

Chapter 6 Educational innovation through techno-pedagogical tools in virtual education

Capítulo 6 Innovación educativa a través de herramientas tecno-pedagógicas en educación virtual

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Abstract

Virtual education is present more than ever at all educational levels, as a result it is essential that institutions incorporate technological advances in the way they teach their courses. In order to identify the influence of techno-pedagogical tools to facilitate and improve student learning, a longitudinal-quasi-experimental and applied research was carried out. A sample of 35 individuals chosen at the investigator's convenience, 19 from the treatment group and 16 from the control group, was considered. Adjustments were made in the treatment group courses and later, using the survey as a data collection instrument, the impact of the use of techno-pedagogical tools was evaluated, in addition a comparison of the results of the final grades of both was made. groups. The results show that the techno-pedagogical tools that include small capsules facilitate learning in students, therefore presenting improvements in their learning.

Educational innovation, Techno-pedagogical tools, Instructional design

Resumen

La educación virtual está más presente que nunca en todos los niveles educativos, por lo que es fundamental que las instituciones incorporen los avances tecnológicos en la forma en que imparten sus cursos. Con el fin de identificar la influencia de las herramientas tecnopedagógicas para facilitar y mejorar el aprendizaje de los estudiantes, se realizó una investigación longitudinal-cuasi-experimental y aplicada. Se consideró una muestra de 35 individuos elegidos a conveniencia de la investigación, 19 del grupo de tratamiento y 16 del grupo de control. Se realizaron ajustes pertinentes incluyendo diversass herramientas tecnopedagógicas en los cursos del grupo de tratamiento y posteriormente, utilizando la encuesta como instrumento de recolección de datos, se evaluó el impacto del uso de herramientas tecnopedagógicas, además se realizó una comparación de los resultados de las calificaciones finales de ambos grupos. Los resultados muestran que las herramientas tecnopedagógicas que incluyen pequeñas cápsulas informativas facilitan el aprendizaje en los estudiantes, presentando así mejoras en su aprendizaje.

Innovación educativa, Herramientas tecno pedagógicas, Diseño instruccional

6.1 Introduction

This research was conducted at the Universidad Veracruzana with the purpose of determining whether the implementation of techno-pedagogical tools facilitates learning in virtual education.

We start from the theoretical-conceptual framework that supports the study, giving rise to the study context in which it is developed and that establishes the bases of the methodological design of the research.

It is a quasi-experimental design, with the participation of 35 students of the Bachelor's Degree in Administrative Computer Systems who were taking the educational experience of programming in the period September 2020-January 2021, thus integrating a treatment group with 19 participants and a control group with 16 participants. Several techno-pedagogical tools were applied in the treatment group to later apply a survey as a data collection instrument, and compare the responses of the participants of the control and treatment groups; on the other hand, the results of the final grades of both groups were analyzed. The results confirm the acceptance of the incorporation of techno-pedagogical tools to the virtual course and, according to the students, these tools have facilitated learning in the virtual course.

6.2 Theoretical framework

Educational innovation is increasingly present in learning environments, in March 2020, the World Health Organization, WHO (2020), declared the pandemic by the coronavirus COVID-19 which caused an exponential increase in the use and application of such virtual environments, since then there have been effects in various areas of life, this research refers to the radical changes that the education sector has undergone and the impact on the way of learning.

This is how the use of techno-pedagogical tools went from being an option to a necessity, this has become clear with the worldwide confinement where each of the homes became a virtual classroom, which is why it is important to identify whether in reality the educational resources applied in virtual education are suitable and especially if they have facilitated learning at different educational levels. In addition to this, the application of virtuality in educational institutions took most of them by surprise, so they started improvised and empirical work to reach students with learning content, so it was considered important to identify the relevance of the appropriation of these tools to virtual courses.

On the other hand, it is complex to keep up with technological advances and apply them to the educational sector. According to Cabero (2006), it is of great importance to mobilize diverse strategies, including of course the inclusion of information and communication technologies, to respond to the question of how to learn and what mechanisms will be used to motivate and awaken the interest of students in their training, from the individual use of subjects with study materials to teaching for group use by putting collaborative learning into action.

