGA + model; this model directly supports the evaluation of educational games instead of the generic approach of the ITU BT 500 (for all types of software and not with an educational focus). The main part of the questionnaire applied to students contained the following 14 questions:

1- At the beginning of your programming learning, did you find it difficult to learn programming with the commands in English?
2 - Do you think that a game like this to teach / train technical English focused on programming, can help a beginner programmer?
3- Did you find this game useful for a programming student?
4- The organization of the content helped me to be confident that I would learn from this game.
5- The game does not become monotonous in its tasks.
6- I would recommend this game to others.
7- There was something interesting in the game that captured my attention.
8- I feel satisfied with the topics I learned in the game.
9- The game content is relevant to my interest.
10- It is clear to me how the game is related to educational content.
11- Is the game a suitable teaching method for teaching / training technical English for programming?
12- I prefer to learn from this game than any other way (a technical English book, for example).
13- Does the game contribute to my learning about technical English content for programming?
14- The game was efficient for my learning compared to other activities on this subject.

4 Results

On question 1, 21.4% (9 students) totally disagree; 28.6% (12 students) disagree; 16.7% (7 students) responded neutrally; 26.2% (11 students) agree and 7.1% (3 students) fully agree. On question 2, 0% totally disagree; 2.4% (1 student) disagree; 11.9% (5 students) responded neutrally; 35.7% (15 students) agree and 50% (21 students) fully agree. On question 3, 4.8% (2 students) totally disagree; 4.8% (2 students) disagree; 9.5% (4 students) responded neutrally; 42.9% (18 students) agree and 38.1% (16 students) fully agree. On question 4, 0% (2 students) totally disagree; 2.4% (1 students) disagree; 9.5% (4 students) responded neutrally; 42.9% (18 students) agree and 38.1% (16 students) fully agree. On question 5, 4.8% (2 students) totally disagree; 11.9% (5 students) disagree; 31% (13 students) responded neutrally; 38.1% (16 students) agree and 14.3% (6 students) fully agree. On question 6, 2.4% (1 student) totally disagree; 2.4% (1 student) disagree; 19% (8 students) responded neutrally; 45.2% (19 students) agree and 31% (13 students) fully agree. About question 7, 2.4% (1 student) totally disagree; 0% disagree; 19% (8 students) responded neutrally; 42.9% (18 students) agree and 35.7% (15 students) fully agree.
On question 8, 0% totally disagree; 4.8% disagree (2 students); 14.3% (6 students) responded neutrally; 47.6% (20 students) agree and 33.3% (14 students) fully agree. On question 9, 2.4% (1 student) totally disagree; 0% disagree; 11.9% (5 students) responded neutrally; 54.8% (23 students) agree and 31% (13 students) fully agree. On question 10, 0% totally disagree; 0% disagree; 4.8% (2 students) responded neutrally; 38.1% (16 students) agree and 57.1% (24 students) fully agree. On question 11, 0% totally disagree; 0% disagree; 19% (8 students) responded neutrally; 45.2% (19 students) agree and 35.7% (15 students) fully agree. On question 12, 7.1% (3 students) totally disagree; 7.1% (3 students disagree); 33.3% (14 students) responded neutrally; 14.3% (6 students) agree and 38.1% (16 students) fully agree. On question 13, 0% totally disagree; 7.1% disagree (3 students); 16.7% (7 students) responded neutrally; 14.3% (6 students) agree and 38.1% (16 students) fully agree. About question 14, 4.8% totally disagree (2 students); 2.4% disagree (1 student); 21.4% (9 students) responded neutrally; 38.1% (16 students) agree and 33.3% (14 students) fully agree.

5 Conclusions

Based on the intervention carried out with the questionnaire, we realized that students liked the idea of learning technical English focused on the fundamentals of programming using a digital 2D platform game. It was realized that a game like this can keep students motivated to learn, mainly by answering questions 7 and 9.
The game can make students more interested in the topics of the programming discipline and give more value to the use of the English language for the programming context, since the player is faced with an English vocabulary and expressions to which he must understand to solve the game puzzles that involve programming, as could be seen by the means of questions 2, 11, 12 and 13.

Question 6 resulted in an average of 4 and attests that students strongly recommend this game to other students of programming / technical English.
We realized that the attempt to modify an open-source game was positive and that the educational purpose was achieved; the extension of the 5R model of the open source criteria is possible to include the purpose. This game / MOD can be adapted to other contexts that include other disciplines and students' age groups. What was most changed in the project were the artifacts: programming, setting and educational content; the least altered artifacts were music / sounds and game mechanics, as shown in Table 1.

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Collaborative learning and text productions of original texts

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Abstract. University education faces several challenges and difficulties in the development of soft skills in students, especially in the ability to work in a team and communicate their ideas with coherence and cohesion through original texts. Actually, these skills go beyond academy scenary, because are necessary for successful integration into the labor market. Therefore, this work aims to generate collaborative experiences for the production of original written texts. The methodology applied are two activities scheduled during the 2019- I academic semester: the advance and the final document; hence, it was established to use an anti-plagiarism software to submit academic papers and create collaborative experiences to contrast their errors and seek collaborative strategies to raise observations. The results contributed significantly to both competences, since there is an increase in the average of the classroom of 3.05 in the production of texts; as well as the decrease in the percentage of copy in the final presentation of the academic text of initial research to the 20% of similarity as opposed to the 50% of similarity of the majority of students in the first presentation.

Keywords: Collaborative learning, producctions of texts, originality.

1 Introduction

University education faces several challenges and difficulties in the development of soft skills in students; the reasons range from globalization to the massification of the university offer that was outlined as an opportunity for access to quality education [1]. However, our educational system has not been able to guarantee it completely, since it

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has shown gaps in the development of skills, including communication skills, decision making, ethical culture, conflict resolution, critical thinking and collaborative work.

One of the main problems in the academic and professional life is the production of original, coherent and cohesive written texts and collaborative work. In the first enviroment, if it is achieved, would ensures the understanding of any type of text according to the context presented [2]. In the second, it will help students build their own learning and enrich themselves through the exchange of ideas, exploration and cooperation with their peers. In other words, learning from their own experiences and with the support of others will train them to adapt successfully when they are inserted in the working world [3].

From this perspective, our teaching experience aims to generate collaborative experiences to produce original written texts from a socio-cultural approach, since when human development is analyzed, it is taken into account that the social world influences the individual through the practices of social interaction and social objects [4] Furthermore, it provides fundamental elements for an intervention in the spatial-temporal and social context of a specific academic reality that includes the relationships between human mental functioning, on the one hand; and the cultural, historical and institutional situation, on the other one [5].

In other words, we will apply collaborative learning for the development of activities whose final product is the construction and writing of academic texts requested in their future work environment, characterized by their academic originality. In this context, it results important to identify key concepts to understand the experience developed.

1.1 Collaborative learning

Collaborative learning is assumed like an experience that takes place through the participation of two or more individuals in the search for information, or in the exploration aimed at achieving a better understanding or shared understanding of a concept, problem or situation [6]. That is to say, from these collaborative experiences, the commitment and effort of each member is generated for the benefit and learning of all.

Thence, it is important that students meet basic criteria of responsibility, collaboration, teamwork and communication among peers [7]. It is a collaborative effort to not only respond to a problem or solve a task, but also to achieve in the educational field the acquisition of skills and values with attachment to discipline and ethics [8]. This collaborative experience refers to the cognitive development of the individual in the interaction with others, strengthening the collective construction of knowledge and the cognitive development of each one [9].

In the cooperative learning, the teacher can organize cooperatively any didactic task, of any subject and within any study program [10] In this definition the term cooperative acts as a synonym of the collaborative learning [11]; however several authors differentiate the collaborative work from the cooperative. In this sense, when for the work of the group the tasks are divided and each participant does what he or she has to do, one will be working in the sense of cooperation; while if, in a more open environment and of self-determination of the group, the group itself distributes the tasks and a dynamic of shared responsibilities is established, then one will be in a level of collaboration, which does not exclude cooperation [12, 13].

The objective of collaborative learning is to induce participants to construct knowledge through exploration, discussion, negotiation and debate [14]. Other authors also mention that collaborative learning increases the satisfaction and motivation of the participant, and prepares him/her as a researcher [15]. There is research carried out at primary and secondary levels of education, which has resulted in favor of collaborative learning because it has been proven that students learn better in non-competitive and collaborative situations, than in situations where individuality and competence are emphasized [16]. Therefore, it is wise to bet on the insertion of activities that generate collaboration, and for the whole process to work, it is necessary that the teacher fulfills his or her task as a guide.

1.2 Production of texts

One of the pertinent competencies that students develop to be successful in their academic and professional environment is communication skills: text production, oral expression and text comprehension. The production of texts conceives a communicative competent subject in the same way as he or she uses his or her mother tongue according to the intentions and the situational and cultural contexts [17] That is to say, the activity of writing is understood as the manifestation of the student's capacity to resolve the task of expressing his or her ideas in writing, exploiting the linguistic resources he or she dominates and respecting the possibilities, restrictions and demands of a given type of text [18].

1.3 Academic Integrity: Originality

One of the biggest challenges today has revolved around academic fraud. For some students, it may be easier to decide to commit fraud with the electronic media available. However, it is possible to avoid them by generating motivational activities for the development of academic texts with their own ideas.

Academic originality begins with the responsibility of giving credit to authors whose texts or ideas are used in writing and constitutes an ethical obligation of consensus in the academic and social spheres. Since school times, we have learned about the use of quotation marks as a punctuation mark to note words, phrases and paragraphs of others [19], but very little is put into practice.

