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Digital Pedagogy to Transcend Education, Using Emerging Technologies

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Abstract. This research aims to generate knowledge about the teaching-learning process currently taking place both inside and outside the classroom through the utilization of emerging technologies in the educational sector, such as media and digital information and communication tools. It seeks to understand how the school community, including teachers and students, has adapted to the new normal resulting from the SARS-CoV-2 pandemic in Mexico. Information, Communication, Knowledge, and Digital Learning Technologies, collectively known as TICCAD, are fundamental tools primarily employed to enhance teachers' work on digital skills issues. Additionally, the significance of artificial intelligence (AI) and Three-Dimensional Immersive Digital Environments (EDIT) is underscored, as they facilitate innovation in teaching practices and student learning. The ongoing evolution in the educational sector has enabled us to analyze and identify both the benefits and areas of opportunity. These insights are crucial for the development of study plans and programs established by the Secretary of Public Education (SEP), ensuring a conducive learning environment both inside and outside the classroom. These emerging technologies have become invaluable allies in this regard.

Keywords: TICCAD, Teaching, SARS-Cov2, Learning, Technology and Competencies.

1 Introduction

In the educational sector as digital information and communication media and tools, responding to the way in which the school community; Teachers and students adapted to the new normal due to the SARS-CoV-2 pandemic in Mexico. Information, Communication, Knowledge and Digital Learning Technologies, also known as TICCAD, are fundamental tools used mainly to strengthen the work of teachers in digital skills issues. Currently, the process of evolution that has occurred in the educational sector has made it possible to analyze and detect the benefits and areas of opportunity that must be considered for the development of the contents of the study plans and programs established by the Ministry of Public Education (SEP) and in this way ensure a learning environment inside and outside the classroom (ICATECH, 2021), because they have become invaluable allies.

TICCAD (Khvilon, 2004) allows you to fully exploit a series of resources, platforms, devices and tools that society currently has in order to strengthen and expand the knowledge, as well as skills that human beings acquire in the area of digital technology to potentialize their creativity as well as the development of a motivational environment in educational institutions and in this way it is possible to contribute positively to the education of girls, boys and adolescents in the country.

TICCAD has revolutionized the way of communication, the way in which the student acquires knowledge and the way in which the teacher transmits it to his pupils and even the capacity that these two social actors manage the information, we must consider that talking about Technology in the educational field is not a new topic, however, it is a topic that is constantly involved in a series of social, cultural and economic changes.

The implementation of TICCAD (García, 2010) allows to continue with the educational plans and programs, with the purpose of integrating the knowledge from year to year to achieve that these digital tools are a substantial resource in the learning and teaching process in the face of the new normality that young people, teachers, and parents have faced with the return to classes in a face-to-face way.

In this way it is clearly expressed the fact that it is a study and inquiry into the reality of a social phenomenon involving the educational system which allows to analyze, explore, examine to understand a series of problems, the formulation of hypotheses or suggested solutions, the collection, organization as well as the evaluation of data, the formulation of deductions the scope of consequences, the presentation of conclusions to determine and evaluate the use of TICCAD in education in the face of a health emergency of SARS-CoV-2 (Esteban, 2003).

The incorporation of technology in the educational process requires teachers to acquire new skills for the exploration and construction of knowledge, allowing them to have physical tools that make students open their minds to new ways of learning to work, facing the need to experiment with new models to carry out the teaching and learning process. Among its many positive aspects, the (Acuerdo Educativo Nacional, 2020), proposes two primary objectives:

To offer an excellent, inclusive, and equitable education to the children, adolescents, and young people of our country and to grant teachers of the Sistema Educativo Nacional (SEN) (SEP, 2020), the right to better training and constant updating. To achieve such purposes, today we have powerful allies: information, communication, knowledge, and digital learning technologies. They are considered as didactic material with a level of importance as appendices in the educational process, part of its objective is to generate a potential of pedagogical character that should be incorporated by its structure in the study plans and pro-grams, being a strategy for the generation of useful knowledge for different educational levels.

Cordovez (2020) states: Education is adapting to this pace and be-coming more dynamic by using the operational properties of technology. The incursion of technology has significantly impacted education, in the sense of whether it is bringing about a profound change in the prevailing educational paradigms, in the way learning, teaching, and assessment take place.

In this context, (García, 2021), points out that The change from face-to-face classes to distance education occurred suddenly. Neither teachers nor students had time to prepare, so they adapted with the resources they had available. Even the closing of schools due to the health emergency has no historical comparison, students stop going to the institutions and start learning from home with the support of teachers who found it necessary to seek and incorporate means of communication and digital tools to continue with the distance teaching and learning process.