Currently there are many technological tools to complement learning and to design classrooms that favor higher quality learning; many of these tools are used online, others require downloading and installation, most of them allow information sharing and collaborative work, and others can be embedded in educational spaces. Valverde (2002) also emphasizes that "materials should be created that encourage the student to move through the information and the meaningful construction through their own paths using text, sounds, images, animations, videos and others"; hence, the importance of analyzing the use and impact given to them in order to favor learning in students in virtual courses.

6.2.1 Techno-pedagogical tools within virtual learning environments.

Technological tools are identified as those devices or programs that facilitate work, allowing the application of resources effectively, exchanging information and knowledge (Mejía, Nieto, Rodríguez, M., 2014).

Technological tools can be effective for learning only to the extent that they can be properly used to facilitate the construction of knowledge and that "technology should not direct the teaching-learning process, but the educational objectives and the needs of the students" (Tancredi, 2004).

To achieve the above, it is essential that there is a correspondence between the training needs, the contents and the activities that students must perform; such content must be of quality and in adequate quantities, organized, structured, flexible and presented in a variety of formats, allowing learning according to the diversity of styles. The interaction that is propitiated in the environment must generate an active environment of exchange between the content and the students.

According to Tancredi (2004), through specialized tools, educational platforms allow the following functions:

- Student management. Administrative management of students in terms of monitoring their activity in the environment.
- Communication management. Management of synchronous and asynchronous interactions carried out for instructional or socializing purposes, using various Internet services integrated to the virtual platform, such as chat, forum, etc.
- Content management. Management of texts, images, sounds, animations, documents, SCORM content packages, etc., that have the purpose of communicating an instructional message.

In this sense, and from a purely technical point of view, they are virtual environments, but there is a need for an educational design that considers the interactive triangle of learning (student, teacher, content) and that allows these tools to function as true learning tools, Latorre (2010).

In the case of this research, the virtual educational platform where the programming course with the inclusion of the techno-pedagogical tools was hosted was *eminus*.

Eminus is a Flexible Learning Environments Management System that allows the presentation and distribution of educational content, providing the possibility of having a digital campus for communication and collaboration without time and distance limits. One of its main characteristics is that it is a proprietary system of the Universidad Veracruzana, given the facilities it was considered suitable to contain all the techno-pedagogical resources of the course (Eminus, 2021).

The techno-pedagogical tools within an instructional design, besides facilitating access to information in a meaningful way to students, allow to keep them interested and not bored, enjoying the trends that are regularly demanded in these media by the knowledge society.

6.2.2 Use of techno-pedagogical tools in virtual courses

The success of learning situations in virtual learning environments depends on the adequate use of techno-pedagogical tools to mediate the constructive activity, so that they enable the creation of spaces for personal interaction and act as cognitive tools.

To guide the process of interaction and educational communication, it is necessary to have an instructional design that contemplates both the possibilities of technology for the learning process and the way in which the interactions supported by these tools should be carried out, in order to promote the constructive activity of the participants.

In all instructional design models, before planning any program, an analysis of the target population is made, allowing to identify the elements that can be used to facilitate the information in an adequate and meaningful way to the students. Based on this, the appropriate tools must be visualized to achieve the objectives, because if a student does not have the skills to use certain software, instead of increasing learning, it will be frustrated by the complexity that its use may represent.

Technological tools are ideal for fostering cooperative and collaborative learning, which allows the knowledge acquired to be enriched through knowledge networks and contributions from the experiences of each of the participants.

The effectiveness of this learning depends on learning strategies, which also use different resources or technological tools that impact students in their process, promoting significance. Another important factor is motivation; implementing innovative or cutting-edge resources is motivating for the student, because knowing that their interests are taken into account, feeling considered, allows them to consider themselves special and important.

Thus, it is considered of great importance the use of techno-pedagogical tools, which also cater to the diversity of learning styles; relying on them allows finding an appropriate tool to meet each of these.

Therefore, the appropriate tool must be selected to design activities and contents that favor the acquisition of knowledge by the student, promoting the practice and development of specific professional competencies.