This fault has shown in recent years an explosion in the number of plagiarism cases. In recent years, this fault has led to an explosion in the number of cases. The reason is simple: today we have access to an enormous repository of information between specialized pages, digital libraries and digital encyclopedias [20]. Plagiarism, in the strict sense of the term, is defined as the phenomenon whereby the words of an author are quoted verbatim, with little or no attempt at paraphrasing [21, 22] For his part, he states that plagiarism consists of using the words and ideas of another person and claiming them as one's own by not attributing them to the original author, whereas textual plagiarism is the use of words or ideas from another source without proper attribution [23]. In recent years, the concept of patchwriting has emerged, which refers to the reconstruction of original material that is not attributed to other sources [24]. It is a procedure that consists of "copying from a source text and deleting some words, altering grammatical structures or changing some synonym for another" [25].

Plagiarism is a practice that is covered, in the educational tradition, by "a deep negative charge, so much so that it has led to the development of various types of software to detect it" [26, 27] The emergence of the Internet, digital technologies, and the dissemination of written texts on the Web has led to a profound debate on the concept of authorship. The originality of a text is very important and is a sign that it is the result of previous work and a contribution to knowledge in the subject matter [28].

2 Methodological estructure: description of the innovation

This innovation experience seeks to discover and analyze how collaborative learning influences the production of original academic texts: for this purpose, they were asked to write initial academic research texts on topics related to their professional career in groups of 3 to 4 members. The objective was to produce their original academic texts through collaborative learning. A sequential schedule of the activities was elaborated in the 2019-1 semester with 58 students of the II academic semester of Medicine.

Used resources
• Google Drive, Virtual Classroom and Antiplagiarism software (Turnitin)

Chronogram
10 class sessions (week 6-15)
Every two weeks review and feedback on team progress
1st presentation: week 10
2nd presentation and final: week 15

1. Presentation of the objective of the work, structure of the initial academic research text related to topics of your career, schedule for presentation of work progress and requirements to be met. Within them, a 20% similarity in the work was determined.

2. Work teams were formed (three to four students with their respective roles within their teams) to encourage and promote collaborative work, students created a Google-Drive shared for the construction of their work, which was also shared with the teacher for the respective feedback on their writing in a fortnightly manner of the advances presented.

3. Creation of a Word document in Google-Drive for the elaboration of the text, according to the advance per week, which was also shared with the teacher for the feedback on the advances presented.
4. An anti-plagiarism software was used as a support resource to identify the percentage of similarity (quotes and references) in presentations.
5. Creation (free exercise Turnitin) in the virtual classroom--anti-plagiarism software for the personal use of the students. This activity was established as a strategy for students to use it as a support resource to verify the percentage of similarity in their work (quotes and references), prior to the final presentation.



Fig. 1. Free class exercise Turnitin
Note. Elaborated by Elisa Montoya

The importance of generating this activity, shown in Fig. 1, is to allow them to identify in their texts which part is cited correctly and which is not.

3 Results obtained

1rst Turnitin presentation

Table 1. Grade points average

Grade points average							
10	10	12	12	12	NP	08	14
10	14	13	11	12	12	08	
05	11	NP	NP	13	13	10	
08	NP	13	10	12	10	14	
08	NP	11	NP	13	08	14	
Average rating: 11.3							

Grade points average
Average rating: 11.3
Source: Compiled by Elisa Montoya Cantoral. Note: Population 36 students.

The results obtained in Table 1 show an average score of 11.3. These results correspond to the first presentation of the evaluated progress, as it is observed the average is low, because the following errors were evidenced.

a. Problems of thematic coherence: It is given to the interior of a paragraph and in general of a text leaving aside the central thematic thread of what is written, that is, there is no relationship between the thematic idea and the development of the paragraph itself.
b. Research culture: It is not evident a search with criteria of the information, recovery and selection of sources on your chosen topic, since most of them are not reliable: monografías.com, tutarea.com, Rincón del Vago, and so on.

Upon receiving papers, the program showed the following percentage of similarity in the research work activity:

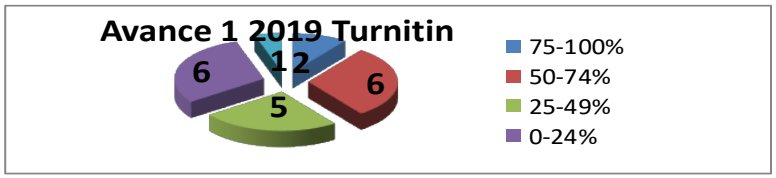


Fig. 2. Percentage of similarity in 1st Presentation 2019
Source: Elaborated by Elisa Montoya Cantoral Note: Percentage of similitude of 20 collaborative papers subtmitted

According to the percentages presented in Fig. 2, we observe that 6 works presented between 50% and 74% of degree of similarity; 5 groups, between 25% and 49% and two works, between 75% and 100%. In other words, of the 20 papers submitted, 13 presented a high percentage of similarity in content, and the established percentage of 20% similarity was not respected, generating doubts about the originality of the paper, since Turnitin produced a large percentage of copies (unquoted parts of the text). Most of the content of the work was copied from web pages. This is reflected in the low weighted average obtained.

Turnitin is not used to place a note, it is only the medium to submit papers.

The use, purpose, and applications of this program for the benefit of your academic activities were also explained in this session.

The results of their first experience contributed greatly to the students' awareness of the formulation and elaboration of their work.

This can be seen in the results obtained from the following work.

2 nd Presentation - Final presentation

The results obtained are as follows:

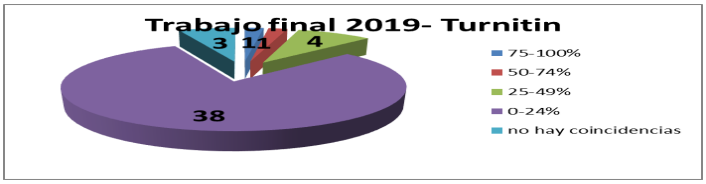


Fig. 3. Percentage of similarity in 2 nd Presentation 2019
Source: Elaborated by Elisa Montoya Cantoral
Note: Percentage of similitude of 47 collaborative papers subtmitted

The results obtained are as follows:

According to the results obtained in Fig. 3, we observe that of the 47 students, 38 presented only between 0% and 24% similarity in their work. This reflects that our students are in the process of becoming aware of the existence of this tool in the process of presentation and especially respect for the ideas of others with the use of quotes and references, as well as greater consistency and cohesion in their writing.

Moreover, this is corroborated by the grades obtained in this work.

2nd Presentation - Average grades

Tabla 2. Grade point average-final presentation

Notes 2019-1 simple average-with Turnitin -Monograph									
14	14	15	15	15	14	12	12	15	13
15	13	14	14	16	10	12	12	15	
16	14	15	16	15	15	14	15	13	
16	15	16	15	16	11	14	13	12	
14	16	15	14	17	11	15	15	10	
Average rating: 14.08									

Source: Compiled by Elisa Montoya Cantoral. Note: Population of 47 students

The results obtained in Table 2 show an average grade of 14.08. This shows a significant progress in the achievement of the communicative competences of the area, since this activity evaluated the following criteria:

-Respects the structure of the initial academic research work
-Construct your paragraphs with coherence and cohesion
-The main secondary and tertiary idea paragraph
-Respect the rules of the language
-The document has a maximum of *20% similarity in content

*We understand this 20% maximum of citations within the work; no unreferenced information is accepted.

3 Discussion of results

To this end, we first determined some basic concepts, since this teaching experience was directed on the one hand to achieve the following competencies:

a. **Production of texts in their initial level:** Student writes texts on general topics, respecting the Spanish regulations, organizing them with a clear structure (introduction, development, closing).

b. **Understanding of texts at the initial level (according to the curriculum):** Identifies the main and secondary ideas in general basic level texts and makes generalizations from them.

The criteria used to measure text production are as follows:

a. It respects the structure of the initial academic research work
b. Construct your paragraphs with coherence and cohesion
c. The main secondary and tertiary idea paragraph
d. Respect the rules of the language
e. The document has a maximum of *20% similarity in content

1st presentation: the results obtained were an average of 11.8 of all the works submitted. The main observation was in criteria b, c and d.

2nd presentation: the results of the second presentation were an average of 14.08 in the classroom, as shown in the following Table 3.

Table 3. Comparison between presentations

1st grade point average	2nd grade point average
11.3	14.08
Rising of 3.05 on study group	

Source: Compiled by Elisa Montoya Cantoral

In the 2nd presentation, a significant advance was observed in criterion b compared to the 1st presentation.

For example, in the first installment, the problems of thematic coherence occur within the paragraphs and the text, since there is no relationship between the thematic idea and the development of the paragraph itself: apart from the errors in the Spanish regulations.

However, in the final presentation, the paragraphs presented the main idea in a sentence at the beginning of it and in a logical and hierarchical way linked the secondary and tertiary ideas for the development of the theme with proper use of punctuation and connectors. Even so, it is pertinent to mention that this work constituted the construction of an original descriptive academic text on a topic of interest. It constitutes a basic level writing, but with good results, which evidence the achievement of our general objective of this good practice. We understand that this is the first step for the complete development of the effective communication competence proposed by the university.

c. Consideration of ethical aspects

The importance of this activity is to create a space to reinforce the importance of respecting copyright and cultivating academic integrity in academic work as well as in their professional life. This software reinforces this purpose, but what it really brings is the very practice of generating authentic works and the academic benefits of doing it with these characteristics.

This was only understood for the delivery of the final work, since in the first presentation of the 20 papers, thirteen obtained more than 50% of similarity-copy of information in them. The first experience contributed enormously in the awareness of the students in the formulation and elaboration of their work.

In the second or final presentation, of the 47 students, 38 presented only between 0% and 24% of degree of similarity in their works presented, being this 24% referenced information. This reflects the fact that our students are aware of the existence of this tool in the submission process, but above all, respect the ideas of others through the use of quotes and references and in the construction of their own ideas in their academic work.

4 Conclusions

This study concludes that collaborative learning influences the improvement in the production of original text, since has developed in the students collaborative skills for

a common objective, wich meaning it generates an autonomous, creative learning and positive attitudes towards the change. In this case, towards the activity of producing an academic text of original initial investigation.