The use of TICCAD during the SARS-CoV-2 health crisis made it possible to carry out activities that strengthen students' learning and performance, considering them as a key element to overcome the contradictions and contextual problems that SARS-CoV-2 has generated for education, but, above all, that make it possible to think about the possibility of moving forward. The TICCAD incorporated in the pandemic (García, 2021) time were platforms for videoconferencing, virtual classrooms (Acosta, 2013), use of browsers (Biblioteca Universitaria de Alicante, 2024) and academic search engines, educational apps, tools for the development of digital resources, with this it is possible to develop collaborative work and project-based learning, which to date, have remained in the classroom. Giving way to new forms of study such as dual education, inverted classroom, among others; as well as a new learning called: autonomous learning, for (Maguiña et al., 2020), Autonomous learning (Baca et al., 2016; Crispín et al., 2011) is a new attitude towards learning and knowledge construction. It provides collaborative and meaningful learning. It is asynchronous and synchronous since it overcomes time and space limits. The main purposes of this learning are the development of intellectual, personal, and social autonomy, independent work.

This article arises from the investigation of a postgraduate thesis (Master of Pedagogy), whose main research question for the development of the project was generated by investigating how TICCAD impacts the teaching and learning process in higher education before and after the presence of a pandemic; SARS-Cov2? To clearly identify the problem, it is essential to pinpoint the underlying factors in order to provide a starting point for the research process. The study is based on a psychopedagogical framework with a mixed methodology. It adopts a socio-critical paradigm and employs descriptive and correlational techniques, incorporating elements of documentary and field research. The applied methods include observation, interview scripts, questionnaires, and sociograms.

2 Experimental procedures

For the development of this inquiry, it is considered to be answered the research question that arises in time of pandemic: How do TICCAD impact on the teaching and learning process in higher education during the presence of a pandemic; SARS-Cov2? based on a psycho-pedagogical line, with a mixed approach, whose paradigm is Sociocritical, its scope is descriptive and correlational, a type of documentary and field research, the techniques applied were: observation, interview, survey and its instruments: case studies, field diary, interview script, questionnaire, and socio-gram, respectively. The following table describes the applied methodology:

Table 1. Research methodology

Criteria	Research	Characteristics
Line	Psychopedagogical	Its objective is to study everything that interacts with a person, both psychologically and in the environment, and that influences their learning (Tamayo, 2003).
Approach	Mixed	Quantitative and qualitative research approach; In the first, it is possible to obtain tangible and rigorous data, being more appropriate for the verification or contrast of hypotheses based on theoretical knowledge, the second is more flexible, allowing the understanding of the facts through its exploratory power because there are phenomena that cannot be explained only with the quantitative method, the purpose is to analyze social reality (Sánchez, n.d.).
Paradigm	Sociocritical	It is characterized by presenting a self-reflective proposal, it considers that knowledge is built by interests that start from the needs of the groups, it accepts the existence of a dynamic and historical reality that must be transformed, in the research that is based on said paradigm. The use of qualitative and quantitative methods is allowed, which implies the interaction with reality and the subjects investigated as well as the obtaining of data and presentation of exact data (Sampieri, Fernández & Baptista, 2006).
Method	Hypothetical Deductive	The research is supported by the hypothetical deductive method, because its proposal presents a series of steps that are essential to develop it. As a starting point, it allows us to observe the phenomenon to be studied, with the aim of creating a hypothesis to explain said phenomenon (De la Cruz, 2024; Sampieri, Fernández & Baptista, 2006).
Scope of the research	Documentary and Field	Implementing an exploratory scope allows us to investigate new problems in order to identify new variables and generally identify areas, contexts and situations of study. Its purpose is to know the relationship or degree of association that exists between two or more concepts, categories or variables in a particular sample or context. These correlations are based on hypotheses subjected to testing; the fundamental part of this scope is presented when analyzing how a variable can behave when focusing on the behavior of the others which are linked (Ramos, 2020; Khvilon, 2004).
Research Techniques	Observation, Interview and Survey	Observation is the main technique by which the problem to be solved is identified. The interview is intended to collect exact information and opinions of interest. The survey applied to groups of numbers, which allows information to be extracted quickly and easily (Sampieri, Fernández & Baptista, 2006).
Instruments	Interview Script, Questionnaire and Sociogram	The interview script allows collecting specific information based on the indicators of the variables that were subjected to analysis. The survey questionnaire focused on collecting hard data and the sociogram for the analysis of the groups, referring to the students' learning (Tamayo, 2003).

Therefore, the following purposes are proposed for the development of this re-search: To analyze the educational impact generated by TICCAD in the teaching and learning process during and after the SARS Cov2 pandemic in higher education students. Specific objectives: to know the use that teachers and students make of TICCAD for their education. To examine the impact caused by SARS-Cov2 in the ITSCH and to observe the mastery and work done by teachers and students at the higher level. To support the thesis work, two variables were structured with the objective of identifying the key elements that make up the research data to answer the research questions and even identify how they are related to each other. The de-pendent variable indicates: The use of TICCAD as an educational resource and the independent variable: SARS CoV-2 and the teaching and learning process, for this reason they have quantitative and qualitative characteristics and properties of the studied phenomenon that acquire values that allow the relationship to be observed. between both variables. Table 2 shows the categories of analysis, referring to the variables involved in the research.