The implementation of techno-pedagogical tools guarantees access to large amounts of updated information for lifelong learning in a flexible manner at home, work or recreation centers by means of a computer and access to the *internet*.

In addition to being tools that enable communication and the transmission of information, technological tools have become tools of the mind, (Jonassen, 2021). Technological literacy is a requirement derived from globalization and the emergence of the information society. Knowing how to use them is a competitive advantage that comes to mark economic and cultural differences between people.

Nowadays, knowing how to use technological tools effectively is a basic skill, just as knowing how to read and write was once a basic skill. In today's world of work, being able to handle computers and surf the Internet is a basic skill *internet*. However, it is not enough to master the technical aspects of technological tools; people must also make a strategic use of information, which is achieved through the acquisition of search skills, analysis and understanding of information, develop attitudes and values aimed at a rational use of technology, a position in which it is understood that its use does not occur outside a social and political context.

Given this panorama, it is clear that educational institutions must not only introduce technology in the classroom, but also instruct students and teachers to take advantage of its possibilities for learning and teaching.

The knowledge society is changing, in which greater importance is given to the development of creative and flexible thinking, capable of adapting to the continuous change of the global world, so innovative people are required with professional skills aimed at the constant updating of knowledge and the effective management of both information and its transmission mechanisms.

6.3 Contextual framework

This research was carried out at the Universidad Veracruzana, in the Administrative Computer Systems program. (LSCA), the Educational Experience (EE) where the virtual programming course was implemented, using the platform called *Eminus*. For this purpose, the elements described above were considered as a result of the analysis of various authors and our own experience. Subsequently, the course was validated according to certain categories of analysis described below.

6.4 Methodology

The research paradigm applied was socio-critical and propositional, since it promotes social transformations, responding to specific problems; likewise, it presents a self-reflective and critical collaboration in action. In the field of educational innovation, the aim is to design tools for its application in the students' professional practice.

When talking about the constant updates of the techno-pedagogical tools that support education, it unquestionably encompasses changes at a social level, since it must keep pace with the pace that society itself does and what it demands; it is also collaborative and critical, by requesting the opinions of the students.

The type of research assumed is applied, since it seeks or perfects resources for the application of knowledge already obtained through pure research, and, therefore, it does not seek truth, as pure research does, but utility.

It is an instrumental type of case study, since according to Hernández, Fernández and Baptista (2014), it is examined to provide knowledge inputs to some research topic or problem, as well as to refine a theory.

It is proposed as longitudinal-quasi-experimental, considering that "an experiment is known as a situation in which the researcher introduces a stimulus or independent variable that modifies any of the components of a situation and then observes what reaction is provoked" (Hernández, et al., 2014).

The incorporation of various techno-pedagogical tools in the educational experience of programming was carried out to contribute to self-learning and facilitate the use of the virtual environment.

A mixed approach was considered, because according to (Hernández, et al, 2014), it can be applied to the analysis of complex problems and allows analyzing the variables in depth, so the instrument was built with closed and open questions to help define, describe, interpret and share results.

6.4.1 Sample population and study context

The study was carried out at the Universidad Veracruzana in the educational experience of programming that due to the COVID-19 crisis has been implemented in virtual modality. The population is composed of students of the Bachelor's Degree in Administrative Computer Systems and the sample was non-probabilistic, as it was convenient for the research; therefore, it was directed and intentional.

This sample is made up of 35 students from the educational programming experience. Two groups were formed, one of 19 students, which, for research purposes, was considered the treatment group; and the control group, which is made up of 16 students; the first group was made up of 8 males and 11 females, while the second was made up of 4 males and 12 females. In both groups, the age range of the participants was 18 to 22 years.

6.4.2 Research design

The type of research was longitudinal-quasi-experimental, applied and correlational in scope, since it sought to identify the relationship or degree of association between state-of-the-art techno-pedagogical tools and the improvement of virtual learning environments.

The inclusion of these innovative tools was carried out in the September 2020-January 2021 academic year. Therefore, and considering that the study was quasi-experimental, a comparison was made between the treatment group, in which the tools were implemented, and the control group, in which they were carried out in the traditional way. The results were then verified.