The results obtained in the first presentation with a classroom average of 11.3 showed problems of thematic coherence within the paragraph and text, that is, there is no relationship between the thematic idea and the development of the paragraph itself.

However, in the final presentation of the work, the average obtained was 14.08, since it was identified greater coherence and cohesion in their writings. In other words, the paragraphs presented the main idea in a sentence at the beginning of the paragraph and logically and hierarchically linked the secondary and tertiary ideas for the development of the theme with the appropriate use of punctuation and connectors. In addition, the decrease in the number of copies in the papers, since in the first of the 20 papers submitted, 13 presented 50% similarity in them, that is, without referencing; in contrast, in the 2nd presentation, it is observed that of the 47 students, 38 presented only between 0% and 24% similarity in their papers submitted.These results show a significant change in the importance of referencing their academic work and presenting original work, that is, with their own ideas; having the opportunity to review their percentages of similarity, as well as the quality of their writing contributed to the knowledge and acquisition of skills that will help them to develop in their work environment to express themselves coherently and cohesively in writing and to respect the ideas of others; Therefore, it is important to apply these types of strategies in all courses of their academic training that allow students to observe and identify their mistakes in everyday academic practices to replicate them in work environments that require it.

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Validation of a model in PLS-SEM on the influence of social networks and the learning achievement in the areas of communication and science and technology in high school students in times of Covid-19

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Abstract. The objective of the research was to validate an intervention model using the modeling of structural equations of partial least squares PLS-SEM, to determine the level of influence of addiction to social networks in the learning achievement in the areas of communication and science and technology in high school students in a private educational institution in times of social isolation due to Covid-19 quarantine in Peru. An adaptation of the instrument proposed by Sahin adapted by Valencia-Ortiz & Cabero-Almenara was used for the study, which consists of four factors: problems, satisfaction, obsession to be informed and need/obsession to be connected, as independent variables. Learning achievement acted as a dependent variable. The pilot study followed the reflective common factor model and was carried out with a sample of 47 students, corresponding to the five years of study.

Keywords: Social networks, Addiction, Science and technology area, Communication area, Learning achievement, PLS-SEM.

1 Introduction

Addition to social networks is considered a subtype of internet addiction [1], this has resulted in different emotional problems, such as anxiety or depression, hyperactivity and behavior problems [2]. The excessive and compulsive behavior of social networks is shaped by several factors, such as behavioral and sociocultural, which would lead to health and well-being problems [3]. On the other hand, the use of networks is inevitable because it is one of the most popular type of communication and entertainment, but it is also noted that its excessive use can lead to addictions related to substances and behavioral problems [4].

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The excessive use of social networks is also largely due to addiction to smartphones, the cause of addiction can be traced to adverse childhood experiences, such as psychological abuse of children [5]. On the other hand, smartphones are indispensable for many young people, which in turn increases the risk of addiction. Previous studies have found significant and positive influences of propensity for boredom, sensation seeking, and smartphone addiction [6]. Social networks and the use of smartphones, is an indissoluble relationship for the moment, this has allowed young people to increase their popularity, a distinctive trait in school age, as adolescents become more popular on Instagram (i.e. as the number of followers increases), so does the risk that they will develop an addiction to the behavior of using Instagram and experience cyber-attacks, which in turn can have a negative effect on their psychological well-being [7].

Addiction to social networks is not only a problem for education, it is also a problem for clinical psychology, it is more plausibly considered as a disease on the scale of research and public health policy, but not as a management and personal intervention (e.g. clinical). Addicts must make decisions to recover, and in that sense addiction is a "disorder of choice." However, it is concluded that the most relevant meaning of "disorder" arises on the social scale rather than on the personal one [8]. Impulsiveness and addiction to social networks could be addressed in styles centered on emotions [9]. On the other hand, the subject should be carefully treated, for example personality traits, such as extraversion, openness to experience, neuroticism, kindness, conscience and narcissism, are not related to addiction to Facebook and the intensity of Facebook [10].

Problems of addiction to social networks are the consequences that occur in the social, school and family environment of the student, this as a result of the excessive time spent being connected to the Internet. As for Satisfaction with social networks, it is the pleasure felt when connected, the person being connected overcomes the problems of obsession and goes to a blissful state [11]. Another factor of interest for the study is the Obsession to be informed, this translates into the discomfort that occurs in the person for thinking that things may be happening on the Internet and he is missing them, and therefore feels the obsession of being always connected, in order to not miss anything that is happening on the networks [11]. The need/obsession to be connected produces in the person a latent state of anxiety for not being connected and feels the need to overcome withdrawal by connecting to the internet and with it to social networks.

2 Methodology

In the analysis of reliability to the instrument with the 27 items carried out with IBM-SPSS, Cronbach's Alpha was 0.878, that is, good; However, in the measurement evaluation of the reflective model, the SmartPLS with the PLS Algorithm was used through the External Loads: the acceptance criterion is $\lambda \geq 0.707$ of the indicators, in table 1 the results are presented, in which, the following items would meet individual reliability: F_III_25; F_II_09; F_IV_02; 0.707; F_I_18.

Table 1. Individual reliability of each indicator

	Need/obsession to be informed	Obsession to be informed	Problems	Satisfaction
F_III_24		0,569		
F_III_25		**0,948**		
F_III_26		0,197		
F_III_28		0,576		
F_II_06				0,497
F_II_07				0,676
F_II_08				0,557
F_II_09				**0,814**
F_II_10				0,607
F_IV_02	**0,933**			
F_IV_03	0,507			
F_IV_04	**0,707**			
F_I_11			-0,105	
F_I_15			0,380	
F_I_16			0,244	
F_I_18			**0,856**	
F_I_20			0,530	

The internal consistency of the model expressed through Cronbach's Alpha, accepts a threshold of ≥ 0.7 where the degrees of reliability of the indicators are established, according to the results they would be classified as satisfactory except for the factor (Need/obsession to be informed), therefore, this would partly prove the reliability of the construct. Regarding the coefficient (rho_A), it allows to verify the reliability of the values obtained in the construction and design [19], the factor (Need/obsession to be informed) reaches the threshold of 0.961, the other factors would not reach the expected values. For the Composite Reliability according to (ρc) ≥ 0.7 it would be acceptable, the factor (Need/obsession to be informed) with 0.770 and (Satisfaction) with 0.771 would be at the acceptance threshold [19]. The values of the Average Variance Extracted - (AVE) the acceptance threshold would be ≥ 0.5, the values obtained range between 0.542 and 0.246, the results show that only the factor Need/obsession to be informed) with a value of 0.542 is at the acceptance threshold [20], so it is concluded that the convergent validity is partly acceptable (see Table 2).

Table 2. Reliability and validity of the construct.

Factors	Cronbach's Alpha	rho_A	Composite reliability	AVE
Need/obsession to be informed	0,623	**0,961**	**0,770**	**0,542**
Obsession to be informed	**0,750**	-0,289	0,685	0,398
Problems	**0,776**	-0,489	0,490	0,246
Satisfaction	**0,782**	0,072	**0,771**	0,409

Discriminant validity allows evaluating the instrument from a discrimination of each of the factors, that is, if each of them is capable of measuring something different, according to the Fornell-Larcker criterion and the results presented in Table 3, there would be a discriminant validity in the factors.

Table 3. Discriminant validity according to the Fornell-Larcker criterion.

	Learning achievement	Need/obsession to be informed	Obsession to be informed	Problems	Satisfaction
Learning achievement	**1,000**				
Need/obsession to be informed	0,264	**0,736**			
Obsession to be informed	0,053	0,299	**0,631**		
Problems	-0,294	0,361	0,032	**0,496**	
Satisfaction	0,211	0,32	0,417	0,085	**0,64**

A second criterion for verifying the discriminant validity of the model is the one proposed by Henseler, Ringle and Sarstedt [21] based on the heterotrait-monotrait (HTMT) correlation ratio, the essence of which is the multitrait-multimethod matrix. In an ideal model, the heterotrait correlations should be smaller than the monotrait correlations, therefore, the HTMT ratio should be below ≤ 0.85. Therefore, we have discriminant validity. Table 4

Table 4. Discriminant Validity according to the Heterotrait-Monotrait Ratio (HTMT) criterion.

	Learning achievement	Need/obsession to be informed	Need/obsession to be informed	Problems	Satisfaction
Learning achievement					
Need/obsession to be informed	0,272				
Obsession to be informed	0,03	0,282			
Problems	0,137	0,813	0,261		

Satisfaction	0,131	0,56	0,671	0,494

Fig. 1 is a graphic representation of the analysis of reliability and validity of the model from R2 (Pearson's coefficient), for the dependent variable Achievement in the area of Science and Environment. Thus, taking the values of R2, ranging from 0 to 1, the higher the value, the greater the level of precision in the prediction. As noted [22], it would depend on the complexity of the model and the research discipline. Therefore, R2 values of 0.2 are considered high in marketing studies to explain consumer behavior; in the validation of the model, R2 has a value of 0.262, which is equivalent to accept that 26.2% of the variance explained by the model. Regarding the factorial load that measures the strength of a factor in the dependent variable, that the model is the Learning Achievement of the Science and Environment area, it is the factor (Need/obsession to be connected) that exerts the greatest influence on the endogenous variable with 0.419

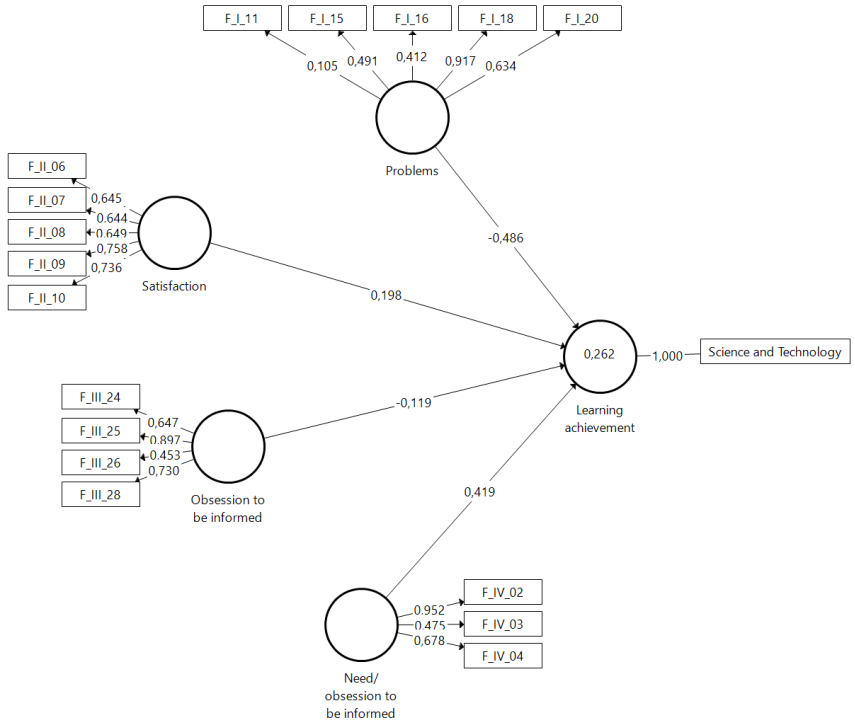


Fig. 1. R^2 of the SmartPLS model for the science and technology area.