Table 2. Categories of analysis

VARIABLE X *TICCAD*	*X1. The use of TICCAD as an educational resource.* *X2. Digital Tools* *X3. Educational platforms*
VARIABLE Y *Students in time of SARS-Cov2*	Y1. SARS-Cov2 Y2. Teaching and learning process. Y3. Educational impact

Within this research, the hypothesis to be tested is as follows: The implementation of TICCAD, as the primary resource designed to analyze, apply, and evaluate the teaching and learning processes during a health emergency caused by SAR-Cov2, benefits many adolescents in continuing their higher education by providing an efficient interaction system between teacher and student. The type of study of this re-search is correlational since it allows the researcher to measure the degree of relationship that exists between two or more concepts or variables; since it is possible to identify the relationships that exist between two or more concepts, categories, or variables in a particular context. These correlations are based on hypotheses subject to testing, the fundamental part of this scope is presented when analyzing how a variable can behave by focusing on the behavior of the others which are linked. Table 3 presents the hypotheses generated from their relationship with the independent variable (X) TICCAD and the dependent variable (Y) Students in SARS-Cov2 time.

Table 3. Working hypothesis.

Hypothesis	Description
H1	The implementation of TICCAD (X) as a main resource designed to analyze, apply, and evaluate the teaching and learning processes in time of health emergency by SAR-Cov2 (Y), benefits many adolescents to continue with their higher education being an efficient interaction system between teacher and student.
H2	With the use of TICCAD (X), student learning is achieved (Y).
H3	Teachers integrating TICCAD (X) achieve the teaching of the subjects of study (Y).
H4	TICCADs (X) are fundamental tools for teaching and learning for students and teachers at the higher education level during and after SAR-Cov2 (Y).

Faced with the pandemic that occurred, some public and private educational institutions saw the need to use and incorporate TICCAD in order to continue with the education of young people in higher education with the aim of achieving the expected learning set by the Secretaría de Educación Pública (SEP), however, it must be considered that not all social sectors have the economic and geographical re-sources necessary to have access to such means, which has been a constraint. García (2021) mentions that: The change from face-to-face classes to distance education occurred suddenly. Neither teachers nor students had time to prepare, so they adapted with the resources they had available. Even the closing of schools due to the health emergency has no historical comparison, students stopped going to the institutions and began to learn from home with the support of teachers who had to look for and incorporate means of communication and digital tools to continue with the distance teaching and learning process.

For the Ministry of Public Education (SEP), addressing the educational crisis must be a priority "as long as all the conditions determined by the federal health authority are met". The return to the classrooms in the State of Mexico became pre-sent and essential as of June during the 2020-2021 school year, considering two weeks of working hours as a pilot test with the purpose of reincorporating the teaching staff and the school community to classes in person, contemplating the protocol of safe return to educational institutions, which was carried out at the beginning of the 2021-2022 school year.

Currently, one of the elements that must be contemplated before the adaptation of the new normality must be effectively reflected in continuing with the care and filters that have been established throughout this period of confinement in order to save the integrity of the people who are within the educational system.

It is also important to contemplate the adaptation process that is taking place in the current social context in which the children and young people of the country are developing, as well as the teachers, who have been a pillar to continue with the education that at some point was at a distance and is currently face-to-face and hybrid.

As Maguiña et al. (2020) points out, to address in depth, and from a critical position, the necessary elements to consider TICCAD as a key piece to overcome the contradictions and contextual problems that COVID-19 has generated for education. The use of TICCAD during the SARS-CoV-2 health crisis has made it possible to carry out activities that strengthen students' learning and performance, considering them as a key element to overcome the contradictions and contextual problems that SARS-CoV-2 has generated for education, but, above all, that make it possible to think about the possibility of moving forward.

For this reason, the integration and use of TICCAD offer a series of tools, communication and learning environments of enormous potential; therefore, the criteria for their incorporation in the educational environment must consider the pedagogical analysis, since the transformation of teaching is due to the reconstruction of pedagogical methods or plans and not to the renovation of media or devices.

The potential of these technologies as an educational medium is mainly reflected in providing the necessary elements to facilitate interaction and interactivity in learning environments, as well as covering the broad demands of educational ser-vices, through access to sources of information, which generates a diversity of opinions on the same topics, developing skills and abilities in both the student and the teacher.

3 Results

The research techniques implemented for data collection were selected according to their level of scope for the collection of data and their veracity for the analysis of the results; observation, interview and surveys were used, with the support of a series of instruments such as case studies, field diary, interview script, questionnaire, and sociogram.

To collect data, we utilized four techniques: documentary analysis, fieldwork employing the ethnographic method, observation, and surveys. This required essential tools such as bibliographic files, a computer, storage units, a field diary, an observation guide, and the questionnaire. It's worth noting that some of this data was gathered through traditional techniques during fieldwork, involving engagement with the interest group and visits to libraries for source consultation. The results obtained from the application of 14 questionnaires to students aged 18, 19 and 20 years old, who were semester of college students and whose educational evolution in the use of TICCAD has been observed throughout their stay at the ITSCH educational institution, when the SARS CoV-2 pandemic reached Mexico, the students had to take classes online, until their return to the classrooms.