The main objective was to implement learning activities, as well as cutting-edge techno-pedagogical tools in the instructional design of the educational experience of programming that is carried out virtually, seeking to promote student learning.

The following hypothesis was assumed: The implementation of state-of-the-art techno-pedagogical tools in the instructional design of the educational experience of programming will improve the learning environment of students, and therefore their academic performance.

As can be seen, this is a causal relationship and the research design is quasi-experimental.

Taking into account the above, the following questions arise to guide the research: What are the techno-pedagogical tools that should be considered in the instructional design of the educational experience of programming, to facilitate student learning?

6.4.3 Design of data collection instruments

In a broad sense, mixed research is visualized as a continuum where quantitative and qualitative approaches are mixed, Hernández, et al (2014), focusing more on one of them or giving them equal weight. In this research, the instruments have more quantitative and less qualitative weight, with the purpose of knowing the students' perception.

The instrument consisted of 16 questions of this nature and a qualitative one that allows knowing the students' opinions and suggestions.

Category I: Appearance of the platform.

Category II: Organization of resources.

Category III: Quality of technological tools.

Category IV: Relevance and usefulness of the content presented in the tools.

Category V: Relevance of self-assessment questionnaires to measure learning.

The survey was applied to a total of 35 students once they completed the virtual course; the data analysis was performed with the SPSS program. The intention of the research was to apply the instructional design elements resulting from the analysis, with the inclusion of innovative technological tools applied to the previously described ES. Therefore, the Programming course was automated, making the pertinent adjustments in order to analyze the results obtained at the end of the course.

6.5 Results

To carry out the application of the instrument to the sample selected for the purposes of the research, made up of 19 subjects from the treatment group and 16 from the control group, adjustments were made that were considered after the expert judgment review.

Subsequently, the questionnaire was designed using the google form tool, followed by a basic descriptive and inferential statistical analysis.

The participants were taking the educational experience through *eminus* where the changes were implemented through the selected techno-pedagogical tools such as modifications in the learning activities and the insertion of informative capsules.

Subsequently, it was sent to the entire selected sample group through an e-mail sent to them through the platform. *eminus*, attaching the link to the resource.

The students showed willingness to collaborate and express their opinions regarding the techno-pedagogical tools used in the platform.

Twenty-eight responses were obtained from the students and were analyzed and interpreted using SPSS software. *Statistics*. The results according to the categories are presented in Table 6.1:

Table 6.1 Results of applied categories

Analysis category	Control group	Treatment group
Category I: Appearance of the platform.	the majority of students find the platform to have a pleasant general appearance, with 58% of them being very pleased with this aspect, while 42% are pleased with it, although it could be even better.	In this case, the home page of the courses was modified, and various technological resources were inserted to present the information, there was a notable increase in the acceptance and liking of the image of the platform; 85% of the students consider it to be very good or better.
Category II: Organization of resources	51% of the respondents in the control group identified the teaching resources as very good or excellent, while 49% considered them to be good.	The above shows that in general, the order within the platform is adequate; however, there are still aspects that could be improved.
Categoría III: Calidad de las herramientas tecnológicas	<ul style="list-style-type: none"> - 76% of the first group consider the quality of presentations, diagrams, graphics and presentations to be of very good or excellent quality; only 24% of them consider it to be good. - 57% of the participants in the control group identified the quality of the videos as very good or better. - the acceptance of traditionally designed presentations showed a decrease in their acceptance. 	<ul style="list-style-type: none"> - In the treatment group, there is a growing satisfaction with the integration of different interactive and multimedia contents; there is still room for improvement, but most of the students are comfortable with them. - As for the quality of the videos, the results are also favorable in the treatment group, with 75% of the respondents showing greater satisfaction. - a notable difference is observed in terms of liking and acceptance of the presentations used in the courses by the treatment group, since the tool was changed for one that allows 3D movements; for another that favors interaction with the student. The results in this group were 75% of those surveyed considered these resources to be very good or excellent.