Fig. 2 is the graphical representation of the analysis of reliability and validity of the model from R^2, for the dependent variable Achievement in the area of Communication, the value being 0.271, which is equivalent to 27.1% of the variance explained by the

model. Regarding the factorial load that measures the strength of a factor in the dependent variable, that the model is the Learning Achievement of the Communication area, it is the factor (Need/obsession to be connected) the one that exerts the greatest influence on the variable endogenous with 0.411, very similar to the data obtained in the learning achievement in the area of Science and Technology.

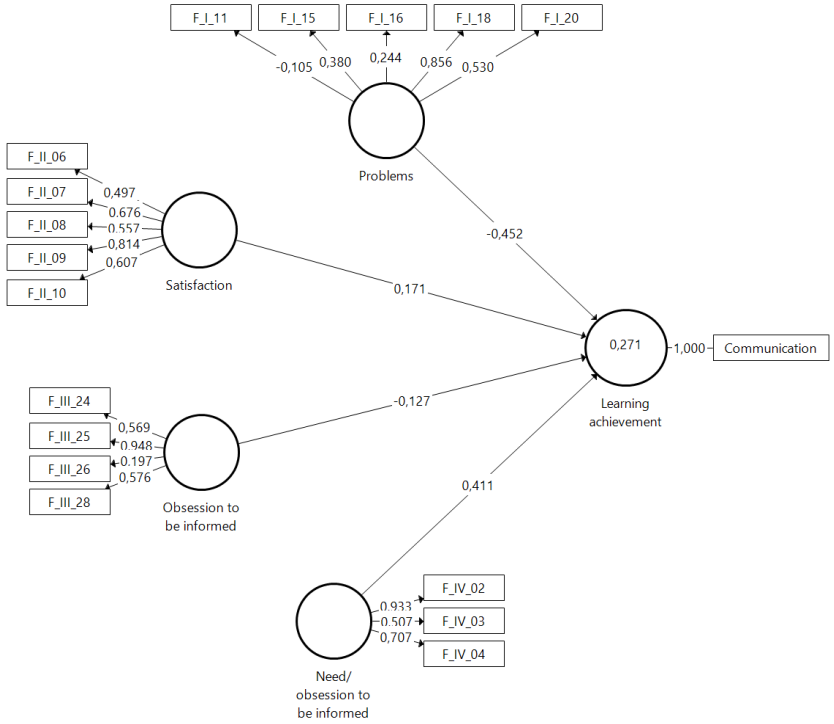


Fig. 1. R^2 of the SmartPLS model for the communication area.

3 Conclusions

The results obtained in the validation of the educational intervention model using the PLS-SEM to determine the level of influence of addiction to social networks in the learning achievement in the areas of communication and science and technology in high school students, it would only explain the causal relationship of the 4 factors in the dependent variable Learning Achievement, from an interpretation of R2 in 26.2% for Science and Technology and 27.1% for Communication, which means that there are other factors that influence the learning achievement. Likewise, the intervention model is validated in part, due to the fact that the results of the Reliability and Validity of the Construct, some values do not reach the required thresholds; however, the Discriminant Validity according to the Fornell-Larcker and Heterotrait-Monotrait Ratio (HTMT) criteria show very acceptable values, so the model has discriminant validity.

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Immersive experience through virtual reality app to generate spaces for synchronous interaction

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Abstract. This research analyses the potential of the use of a virtual reality app developed by the same university in the context of providing an immersive student-teacher and student-student interaction space that replicates the Huancayo campus and the university's classrooms that allows to overcome the nostalgia of not "attending" the university campus and having a digital means of interaction. For the evaluation of the same, an adapted questionnaire was administered to the students from the subject who attended regularly and to the teacher an interview about the benefits and difficulties arising from the use of the app. The results reveal a high degree of student satisfaction on the scales consulted: dynamization of the teaching-learning process, personal relationships, motivation and content acquisition; the biggest drawback manifested stems from the student's connectivity and data plan for greater dedication and usage.

Keywords: Mobile App, Virtual Reality, Inmersive, Experience

1 Introduction

In 2016, only 2% of U.S. teachers had used VR in their classes, up from 60% who intended to incorporate it as part of the educational process [1]. This data shows that Virtual Reality is a fledgling technology but with a high recognition of its potential on the part of the teaching community. In the same survey, 83% of teachers are convinced that Virtual Reality will help improve academic outcomes, with a better understanding of the concepts taught (77%), an improvement in collaborative processes (71%) and an increase in student motivation (84%) [1].

1.1 Virtual reality

Virtual reality doesn't have a single concept; for example, we can cite three interesting conceptualizations; [2] It defines it as "the complete immersion of human sensomotor channels in a vital computer-generated experience", for [3] "virtual reality, is a new way to explore reality. An extension of the senses by which we can learn or do something with reality that we could not do before", finally for [4] "Virtual Reality is a simulation of a three-dimensional environment generated by computers, in which

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the user is able both to see and manipulate the contents of that environment". These concepts present some elements in common: a) is a computer-generated simulation, b) is three-dimensional and c) is interactive. According to [5], a virtual reality system has three phases: passive (cannot be controlled), exploratory (allows a user journey) and interactive (allows you to experiment and explore the environment in addition to modifying). There is a number of researches that recognize the contribution of virtual reality in education; [6] For example, they highlight the implication of virtual reality in the added motivation for the student, as they will encourage them to learn and continue exploring the virtual world, while watching and listening at the same time. They cite researchings [7], [8] and [9] that have shown that the learning curve with virtual aids is faster and achieves greater and better assimilation of content than traditional teaching tools, mainly because students use almost all their senses in the process of learning a subject.

For [5], a virtual reality system is immersive when it gets "the user to feel like they are within the environment generated by the computer. For this the equipment used must be equipped with devices capable of deceiving (or stimulating) as many senses as possible", although the developed system allows access from oculus glasses, the social distancing originated as a result of the Covid-19 pandemic has motivated the development of the app version to be accessed by low-cost glasses.

1.2 Contextualization and description of the experience

This work is primarily aimed at highlighting the potential of using a virtual reality app in higher education. To do this, an experience has been designed consisting of student-teacher and student-student interaction in a classroom on the Huancayo campus replicated in 3D through virtual reality. In total, four learning sessions were held in this virtual space for student-teacher interaction and the space was open throughout the academic period to facilitate student-student interaction; participants were the students and the teacher of the Business Solutions Development subject of the Professional Career in Business Engineering. In the first class through this app, five questions were asked to students in order to know the resources and previous knowledge. 80% of students had a computer, 90% had a smartphone and 93.5% had an Internet connection, 10% who did not have a smartphone used the Nox emulator (see Fig. 1). As far as virtual reality is concerned, only 15% knew or had notions of what virtual reality is, only 3 out of the 32 students had participated before in some virtual reality experience, in both cases through video games. Based on these results, it can be said that students are especially receptive to the use of new technologies, but this does not mean that everyone is digitally trained for the use and exploitation of all tools. Therefore, the first class had to be dedicated to explain the various access methods (smartphone and Nox emulator). In the last session, a survey was applied to know the perception of student satisfaction in five topics (student participation, dynamization of the teaching-learning process, social relations, motivation and content acquisition).

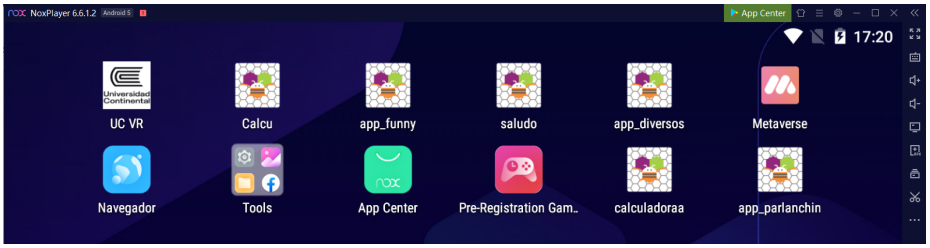


Fig. 1. Screenshot of the Nox emulator and the installation of the UC VR app

The simulated experience is to generate a virtual space that facilitates interaction in learning and is a major part of the teaching-learning process. Actually, as noted by [10], it is the interaction that exists in an educational experience that defines how the student learns about the content, his peers and the teacher; that is, the interaction can be student-content, student-student and teacher-student.

As for student-teacher interaction, the essential part that is always motivating for a culture where the teacher's figure and intellectual opinion is appreciated is reflected in the facilitator's interaction with his students [10]. The most relevant moments are when instructions are given, the learning process is guided, a specific topic is presented, it is explained or exemplified, links are created, reflection questions are asked, schemes are proposed, activities are organized or participations, tasks or jobs [10] are given feedback. The following table 1 details the simulated student-teacher interaction experiences.