Additionally, a questionnaire was administered to 12 teachers, including 7 female and 5 male teachers, responsible for the educational process of the students who participated in the questionnaire. They taught various subjects such as mathematics, biology, physics, chemistry, Spanish, arts, English, geography, history, civic and ethical training, workshop, physical education, tutoring, healthy living, and gender equality. This spanned from first grade in the 2020-2021 school year, through second grade in 2021-2022, to third grade in 2022-2023. The objective was to observe, analyze, and interpret their teaching and learning process through the utilization of TICCAD as an educational resource during the period of confinement.

The study population was the educational institution with a registered enrollment of 890 students as the space from which the population will be delimited, which corresponds to group "A" currently in third grade made up of 27 enrolled students; of which 16 are female students and represent 59.2% and the remaining 40.8% are identified by 11 male students. The sample that was considered in total is 14 students who represent 51.8% of the total sample, this is the result of half of the total established population, the questionnaire was applied to 7 female and 7 male students.

It should be noted that during this process, it was crucial to also observe, comprehend, and analyze the work conducted by teachers from various disciplines who attended to the group of students representing the sample. This approach enabled the monitoring of their learning process using TICCAD. The teacher enrollment comprised a total of 45 teachers between the morning and afternoon shifts, with 24 being female, representing 53%, and 21 male, representing 47%. Therefore, the sample consisted of 14 teachers who supervised their academic training.

The unit of analysis is the main environment and the sample that is studied within the research work, considering the determination, type, calculation, and identification of the elements of the population that are immersed in said unit of study being students and teachers since they comply with the sampling parameters and that in the development of chapter four the information will be presented.

As a result, it is obtained that the TICCAD that were incorporated during the SAR-Cov2 time were: the use of cloud computing (Google Drive and Drop box), integration of platforms for videoconferencing (Cordovez, 2020) being Meet, Microsoft Teams, and Zoom (Poket-lint, n.d.) as the main technological media used by young people, virtual classrooms such as Google Classroom (ICATECH, 2021) and Moodle, design of activities through Genially, Ka-hoot, Educaplay and Canva as online support tools for the creation of interactive content and browsers such as Google Chrome, Mozilla Firefox (Firefox, n.d.) and Internet Explorer, which corresponds to the independent variable (x) of the thesis, see Fig. 1.
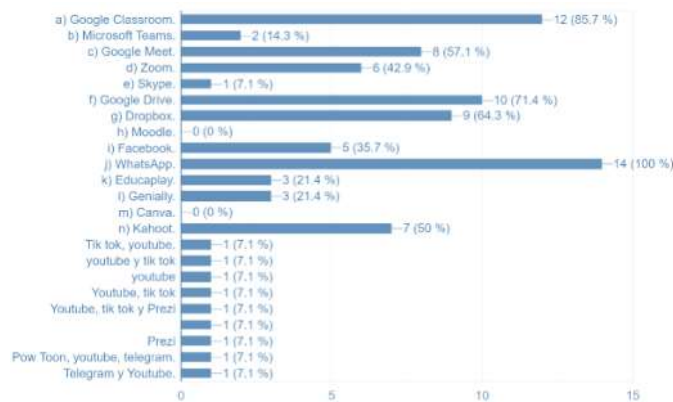

Fig. 1. Platforms used during the pandemic

As it can be seen in Fig. 2, most used mobile devices, a considerable percentage uses the cell phone as the main device, representing 92.9% of the total sample, which indicates that there are 13 students. In second place, the desktop computer is shown as a technological tool that 9 students have at home, representing 64.3%.
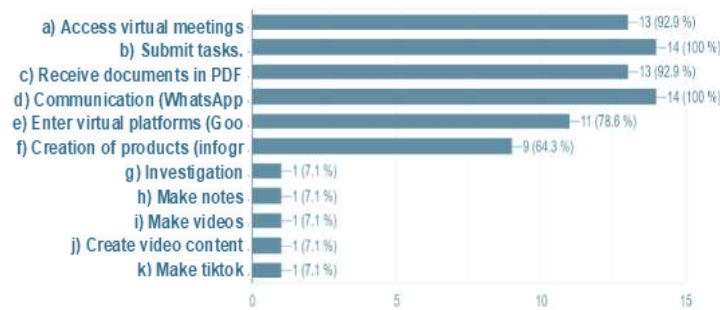

Fig. 2. Purpose of using platforms

According to new data from INEGI (2022), there were 342 thousand people trained and working in the field of information and communication technologies - TIC in Mexico. 75.6 % of the Mexican population (88.6 million people) used the Internet. Therefore, the TICCADs that continued to be used after SAR-Cov2 are multimedia content presentations: Power-Point, Canva, Genially, Slideshare, Prezi, Padlet, Emaze, Jamboard, Powtoon, Piktochart, ZohoShow, wordwall, among others. Collaborative tools: forums, Blogs, wikis, Webquest, and Padlet. Cloud computing: DropBox, Drive, Box, Box, iCloud, OneDrive, Nextcloud, Mega, Adrive, ClaroDrive, AmazonDrive. Messaging and social networks: Skype, WhatsApp, Google Chat, SnapChat, Telegram, Matrix, Allo, Twitter and email. Online platforms and campuses: GoCongr, Moodle, Google Classroom, Microsoft