<p>Category IV: Relevance and usefulness of the content presented in the tools</p>	<ul style="list-style-type: none"> - Regarding the relevance and usefulness of the contents presented in the tools, it was found that 71% of the control group considered that the videos were very useful to promote their learning and 29% thought that they were moderately useful. - as for the interactive materials, the control group rated them as very good or better by 54%. - Regarding the incorporation of multimedia content in the platform, 43% of the respondents of the control group consider that the technological tools used are very good or better, to favor their learning; however, most of the participants consider them only good, which shows that it is still necessary to work on this aspect. 	<ul style="list-style-type: none"> - Regarding the relevance and usefulness of the contents presented in the tools, in this group where they were replaced by more current videos, 86% considered them to be very good or better, which reflects the importance of having updated materials. - As for the interactive materials, which were presented to them with greater recurrence and variety of resources, the majority (92%) consider them to be very pertinent. - the incorporation of multimedia content in the platform, 88% of the participants consider the use and application of technological tools, as well as the presentation of information in small capsules, to be very good or better, in order to favor their learning.
<p>Category V: Relevance of the self-assessment questionnaires for measuring learning</p>		<p>In this category, the responses are only from the treatment group, since the control group did not have self-assessment questionnaires. 53% of the participants consider their relevance for assessing learning to be good or less, while 47% think that they are very good to excellent.</p>

Source: Own elaboration

Regarding the students' perception of which activities are more enjoyable for them, it was found that most of them prefer activities such as participation in a forum, as well as carrying out integrative activities and application to real cases, problem solving and delivery of source codes in the programming language adopted.

6.5.1 Results of the final evaluations of the control and treatment groups

The results of the evaluations of the control group and the treatment group and their analysis through the SPSS *Statistics* tool are presented below.

The result of the statistical comparison of evaluations identifies a considerable difference in the mean of the results, since the overall average of the treatment group was 92 points in contrast to the overall average of the control group, which was 83 points.

Likewise, it is identified that the range between the lowest and the highest score is much wider in the case of the control group, which could be a sign that the learning obtained in the students of the treatment group is more homogeneous than in the control group; however, in the latter the mode is greater than in the treatment group.

It can be affirmed that the implementation of state-of-the-art techno-pedagogical tools in the instructional design of the educational experience of programming improved the learning environment of the students, and therefore their academic performance, based on the results already presented and pointed out: the students of the treatment group have stated, within the survey, that the state-of-the-art techno-pedagogical tools implemented did improve the environment and facilitate their learning; derived from the results of the grades of the treatment group, compared to the control group, it is identified that the questionnaires programmed as a means of self-evaluation of the theoretical subjects, improves the academic performance of the students; However, analyzing the survey sent to the students, despite the fact that a small majority considers the self-evaluation questionnaires pertinent and to their liking, the great majority prefers the traditional learning activities instead of them.

6.6 Conclusions and future work

Several techno-pedagogical tools were used in the implementation of the virtual course of the educational experience of programming, seeking the collaborative participation of students.

Multimedia content was used in small capsules and self-assessment questionnaires to encourage self-reflection on learning, in addition to having a mechanism to provide the student with those elements that, in their opinion, needed to be reinforced.

It is clearly identified that students prefer that the contents within the course were provided in informative capsules or pills, considering only the indispensable topics linked to their professional profile. The incorporation of techno-pedagogical resources such as: more videos of short duration and explanatory (not conceptual); interactive diagrams and graphics, such as prezi or mindomo, in order to support the relationship of knowledge with its application in the work environment; multimedia content that motivates students, mainly those whose learning is kinesthetic, this could be done with tools such as genial.ly, emaze, playbuzz, among others; use the information in small capsules, without going deeper into the contents and present indispensable information for problem solving.

Regarding the use of self-assessment questionnaires as a learning activity, the idea should be discarded, since the students showed little interest, mentioning that they can generate greater stress, contrary to what was expected.

Finally, the implementation of state-of-the-art techno-pedagogical tools and programmed questionnaires as a means of self-assessment, in the instructional design of the Programming course of the Bachelor's Degree in Administrative Computer Systems in virtual modality, improved the students' learning environment.

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