Table1. Details of the immersive experience to generate student-teacher interaction.

Type of interaction	Description	Participating students
Student – teacher (Class 1)	Week 4 - Extended Reality	30 students
Student – teacher (Class 2)	Week 7 - Review of various topics prior to partial evaluation	29 students
Student – teacher (Class 3)	Week 11 - Emerging Technologies	31 students
Student – teacher (Class 4)	Week 15 - Review of various topics prior to the final evaluation	27 students

As for student-student interaction, the "best means of promoting learning is the interaction that occurs between several apprentices" [10]. "The primary part of the constructivist approach that promotes knowledge building arises at a time when students interact with each other to reach conclusions, create, evaluate, form judgments, research, solve problems and carry out other cooperative learning means. That's where the teacher's intervention focuses on guiding this process of negotiation and knowledge management" [10]. Team, couple or full-class cooperation creates a socio-effective and intellectual environment that promotes openness, tolerance to diversity and teamwork for intellectual development. "The active part of the student

and the teacher's guidance and framing create a very productive intellectual and affective practice" [10].

As Moreno points out [11], "intersubjective access in interpersonal relationships generates a dynamic of demands and expectations that influences the ways of acting and thinking of the people involved in the process". Table 2 shows the details of the experience of using the application to generate student-student interaction, some data is shown such as number of accesses and number of students synchronously connected to the app per week during the academic period.

Table 2. Details of the immersive experience to generate student-student interaction.

Week	Access Numbers	Number of synchronously connected students
Week 4	24 students	18 students
Week 5	20 students	08 students
Week 6	28 students	12 students
Week 7	29 students	19 students
Week 8	15 students	11 students
Week 9	28 students	12 students
Week 10	25 students	19 students
Week 11	31 students	21 students
Week 12	24 students	16 students
Week 13	26 students	15 students
Week 14	22 students	18 students
Week 15	27 students	19 students
Week 16	07 students	5 students

2 Developed app

To understand the development of the app, it's necessary to present the architecture of the solution for the virtual reality platform [12], Oculus Rift, which uses the helmet (HDM) for video output and the Oculus Touch controls (Fig. 2), as an input device, this was the architecture of the virtual reality experience solution and initially conceived. However, due to social distancing and the impossibility of using Oculus equipment, a systems component was implemented for the mobile app, which would allow access and experience from a mobile app. Below will be presented a series of screenshots, to know the main images of the immersive experience.

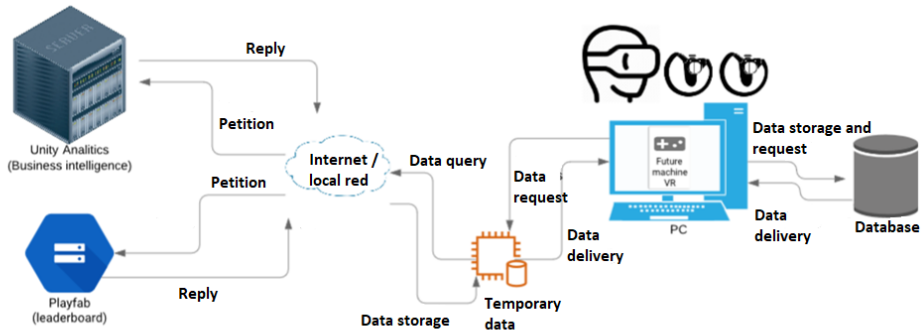


Fig. 2. Project solution architecture (Virtual reality)

The application makes use of a local database serialized in binary format, consisting of several files stored within the persistent folder on the device where the application is running. Each new scene will have its own data file, there will also be a local file to store the data requested from the remote Playfab server, which is a BAAS (back-end as a service). Finally, some application metric data is sent to Unity Analytics, a business intelligence service. The application requires Internet access to communicate with the Playfab and Unity Analytics servers. At the design level, it should be noted that it was designed in 3D from the plan of the physical campus of the university and the one-person tables and chairs, doors, curtains, among other elements are similar to the shapes, colors and textures of these elements of the campus in Huancayo.

Fig. 3 shows the Continental University campus, in the city of Huancayo; which is a replica of the real campus that exists in this city; with regards to pavilions, the pavilions B and C have been simulated.

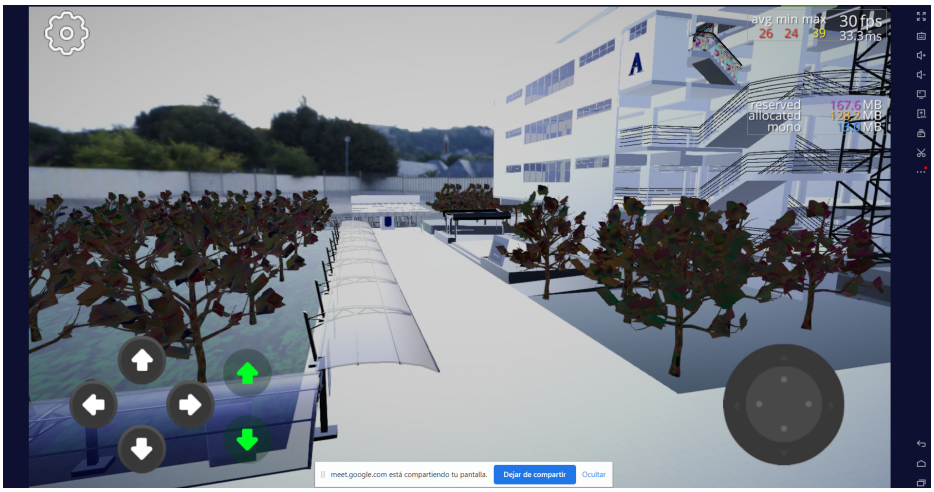


Fig. 3. Campus tour in virtual reality

In Fig. 4, an interface for the logging and registration of new users is shown.

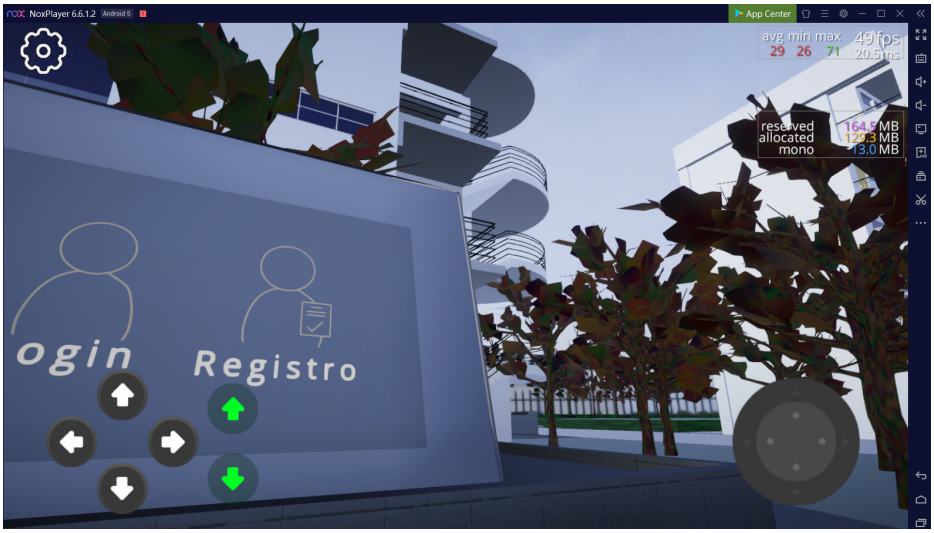


Fig. 4. Screen for user logging and registration

Finally, Fig. 5 shows a simulated class in the app within a classroom that is also a replica of a physical classroom, in which the user interface is observed and options for managing the quality of the resolution of the the 3D components, scrolling controls, microphone, and viewfinder mode in any glasses that support the placement of the smartphone within these glasses.



Fig. 5. Screen showing the simulation of a class

3 Methodology

This research was aimed at knowing the assessment that students and teachers make of the app in a subject, in relation to the promotion of participation, the dynamization of the teaching-learning process, social relations, motivation and the acquisition of content in their training as future teachers. For the evaluation of learning experiences, a questionnaire was administered to the students of the subject, adapted from Durán [13]. The questionnaire consisted of 46 Likert items grouped into five scales: participation, dynamization of the teaching-learning process, personal relationships, motivation and content acquisition.

These items offer 4 response options, with the intention of forcing the student to lean in one direction their rating. The four possible alternatives are: totally agree, moderately agreed, moderately disagreed and totally disagreed. The questionnaire is completed with 4 overall rating questions of the app, which students had to answer by completing a score scale between 0 (minimum negative value) and 10 (maximum positive rating). The questionnaires were answered voluntarily and anonymously by the students. In total, the students who participated and collaborated in the research were 28. The data analysis mainly used univariate descriptive statistics techniques, mainly percentages and central trend (average) statistics using the SPSS statistical program for Windows. The teacher's assessment was based on an open interview with two issues related to the benefits and difficulties identified in the use of the app, taking particular attention to the five topics that constituted the scales of the student questionnaire.

4 Results: Learning Experience Assessment

The information obtained in the student survey refer to very favorable results and a high degree of satisfaction in the five topics (scales) consulted.

- On scale 1 (student participation) student participation was valued considering visits and entries in the virtual reality app. An acceptable number of the app's visits to interact with your peers is reflected. 90% of respondents entered the app for student-student interaction; and 100% of them entered the app for student-teacher interaction classes.
- In the analysis of scale 2 (dynamization of the process teaching - learning) we can highlight the excellent assessment that students make of the app as an dynamizing tool of the teaching-learning process; thus, it exceeds 90% those that indicate that it stimulates the follow-up of the subject, stimulates the search for new information on the subject, facilitates the expression of ideas and opinions on current topics related to the subject, encourages the participation of students in the subject, promotes critical thinking and promotes creative thinking. The item "the app favors the resolution of doubts regarding the subject" receives a less high rating, although with a positive trend; 30.4% express moderately disagree with such a proposition.
- The current education system generated by the pandemic has limited the development of social competences. The analysis of scale 3 on social relationships

sets an opposite trend, clearly indicating that students perceive that the app promotes personal relationships, establishing new modalities of teaching-student relationship, as well as increasing the possibilities of contact between the group of students. Thus, over 80% students who appear to be totally or moderately in agreement on proposals such as: facilitates contact with the teacher; enhances collaboration with the teacher; facilitates communication between students; encourages personal relationships with peers; encourages the student to feel part of the group; stimulates new forms of relationship. It stands out that 93.5% perceive that the app favors the interaction and collaborative work of the students.