Teams, and TedEd. Tools to dynamize virtual and face-to-face classes: Kahoot, EducaPlay, Quizizz, Cerebriti, AhaSlides, Cerebriti, Brainscape, Quizlet, Peardeck, Jigsaw Planet, Pixton, Kubbu, Paper.li, Popplet, Random Name Picker, mentimeter, appsorteo.
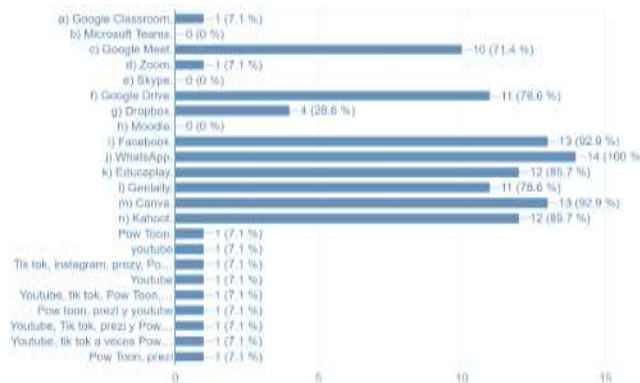

Fig. 3. Platforms used after the pandemic

On the other hand, it is shown that according to the information obtained from the teachers, it is analyzed that the most known and used platforms during the time of confinement were: Google Classroom as a virtual classroom and WhatsApp as a means of communication, representing 100%. In second place with 83.3% is Kahoot, subsequently 75% of the sample selected applications such as: Google Meet and Google Drive, therefore Educaplay was selected by 33.3%, while 25% is represented by Zoom as an alternative for video calls, 16.7% are Microsoft Teams, Dropbox and Genially. See Fig. 4. Technology used by teachers.
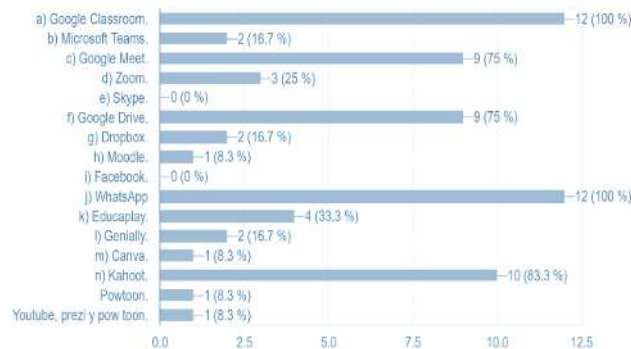

Fig. 4. Technology used by teachers

It is important to know if TICCAD after the confinement period and with the re-turn to the classrooms are still useful. With this item it is possible to analyze and interpret that, in fact, the majority of the teachers surveyed make use of different platforms, applications and technological tools. For the digital learning of their students, information that can be compared and verified in the same way with the in-formation obtained in the previous point. The applications and platforms with the highest demand for use are: Google Drive, WhatsApp, and Educaplay, all with a demand of 91.7%. Following closely with 83.3% demand are Genially and Kahoot. Notably, before the pandemic, Genially did not hold significant relevance, but it is now widely used by teachers. Dropbox and Canva represent a case of 75%, a different scenario from the analysis in item number 9. Meanwhile, Facebook is utilized by 66.7% of respondents. Among the results with the least demand are: Google Meet with 33.3%, Google Classroom and Moodle with 8.3%. Additionally, we have included answers provided in another section: Telegram, YouTube, TikTok, and Powtoon. Knowing the results of the research, the teachers consider the importance of taking a course or training, since 100% mention that they have interest and willingness to enroll in a course on TICCAD, which has already aroused their interest and commitment. with their performance as people at the service of education, see Fig. 5:
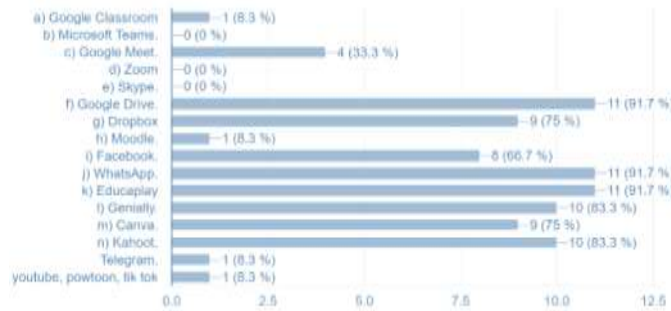
Fig. 5. Platforms used

This data yields quantifiable insights, emphasizing the need to delve into what motivates teachers to pursue technological courses. This is driven by the imperative to acquire new knowledge and their personal interest in furthering their education, particularly in specialized courses focusing on TICCAD. It is evident that they are already somewhat acquainted with TIC and TAC, and they recognize the importance of staying updated.

Consequently, they emphasize the crucial necessity for teachers to continually engage in their training process. There is still ample terrain to explore, especially considering that TICCAD resources were in existence even prior to the emergence of the social phenomenon of SARS CoV-2. Society will seek an educational resource to adapt to the teaching and learning process, a resource that was not widely known before. Now presents an opportune moment to delve further into them. This involves not only acquiring proficiency in managing platforms but also recognizing the par-amount importance of using these media responsibly to extract the maximum benefit from these educational technological resources.