- Scale 4 (motivation) represents the results of students in the face of the app usage as a tool that favors motivation. None of the included propositions gets negative assessment, presenting, on the contrary, a clearly positive trend in relation to fostering interest in healthy habits, deepening the subject, performing activities of the subject, using new technologies.
- With the last scale, it is intended to know the suitability of the app in the acquisition of content. One of the most positive aspects of the use of this resource in teaching is that it facilitates the acquisition of specific content of the subject, both theoretical and practical; positive attitudes to educational innovations and practice as future teachers; the development of less specific knowledge (relating to New Technologies), and, fundamentally, in this information society, is that to the 88.8% it favors the construction of new knowledge, new thoughts.
- Finally, with regards to the global issues about the app and its usage (on a scale of 0 to 10) students make a remarkable assessment of the app as a tool ($\bar{X} = 7.1$); they significantly rate ($\bar{X} = 8.2$) the teacher's use and value their participation by 7.5. Finally, we find that they consider positive ($\bar{X} = 7.8$) the interest that, to them, have the virtual reality app in teaching practice.
- The teacher welcomes positively the experience, he believes that students have improved competencies such as: increased interest in health education, better self-learning capacity and greater responsibility. She recognizes the existence of meaningful learning and states that she improved the abilities not only of the students but also of herself.
- Regarding the difficulties, the teacher identified that not all students have a smartphone and that most of them have recurring frequencies of slow internet during the day or with limited megabytes, which restricts or limits the usability of the app. only 20% of students have a virtual reality goggle that gives them an even more immersive experience.

5 Conclusions

- First, the use of the virtual reality application contributed to generating participation processes, assuming high rates of student participation; The use of the application as an educational resource has impacted, opens up and brings them

closer to participation channels and offers them new perspectives inside and outside the classroom, coinciding with similar research results [14, 15, 16, 17].

- Secondly, it can be considered an adequate practice to maintain an active role of the student, allowing reflection and contrast of their own and other people's ideas and facilitating the student to be more autonomous as indicated [18, 19].
- Third, the experience was also favorable for the development of social skills in the collaborative construction of knowledge. Virtual reality can become a tool for collaboration and communication, as suggested by research [20, 21, 22, 23].
- Fourth, the application has become an easy-to-use tool that increases motivation. Students obtain benefits when using the 3D application, since their interests and motivation increase due to the interaction and feedback with their classmates and teachers, this conclusion is reinforced with similar results and research conclusions [24, 25, 26, 27, 29, 30]
- Fifth, the cognitive benefits cannot be overlooked either; The application facilitated the acquisition of content, helping to improve understanding and dictation of the subject, serving as a support for teaching. However, there is a great opportunity to continue improving the application so that it is not only limited to the transmission of content but also in the acquisition of abilities or skills, as shown by the following investigations [31, 32, 33, 34].

6 Future work

- We are aware of the limitations of this research: limited number of subjects, a single teacher, exclusively students from a career where these emerging technology topics are addressed so it is necessary to expand the research in this line, which considers aspects such as the teaching style, use of the app in the pedagogical model, characteristics of the students, educational level, history of use.
- It also seems necessary to delve into some of the drawbacks of using the app that may arise from this study: the "investment" of work and time that the teacher spends in designing a learning session with the app; the use of technology as a tool and not as a goal in itself in teaching-learning processes; changes in educational practices with the use of the app; potentialities versus app usages.
- At the technological level, the app has great opportunities to improve, such as the possibility for each user to select or customize their avatar, the possibility to generate actions such as walking, flying, sitting, raising their hand, among other actions to fine-tune and improve the user experience.

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Post Covid-19 macrotrends in the pedagogical practice of professors

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Abstract. The temporary lockdown of Educational Institutions provoked scenarios of emergency against the Global Crisis of the COVID-19. Which global macrotrends can be applied in the context of a Post COVID-19 pedagogical practices? Three categories were identified: I) Global macrotrends related to the Education Sector; II) The Post COVID-19 pedagogical practice, as a role assumed by the professor involved in the different education spaces (academicist, technological, cultural interpretative, socio-critical and socio-formative); and III) Student Outcomes (SOs), the accreditation model. Global macrotrends were selected to be applied in the post COVID-19 pedagogical practice that contribute to accomplishment of SOs and were consequently classified into three areas: i) Crosscutting Macrotrend (public awareness), ii) the Macrotrend of Post COVID-19 pedagogical practices (Disrupting Education: the assessment of progress, harnessing innovation, multiple senses, co-creation, instant entrepreneurship, the User Experience business-focused model approach for education, and gamification), and iii) the Macrotrend of Support (Networking & Technology).

Keywords: COVID-19, global macrotrends, higher education, pedagogical practice, professor development.

1 Introduction

Currently, Perú faces one of the biggest educational crisis as a result of the pandemic produced by the Coronavirus Disease 2019 (COVID-19), transforming the on-site educational system into e-learning or remote one as a result of the state of emergency. In 2019, the Organization for Economic Cooperation and Development (OECD) claimed that an answer to this current educational crisis will require smart strategic systems that can be adapted to face dynamic challenges; plus, OECD pointed out the relevance of supporting solid investigation systems as well as the development in education, re-designing both the learning and teaching processes. In accordance with the current context, current global macrotrends from the education system – that can be employed in the Post COVID-19 pedagogical practice in order to achieve Student Outcomes (SOs) accreditation model – were chosen [1]. In the last months of the educational emergency provoked by the spread of COVID-19, UNESCO has systematized and broadcasted government initiatives implemented by Latin American educational systems, focused

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on sharing government planning actions adopted by the different entities from its education sector; as well as, established strategic alliances within those groups and other sectors of interest involved in current scenarios, in order to ensure educational continuity, in the framework of distance learning, based on internet usage and other means of communication [2].

This has implied the consideration of certain aspects within the agenda of education policies, such as the design of strategies that address the complexity of the current educational situation in relation to the adequacy of curricular plans, evaluation systems, teaching methodologies, and student's and professor's overall wellbeing; just like the reduction of gaps: digital competencies, connectivity and access to informatics and technological equipment usage, among others. Furthermore, the preparation and the differentiation of specific labor are acquired in the exercise of teamwork and communicative skills within multidisciplinary teams, because a person on his/her own can't have all the necessary skills and competencies to solve new tasks. Therefore, the importance of communicative and socio-psychological of Engineering education is growing. For this reason, it is important to consolidate integrated education systems; that is to say, there should be a collaboration between universities and the aforementioned industry, where Engineering students can combine both the academic learning experience and the acquisition of a part-time job. In other words, an en-bloc modular education system.

2 Contextual frameworks

2.1 Post-COVID19 Global Macrotrends from the education sector

The current trend consists of multilevel teaching that is student-oriented and competency-based – with engineers that are ready to continue – which highlights the need for a change in the educational/professional paradigm, urged by globalization, the fast development of innovative technologies, the social development, the instability and the variability of the contemporary world [3]. In April 2020, the United Nations Educational, Scientific and Cultural Organization (UNESCO), in collaboration with the International Institute for Higher Education in Latin America and the Caribbean (IESALC in Spanish) claimed that initiating schooling through a virtual mode is not such an easy task to achieve, since many countries lacked the preparation for a large-scale disruption like this.

Also, because education actors believe that the development of competencies can't be achieved through digital tools or videos, taking into account that the COVID-19 pandemic affected roughly 1570 million students in 191 countries, being 23,4 million higher education students, and 1,4 million professors from Latin America and the Caribbean [4]. Likewise, they consider that maturity to face the actual problems is needed, due to the fact that the dynamic changed and is time to seize this context for redesigning the education processes, that involve the analysis of the different resources at disposal, that can contribute to solve gaps of connectivity, lack of digital technological resources in both professors and students (educational technology), lack of articulated online

contents with study plans; as well as professors and students prepared for this "new normality", among others.

In light of this, in the middle of the 1st semester of 2020, Trends Shapping Education Spotlight 21 and Ipsos Macrotrends have pointed out that education should analyze and adopt certain Global Macrotrends (GMTs), such as [5]: GMT.1) Public awareness: it involves the compliance of rights and duties within the framework of a democratic citizenship, that promotes civic and social participation among students and within every person. To this end, educational programs, projects, and subjects aligned with this cross-cutting competency are needed with the intent to prepared students for full citizenship. GMT.2) Progress assessment: it's a systematic analysis that will allow the acquisition of competencies naturally based on the formative assessment for the permanent learning process, regardless of time and space. In other words, learning from failure or mistakes should be allowed, considering the ubiquity of learning, and designing pedagogical measures to ensure a formative assessment (diagnostic, formative, and summative assessment).

GMT.3) Co-creation: it's a strategy meant for the consolidation of professional networks for professors or the collective knowledge of the teaching practice. GMT.4) UX-focused teaching: the User Experience-focused model approach for education (UX) is an approach that prioritizes a student's needs, in accordance with the experience of every professor, making interaction and communication simple and easy by helping to overcome challenges. GMT.5) Gamification: it's important to consider this in terms of educational transformation, as an opportunity to motivate and improve group dynamics, as well as a critical, reflective focus by students, in order for the aforementioned strategies to attain greater significance in both an attractive and competitive world.

GMT.6) Harnessing innovation: a process that allows making the best decisions regarding technology usage, creating a balance between what has and hasn't worked out. And, to whom this was useful. GMT.7) Instant entrepreneurship: mainly defined in entrepreneurship and self-employment. GMT.8) Networking & Technology: fundamental for the creation of new environments (both artificial and human) of communication, establishing those tools as new ways of interaction, based on innovative digital solutions for education.

2.2 Pedagogical practice

In 2020, OECD targeted three aspects that professors should consider in order to ensure the continuity of a high-quality educational service: (a) Cognitive skills, in reference to cognitive skills, processing, creativity, and knowledge; (b) Interpersonal skills that include teamwork skills and leadership, and (c) Intrapersonal skills, oriented to intellectual openness, work ethic, responsibility and self-efficacy [6]. When thinking about consolidating Public Awareness as a GMT.1), it is important to consider the articulation of democracy and social justice within a society, where said relation should be developed from (5) main dimensions that could originate from educational institutions. Among them, the redistribution of opportunities and the benefits of education, the recognition of cultural values and social diversity, school governance, a critical and participatory curriculum and democratic school culture.

In this regard, it becomes necessary to focus the professor's role in aspects such as: the promotion of democracy and social justice from democratic participation in the context of equal opportunity, recognizing cultural values in accordance with cultural diversity, with inclusion and respect of the different lifestyles, with inherent co-responsibility to new scenarios, pondering the development of critical and participatory thinking based on the appreciation of experiences and knowledge possessed by local communities, and adopting a democratic culture for learning achievement [7]. In relation to the foundation of the GMT.7) Instant Entrepreneurship, these new Post COVID-19 scenarios demand the development of new roles and responsibilities within the student, in such a way to allow him/her a meaningful and efficient learning process. As far as the professor's role concerns, he/she must promote self-regulated and autonomous learning strategies in flexible working environments, ensuring a student autonomous, active and self-regulating participation, which will prove valuable in these new scenarios and, that can allow a systematic change that enhances the personal construction of learning by the student, fostering meaningful learning experiences [8].

For the GMT.6) Harnessing innovation, as well as GMT.8) Networking & Technology, it's fundamental to develop the field, known as The Learning Analytics (LA), which allows obtaining information regarding the interaction between professors and students with virtual learning environments and the use of technology tools that support the teaching-learning process. Furthermore, in the context of Information and Communications Technology (ICTs), the use of tools for Learning Analytics should be considered for the purpose of helping the teaching practice in the evaluation of educational resources that are meant to be inclusive, available and valuable, and focused on digital competencies as a tool that contributes to the creation and assessment of meaningful learning experiences.

On the other hand, the development of the GMT.3) Co-creation should be focused to highlight the co-creation of adaptive components for a virtual learning platform that these new Post COVID-19 scenarios require, through the innovation, adaptability and identification of expectations from the people concerned with no inhibitions whatsoever, in trusted environments with ideas generated and arisen from an innovative, proactive and creative environment [10]. Therefore, collaborative approaches ought to be utilized in order to allow a wider range of action and contributions made in that regard. Thus, the personalization of contents in virtual learning platforms, as well as the co-evaluation, could fall into an inefficient work, if the professor doesn't empower him/herself throughout good practice that allows him/herself to generate an efficient performance, expertise and strengthening of activities in the virtual model.

When talking about the GMT.2) Progress assessment; just as the GMT.4) UX-focused teaching; it has to be taken into account that teaching practice increases in quality when there's a proposal of continuous improvement that fosters the systematization and communication of experiences from the university professor, based on the following strategies: an ongoing. Definitely, it's important to take into account the different factors that might influence the teaching practice, just as its improvement. For this reason, the direct experience contributes significantly and it's truly efficient in student learning.

Finally, the GMT.5) Gamification, which is significantly supported on the use of ICTs, is important in regard to the educational transformation as a learning strategy, since the student is able to make knowledge his/her own (besides the use of mobile devices or informatic equipment), which increases the motivation and leads to a better understanding, as well as their focus, through the promotion of critical thinking and creativity, this being quite a very versatile strategy for professors while teaching [12].

2.3 Student Outcomes (SOs) of the accreditation model

The student results are related to skills, knowledge, and behavior acquired by students throughout their process during the program", which promotes innovation in higher education. "Fig.1." presents the SOs, grouped in such a way that they can be considered as the 4 pilars of education according to The Delors Report [13].

Results for learning to know (a) Engineering Knowledge (b) Research	**Results for learning to be** (d) Individual and Team Work (f) Ethics (g) Communications (i) Lifelong Learning	**Results for learning to do** (e) Problem Analysis (c) Design and Solution Development (l) Project Management
Results for learning to live together or cross-cutting results (h) Sustainability and Environment (j) Engineering and Society (k) Use of Modern Tools		

Fig. 1. Student Outcomes (SOs) accreditation model – Delors education pilars.

In the socio-formative model and the competency-based approach, the SOs can also be classified by general competencies that articulate SOs (d), (f), (g) and (i). Cross-cutting competencies are oriented to achieve SOs (h), (j), (k) and (l), as well as, technic competencies group SOs (a), (b), (c) and (e). To that effect, the 4 pillars of education and the 3 competencies that cover the SOs, should be taken into account while developing the pedagogical practice in the current scenario, articulating said actions with Post COVID-19 education macrotrends.

3 Methodology

The present investigation inquired: Which global macrotrends can be used in the Post COVID-19 pedagogical practice? For that purpose, the General Goal (GG) establishes general macrotrends that can be employed in the Post COVID-19 pedagogical practice to achieve the SOs. Besides, the following Specific Goals (SG): SG1. Identify global macrotrends related to the pedagogical practice; SG2. Identify the Post COVID-19 pedagogical practice that contributes to the achievement of SOs from accreditation model;

and, SG3. Determine the level that exists between global macrotrends that could be used in the Post COVID-19 pedagogical practice. Likewise, the research addressed qualitative and quantitative methods through the matrix of documentary analysis and the matrix generated from a rating scale that considered the socio-formal levels of Tobon; we worked with categories and subcategories identified according to documentary analysis, as well as the design and processing of information detailed below:

3.1 Categories and subcategories

If we take the current literature – regarding global macrotrends linked to the education system – into account, three categories can be identified:
I) Global macrotrends, that consider global trends related to the education sector.
II) Post COVID-19 pedagogical practice, understood as the role assumed by the professor in the different education spaces aligned with the didactic approaches (academicist, technology, cultural interpretative, sociocritical and socio-formative).
III) Student Outcomes (SOs) comprehends 12 subcategories: a) Engineering Knowledge, b) Research, c) Design and Solution Development, d) Individual and Team Work, e) Problem Analysis, f) Ethics, g) Communications, h) Sustainability and Environment, i) Lifelong Learning, j) Engineering and Society, k) Use of Modern Tools and l) Project Management. Likewise, from a qualitative approach we worked with categories and subcategories, as well as the design and processing of information detailed below:

3.2 Design and processing of information

The instruments to gather information were developed according to the Specific Goals. In that regard, it is shown that to get the SG1 a documentary analysis technique was utilized through a matrix of documents, which contains specialized information of current global macrotrends. The latter was reduced by selecting education sector-only trends. In order to identify global macrotrends that could be applied in the Post COVID-19 teaching practice, OECD's 2020 Methodology was taken into consideration [14].

The aforementioned examines four (4) indicators to create awareness about the influence of macrotrends in the education sector. These are: a) Tools for rigorous thinking, b) Education sector scope, c) Lines of educational research, and d) Teaching practice. In relation to this, macrotrends that contribute to the last indicator were analyzed. For developing the SG2, a matrix of documents – that contains curricular approaches and different roles assumed by professors who relate to these – was designed. A reduction of the said matrix was done, considering the Post COVID-19 pedagogical practice. 51 criteria were elaborated in accordance with the Student Outcome (SOs), which were related to global macrotrends to determine their level of contribution, in a quantitative manner, through a value scale that considered Tobon's definition of levels of the socio-formative approach by competencies (developed in 2017), levels for the assessment scale of Tobon's socio-formative competence approach (2017). Very Low (0-25%) it does not relate to the criteria; Low (26%-50%) it relates to some elements of the criterion; Middle (51%-75%) it relates to essential and basic elements of the criterion and High (76%-100%) it is related to essential elements of the criterion, achieving quality

impact. Furthermore, the triangulation technique was utilized in order to describe this relationship in a quantitative manner, and it was used through a matrix of triangulation by Stake and Forbes [15]-[16], to give a proper answer in relation to the SG3, regarding the teaching roles that contribute to the achievement of SOs from ICACIT accreditation model, and the macrotrends linked to the Post COVID-19 pedagogical practice.

4 Results and Discussion

4.1 Global Macrotrends related to the pedagogical practice

In accordance with 4 indicators by OECD (tools for rigorous thinking, educational sector scope, lines of educational research, and teaching practice), 10 macrotrends related to the education sector were obtained [17]-[18]. Nonetheless, for effects of the analysis, they were grouped as follows, according to "Fig. 2.": (1) Cross-cutting macrotrend: "Public awareness", that comprehends teaching roles to foster a democratic participation as well as the coexistence. Secondly, (2) Macrotrend in the pedagogical practice: "Disrupting education", focuses on the assessment of progress, harness innovation, multiple senses, co-creation, instantaneous entrepreneurship, User Experience-focused model approach for education (UX), and gamification; considering the latter as an essential part of the discussion and approach in regard to the pedagogical practice itself, according to the role assumed by the professor, the role of the student, the role of evaluation and the professor-student interaction. Likewise, (3) Macrotrend of Support: "Networking and Technology". It contemplates support given by technology and internet during times of crisis and constant change.