Another result obtained was that with the online classes, the exams were elaborated in technological forms that were easily accessible through a device connected to an internet network, currently these tests in the last school cycles have also been carried out through these educational resources, by the teachers who use the TICCAD in the school environment, also the MEJOREDU exams, the zone exams and those requested by the school supervision to which this institution belongs are applied through online platforms; see Fig. 6.
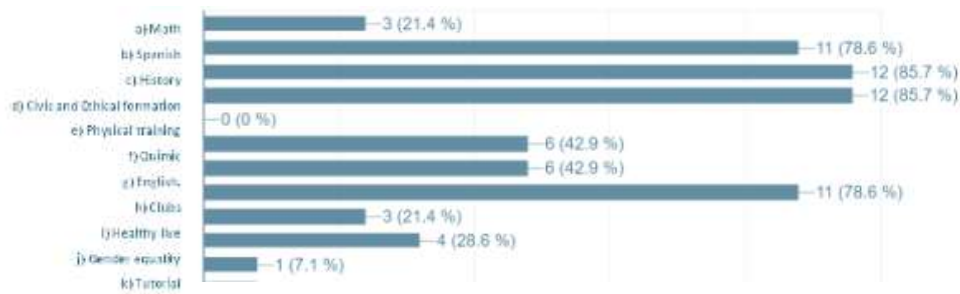

Fig. 6. Subjects where technology is applied

The subjects that make use of TICCAD in the teaching and learning process and according to the results obtained from the questionnaire it is concluded that the sub-jects of; Spanish, history, civic and ethical formation and workshop stand out in the use of TICCAD by students and teachers representing 85.7% history and formation, 78.6% Spanish and workshop having these last ones a focus on the knowledge and use of technological media for the development of skills in students. Consequently, subjects such as; chemistry and English represented 42.9%, followed by gender equality with 28.6%, healthy life and mathematics with 21.4% and to conclude as can be observed in the valuation of this group the subjects of tutoring and physical education are the ones that presented the lowest percentages, emphasizing that almost no and TICCAD are not used, which minimizes the accumulation of knowledge acquired in these subjects; whose data were validated in the final grades of the students.

The following graph also shows that 64.3% of the students stated that they had acquired a new device because of the need to be able to download and access the virtual sessions, as well as to design, prepare and submit activities for evaluation, while the remaining 35.7% indicated that it was not necessary to acquire a new technological device. Here it can be observed that the number of students who purchased a new device was higher, and some even expressed that technology is becoming obsolete and

anyway at some point they would have to replace it with a more current one that meets their needs and that the pandemic only expedited this moment. Of the technological devices purchased were: tablets, cell phones, laptops and desktop computers; see graph 8.
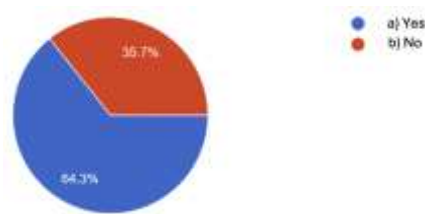

Fig. 7. Technology purchase

Some important and unexpected findings were also to identify how TICCAD re-lates to artificial intelligence (AI) and Three Dimensional Immersive Digital Environments - EDIT (Valdés, 2021), their possibilities and implications in the field of education. Regarding AI, chat GPT (Esteban, 2003) launched in May 2020, was used by millions of users around the world, who have been impressed by its ability to understand natural language and respond coherently to what is questioned or prompted. It helped students during the pandemic to understand difficult concepts and answer questions efficiently. They were able to use it to get additional explanations on a topic, practice language skills or even prepare them for exams; certainly, an artificial intelligence language system, which supported them during the confinement.

Regarding the construction and integration of the EDITs, it explained through simulators, the various forms of experience of the physical world, mediated by today's 3D technology. The EDITs conceptually abstracted key elements of virtu-al environments: Virtual Reality (VR), Augmented Reality (AR), Virtual World (VM), Mixed Reality (MR), Extended Reality (ER) to provide a broad and comprehensive explanation of their didactic possibilities, which would allow a future debate about the educational relevance of immersive systems, contemporary and future, in 3D technology.

Through the analysis of EDITS, they could be integrated into education to assist teachers in understanding these immersive environments in their subjects. From there, it is intended to project a pedagogical strategy according to the generation of an appropriate type of learning. The main terms of analysis are: the user's practice, his level of immersion (perception and interaction through a playful narrative in terms of space, time, body and identity) and the presentation mode of the immersive system.

EDITs (Valdés, 2021) have the ability to share experiences in a much more immersive way than current technology allows, and the virtual potential to create vivid situations although an experience may be virtual, all learning acquired through it is real. Academic knowledge is approached as a way of conceptualizing the constructivist educational process suitable for teaching with EDITs. In practical terms, gamification is considered an aspect of the design of virtual experiences that motivate and engage the learner.