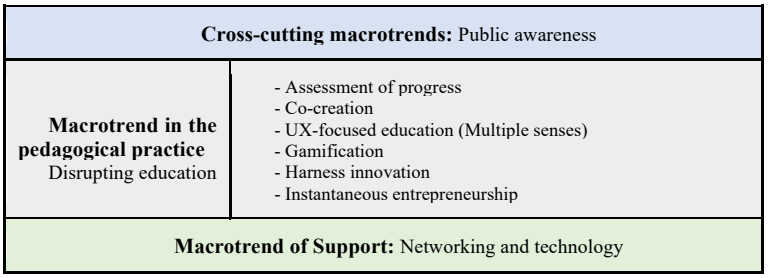


Fig. 2. Global macrotends that could be implemented in the pedagogical practice

4.2 Post COVID-19 pedagogical practices that contribute to the achievement of SOs

It was evident that teaching roles generated by curriculum approaches (such as the academicist and the technology one) don't contribute to the development of SOs. Whereas, roles promoted by the cultural interpretative, sociocritical and socio-formative curriculum approaches, contribute significantly to the achievement of SOs. In that sense, it is shown that the professor's role: "Foster democracy and social justice" is related to the SO to learning to be, which comprehends:

Team and Individual Work, Ethics, Communications, Lifelong Learning. Likewise, as a result of the analysis it is shown that all the OSs to learning to know (Engineering knowledge and Research) and learning to do (Problem Analysis, Design and Solution Development, and Project Management) develop with the professor's roles themselves, which are: Foster autoregulated and autonomous learning strategies, Foster analysis of research and information, Harness ICTs, evaluate learning and Create innovative methodologies. Finally, the SOs to learning to live together (Sustainability and Environment, Engineering and Society, and Use of Modern Tools) are fostered with the aforementioned (6) professor's roles.

4.3 Global macrotrends that could be implemented in the Post COVID-19 pedagogical practice to contribute to the achievement of Student Outcomes

To respond to SE3, it has been necessary, on the one hand, to identify the level of incidence of macro-trends in the development and acquisition of the Student Outcomes; and on the other, mention what roles the engineering professor should assume in pedagogical practice according to the macro trends that contribute to the achievement of these Student Outcomes. 51 criteria have been established, where essential elements of the SOs are extracted to analyze them in the light of pedagogical macro trends. For this, a four (4) level assessment scale has been made: very low, low, medium and high. (See Table II). From this, it was obtained that:
- The macro trends of Co-creation and instant Entrepreneurship achieve a high level of relationship, since they include essential elements (criteria) of the SOs, achieving quality impact; -Teaching macrotendencies UX focued education, taking advantage of innovation and technologies and interconnection, manage to relate to essential and basic elements (criteria) of the SOs. This places them at a medium level; - The macrotrends of public awareness and Gamification are located at the low level, since it manages to relate to some elements of the SOs; - The progress assessment macro trend has achieved a very low level of relationship. It is worth mentioning that the analysis described has been carried out in a general way, the level of macrotrend relation varies according to the SOs; therefore, this study shows that the professor must orient his pedagogical practice according to the SOs that he intends to develop.

The macrotrend in the pedagogical practice: "Disrupting Education", takes five aspects into account: (a) The assessment of progress refers to the design of pedagogical measures to guarantee formal education that allows ongoing feedback, without considering neither space or time as obstacles. Also, it values the importance of learning from mistakes and failures. This is related to the role "evaluate learning" and "create innovative methodologies", since it brings up the importance of documenting and systematizing pedagogical changes translated from evaluation and its impact at the same time. These roles are associated to the SOs "learning to know", "learning to do" and "learning to live together" [19]. (b) "Co-creation" considers it essential to create collaborative work between professor s and students with the aim of creating collective knowledge. This is linked to the professor's role to "create innovative methodologies". (c) "UX-focused education" promotes the design of meaningful learning experiences through the identification of students interests and needs. This is linked to the professor's role

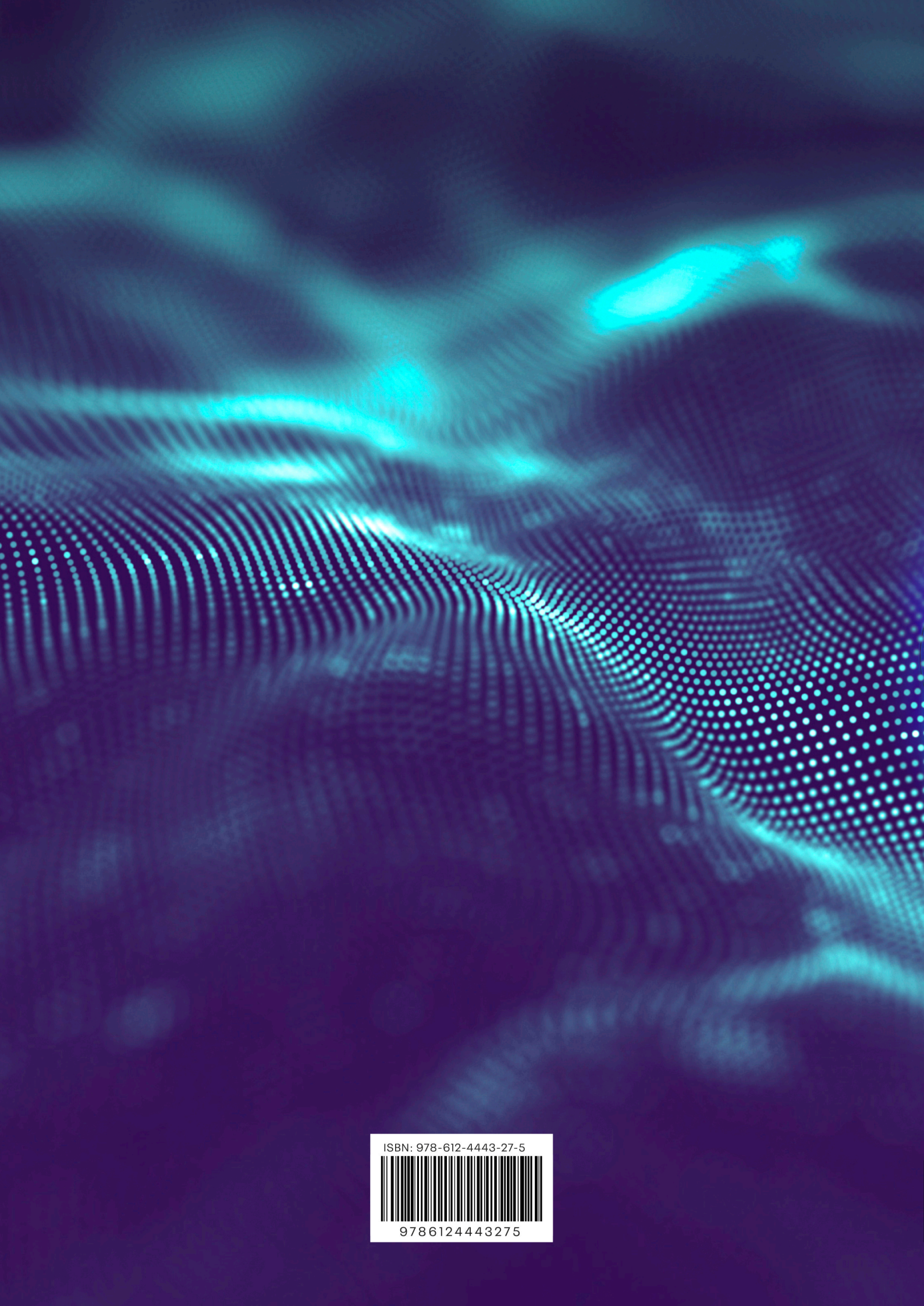
to "foster autoregulated and autonomous learning strategies" and to "create innovative methodologies".
(d) "Gamification" proposes the design of game-related learning experiences and competitiveness; This is directly connected with the professor's role to "create innovative methodologies" and "evaluate learning". (e) "Instantaneous entrepreneurship" promotes autonomous work and entrepreneurship, which is linked to the professor's role to "foster autoregulated and autonomous learning strategies". The last one, "harness ICTs" fosters the planning of learning experiences in an interdisciplinary and multidisciplinary manner, which sets the professor's role for "fostering analysis of research and information". These roles, configured by macrotrends, allow the development of SOs to "learning to know", "learning to do" and "learning to live together".
(f) The Macrotrend of Support: "Networking and Technology" promotes digital coexistence, the use of tools for remote collaboration and platforms of online streaming, the assurance of cyber safety, learning to consider Augmented/ Virtual Reality, Robotics and Artificial Intelligence, and the use of innovative digital solutions for teaching. In that sense, this macrotrend is directly related to the six teaching roles in the present investigation. Likewise, it can be inferred that this macrotrend provides support to the development of the four SR groups: learning to be, learning to know, learning to do and learning to live together.

5 Conclusions and Future Work

The macrotrends constitute a global perspective of the education sector that contributes to the rethinking of pedagogic practice, and with this, to the configuration for the development of knowledge, in such a way that innovation can be seized, with the support of networking and technology. Likewise, it weights co-creation and instantaneous entrepreneurship, considering both harnessing innovation and the application of the design process of UX-focused education. The professor is conceived as an agent that encourages students, designing meaningful learning experiences. It is projected that he/she deconstructs the term "evaluation" to structure it as part of the ongoing improvement of learning, leading to the development of the main purpose of education: transform society through a change of attitude and the practice of values that guarantee an integral high-quality education. On the other hand, lesson planning based on rote learning is expected to be avoided; in other words, from the conceptual content from syllabi, because students can check documents about each topic before the lesson, which will be dedicated to reinforce autonomy, talent, soft skills, digital coexistence and the resolution of problems-in context. Finally, global macrotrends to be used in the Post COVID-19 pedagogic practice, can be classified into three areas: Cross-cutting macrotrend (public awareness), pedagogic practice (Disrupting Education: assessment of progress, harness innovation, multiple senses, co-creation, instantaneous entrepreneurship, and education focused on the User Experience business, and gamification), and the Macrotrend of Support (Networking and Technology). In that sense, it is claimed that global macrotrends set Post COVID-19 pedagogical practices in such a way that they can enhance the teaching and learning strategies designed and planned.

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