Through the analysis and interpretation of data collected from the sample population, the veracity of the proposed hypotheses is confirmed. Over the course of three academic cycles, we observed and studied the social phenomenon. This confirmed that both teachers and students in the institution adopted the use of TICCAD as an educational resource for various academic activities during the period of confinement due to the pandemic. This significantly impacted the teaching and learning process for both parties involved. Table 4, showcasing the contrast of the hypotheses tested in this research, is provided below.

Table 4. Hypothesis testing

Hypothesis	Description	State
H1	The implementation of TICCAD (X) as a main resource designed to analyze, apply, and evaluate the teaching and learning processes in time of health emergency by SAR-Cov2 (Y), benefits many adolescents to continue with their higher education being an efficient interaction system between teacher and student.	Accepted Accepted Accepted
H2	With the use of TICCAD (X), student learning is achieved (Y).	Accepted
H3	Teachers integrating TICCAD (X) achieve the teaching of the subjects of study (Y).	Accepted
H4	TICCADs (X) are fundamental tools for teaching and learning for students and teachers at the higher education level during and after SAR-Cov2 (Y).	Accepted

The TICCAD presented in this article were designed to support teaching by facilitating content development, fostering autonomous and meaningful learning, promoting self-esteem, and cultivating a positive attitude towards technological advancements at a higher level. This empowers students to pursue their studies with greater confidence and proficiency.

As a result of this exploration, students were able to identify errors during the handling of the activities, generate problem-solving guides, develop their logical thinking through technological applications, manipulate it easily due to its easy access interface, measure its scope and generate self-evaluation, greater skill in the use of TICCAD. Improved communication, application of new teaching-learning methods, use of different digital tools, development of competencies, personalized and collaborative work.

4 Discussion

According to the results acquired, it becomes evident that TICCAD in education and society demonstrate a remarkable degree of flexibility and adaptability in an increasingly dynamic environment. Before 2020, the integration of technology in education was a gradual process. However, with the emergence of the SARS-CoV-2 pandemic, it became imperative. Currently, it has transitioned to a voluntary but essential aspect of education, driven by the recognition of the substantial benefits that arise from the correct implementation of TICCAD.

The mixed approach developed in this research process has allowed the analysis of two perspectives, on one hand, quantitative data obtained through surveys and on the other hand, qualitative data collected through an interview process and socio-grams, which have allowed substantiating information, as well as raising new perspectives that were not foreseen at the beginning of this research process. As a result of the quantitative analysis, employing both descriptive and correlational statistical methods, it became evident that 71.4% of the surveyed teachers found the transition from classroom to virtual mode to be challenging. Additionally, the same percentage indicated a lack of familiarity with TICCAD tools. Consequently, 100% of those surveyed affirmed the importance of implementing a training plan focused on the use of technological tools. Such training proved to be of substantial assistance in adapting to the virtual mode.

For the qualitative analysis of the information obtained in the interviews applied, it is stated that the transition from face-to-face to virtual mode at the beginning of the pandemic became complicated, since they did not have the necessary knowledge to perform adequately in these virtual environments (Cuartas, 2017), especially when the implemented training was not of a practical nature, which meant that the management of TICCAD and the adaptation to these new scenarios became a challenge. Based on this somewhat bitter experience, most of the interviewees agreed that the technological tools, beyond the difficulties presented, have resources and applications that lead to the strengthening of the students' knowledge, which is why it is important to have a training plan in the use of TICCAD, to help them take advantage of the potential that technologies have to offer.

It is proposed to implement a structured training plan for the use of TICCAD. This plan aims to establish a clear roadmap including the following steps: identify a TICCAD need, establish objectives, define the contents according to the need, choose a trainer who may be a person from the same institution or an external agent expert in the area, select the teachers who will receive the training, establish the teaching modality, which can be virtual or face-to-face, develop the theory and sub-sequent practice of the topics addressed, to finally follow up on what was covered in the training, in order to adjust certain eventualities that arise in daily practice and continue to be used to promote student learning in this digital age, the information age.

As Valdés (2021) indicates, meaningful learning in conjunction with EDITs are a good reference of understanding for the teacher; since they explain the correlation between VR, AR, MV, MR and RE, as well as the possibility of these models being used in the teaching-learning process with the incorporation of 3D technology in the classroom. Such an objective conceives the teacher as an individual who projects and potentiates his or her educational practice from his or her perspective with the help of immersive digital technology.

Another important term to note is artificial intelligence, which provides the necessary potential to address some of the major challenges of current education and to innovate teaching and learning practices; as well as to improve the positioning of educational institutions. Some of the benefits of AI integration in education are: stimulating personalized and collaborative learning, facilitating teaching, monitoring student performance, simplifying educational management, among others; and as possible uses of artificial intelligence: creation of virtual tutors, identification of new subjects of study, improvement of educational marketing actions, implementation of smart campuses, among others.

Continuing with the relevance of the research, gamification is also highlighted as a strategy for student learning, knowing that it is an innovative (adaptive) teaching resource capable of presenting thematic content in a way that effectively connects with students, in terms of attraction, fun, interactivity and immersion. In fact, in the crisis generated by the COVID-19 pandemic, virtual reality and gamification al-lowed the simulation of various higher-level collaborative projects for the training of students. Gamification as a learning technique transfers the mechanics of games to the educational and professional field, with the aim of improving the results of the teaching learning process, either to enhance the acquisition of knowledge, strengthen skills or encourage specific actions through rewards. Its benefits are associated with the assimilation of content and improvement of skills.

To conclude, the importance of TICCAD in education is determined, since they are linked to more technology and teaching tools that favor the teaching-learning process in the classroom; For this reason, the use of these in any educational approach is considered convenient.

5 Conclusions

The integration of TICCAD in higher education during the pandemic generated a diversity of opportunities to innovate teaching practice. It facilitated the merging of virtual environments with real-world elements at various levels of interaction, effectively adapting to the new reality of that time. The level of acceptance was such that, in the process of developing digital educational resources, many teachers turned to technologies focused on augmented reality and virtual reality, provided their context and knowledge permitted. For its implementation at the higher level, the creation of digital resources involved a systematic process based on pedagogical and methodological approaches, as well as technological guidelines that promote autonomous and meaningful learning for interactivity with the main object of study (students).

Once left behind the fears and uncertainty of how to integrate TICCAD in the classroom, the results were satisfactory; so it can be determined with the results obtained that TICCAD came to stay, since January 2022 that returned to the class-room in a face-to-face manner continued to be used; various digital tools have emerged and innovated for the creation of content, apps, browsers, search engines, virtual classrooms, simulators, computer clouds, artificial intelligence is increasing-ly present in the educational environment, collaborative work, autonomous, meanngful and project-based learning continues to be promoted; even the curricula have been updated, based on the results obtained after the SAR-Cov2 experience and its relationship with technology focused on the educational field.

With this research, we successfully validated the hypothesis and addressed the re-search question. Most importantly, we have tackled a problem. The acquired results not only affirm the current impact but also underscore the need for continuous development and updates. This encourages the creation of new tools and platforms (Rammert, 2021), opening up fresh alternatives for study, teaching, and learning, ensuring that these advancements are here to stay.

Finally, the efficiency and quality of the resources applied by teachers and used by students is examined, considering indicators valued by students such as usability, accessibility and impact on their learning. TICCAD, as technological tools, have increased the degree of significance and educational conception, establishing new models of communication, in addition to generating spaces for training, information, debate, reflection, among others; breaking with the barriers of traditionalism in the classroom. (Ayala, n.d.). It should be taken into account that the teaching-learning process in the classroom, making use of TICCAD, requires a set of competencies that the teacher must acquire with the logic of adding a methodology capable of taking advantage of technological tools, where teacher training should be considered one of the first options before facing new educational challenges.

For future research, it is suggested to investigate TICCAD in relation to AI and EDIT, as well as the use of gamification. Given that artificial intelligence (AI) systems in the classroom enable students to learn and improve their performance over time, adapting to new situations, it is important to note that AI does not replace the importance of the educator's role but rather complements their work and contributes to achieving their goal. Through AI, teachers can easily detect plagiarism in academic work, create an inclusive and diverse learning environment, which is essential in a globalized world. Realistic simulations also promote academic motivation; for example, medical students use artificial intelligence in education to simulate surgical interventions and other medical procedures, gaining invaluable firsthand experience before entering the field. UNESCO perceives AI in education as a powerful tool to promote lifelong learning and provide individuals with the knowledge they need to thrive in the XXI century.

Regarding EDIT, virtual reality (VR) is not futuristic; in fact, most people have already encountered its applications by playing computer games, experiencing a simulator in a museum, or watching a 3D movie in a cinema. VR presents information through a combination of sensory manifestations such as sound and touch, giving users the impression of being in that world. Three types of VR are identified based on the level of immersion and user awareness: low immersion, semi-immersive, and highly immersive.

Virtual environments are settings that support the internalization of the learning process and personalized knowledge acquisition strategies. Similarly, they can make knowledge tangible and create action-based experiences rather than knowledge based solely on theory. Therefore they are related to gamification, as they are considered approaches to immersive learning. Virtual spaces apply theories and strategies that optimize the learning experience, and four of them are presented:

Role-playing: Young people, familiar with avatars, benefit from activities centered around a problem-based teaching exercise, as this promotes a more intentional experience. Situated learning [2]: Immersive virtual reality offers students a variety of situated learning experiences, surpassing those provided in a traditional classroom setting. Knowledge and skills are acquired by reflecting on how knowledge is obtained and applied in everyday situations.

Problem-based learning: Problem-solving ability is a critical learning skill; there-fore, educators adopt a variation of this learning approach to enhance students' skills. This method offers different facets of an issue, allowing students to compare individual thinking with that of others. Students can enhance their creativity by using problem-solving skills, visualizing new ideas, and concepts.

Constructivist learning: Within social constructivism, there is a negotiation of meanings to develop common understandings among students or between students and teachers. Constructivist views include experiential learning, inquiry-based learning, collaborative learning, guided discovery, and learning by doing. Hence, the im-portance of continuing research focusing on these recent findings is emphasized.

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