Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v14i27.1685

Artículos científicos

Propuesta de estrategias tecnopedagógicas para el diseño de cursos de calidad en plataformas virtuales

Proposal of technopedagogical strategies for designing high-quality courses on virtual platforms

Proposta de estratégias técnico-pedagógicas para a concepção de cursos de qualidade em plataformas virtuais

Raquel Mondragón Huerta
Universidad Autónoma de Querétaro, México
raquel.mondragon@uaq.mx
https://orcid.org/0000-0003-1625-2627

Teresa García Ramírez
Universidad Autónoma de Querétaro, México
teregar@uaq.mx
https://orcid.org/0000-0002-5524-2002

Edith Olivo García
Universidad Autónoma de Querétaro, México
edith.olivo@uaq.mx
https://orcid.org/0000-0001-7351-4246

Resumen

Las estrategias tecnopedagógicas de aprendizaje son una herramienta valiosa para mejorar el aprendizaje más efectivo. Al combinar la tecnología con una metodología pedagógica adecuada, se logran mejores resultados en el aprendizaje, así como la formación de estudiantes más preparados para enfrentar los desafíos del futuro. El uso de entornos virtuales de aprendizaje es fundamental en la educación en línea, ya que permite a los estudiantes aprender de forma autónoma. Sin embargo, la calidad del aprendizaje puede verse comprometida por factores como la falta de interacción y motivación. La cooperación entre la tecnología y la pedagogía es crucial para enfrentar los desafíos actuales de la educación en línea y asegurar una educación de calidad.

Por tal razón, este trabajo se centra en mejorar la calidad del aprendizaje en los cursos en línea mediante el uso de entornos virtuales de aprendizaje. El método de investigación utilizado fue mixto y la propuesta se enfocó en tres ejes fundamentales: estrategias didácticas, estrategias tecnológicas y analíticas de aprendizaje. Los resultados del análisis de datos que ofrece la plataforma permiten determinar el impacto que tienen las actividades y la interacción de los estudiantes con ellas para determinar si ayudan a cumplir con los objetivos de aprendizaje establecidos y aprovechar al máximo el potencial de la educación en línea para ofrecer a los estudiantes una experiencia educativa enriquecedora.

Palabras clave: estrategias tecnopedagógicas, calidad educativa, entornos virtuales de aprendizaje y analíticas de aprendizaje.

Abstract

Technopedagogical learning strategies are a valuable tool to improve more effective learning. By combining technology with an appropriate pedagogical methodology, better learning results are achieved and the training of students more prepared to face the challenges of the future. The use of virtual learning environments is fundamental in online education since it allows students to learn autonomously. However, the quality of learning can be compromised by factors such as a lack of interaction and motivation. The cooperation between technology and pedagogy is crucial to face the current challenges of online education and ensure quality education for this reason, this work focuses on improving the quality of learning in online courses using environments virtual learning. The research method used was mixed and the proposal focused on three fundamental axes: didactic strategies, technological strategies and learning analytics. The results of the data analysis offered by the platform make it possible to determine the impact of the activities on the platform and the interaction of students with them to determine if they help to meet the established learning objectives and improve the potential of education. online to offer students an enriching educational experience.

Keywords: Technopedagogical strategies, educational quality, virtual learning environments, and learning analytics.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Resumo

As estratégias de aprendizagem tecnopedagógicas são uma ferramenta valiosa para melhorar uma aprendizagem mais eficaz. Ao aliar a tecnologia a uma metodologia pedagógica adequada, conseguem-se melhores resultados de aprendizagem, bem como a formação de alunos mais preparados para enfrentar os desafios do futuro. A utilização de ambientes virtuais de aprendizagem é essencial na educação online, pois permite que os alunos aprendam de forma autônoma. Porém, a qualidade da aprendizagem pode ser comprometida por fatores como falta de interação e motivação. A cooperação entre tecnologia e pedagogia é crucial para enfrentar os desafios atuais da educação online e garantir uma educação de qualidade. Por esse motivo, este trabalho tem como foco a melhoria da qualidade da aprendizagem em cursos online por meio da utilização de ambientes virtuais de aprendizagem. O método de pesquisa utilizado foi misto e a proposta centrou-se em três eixos fundamentais: estratégias de ensino, estratégias tecnológicas e análise de aprendizagem. Os resultados da análise de dados oferecida pela plataforma permitem-nos determinar o impacto que as atividades e a interação dos alunos com elas têm para determinar se ajudam a cumprir os objetivos de aprendizagem estabelecidos e aproveitar ao máximo o potencial da educação online para oferecer aos alunos. uma experiência educacional enriquecedora.

Palavras-chave: estratégias tecnopedagógicas, qualidade educacional, ambientes virtuais de aprendizagem e análises de aprendizagem.

Fecha Recepción: Enero 2023 **Fecha Aceptación:** Julio 2023

Introduction

The incorporation of information and communication technologies (ICT) and the Internet have transformed the way in which we teach and learn. Educational technology (ET) focuses on the design, development, application and evaluation of technological systems, resources and environments for learning and teaching. Virtual learning environments (VLE) are a type of educational technology that offers great advantages to students and teachers, so their proper use can improve the quality of education and provide more effective and innovative learning experiences (Lavigne et al . , 2015).

The design and implementation of EVAs is crucial to guarantee effective and quality virtual education. However, the appropriate selection of tools and technologies for the design of a VLE should be based on the specific learning needs and objectives of the courses and the teachers' abilities to use them. Indeed, in the implementation of EVAs, teachers must be trained in the use

of the available tools and technologies, as well as in the management of the resources and contents of the environment. In addition, they must be prepared to adapt their teaching to the virtual modality, that is, encourage student participation and provide constant feedback (Saza-Garzón, 2016).

For this objective, an EVA is made up of various synchronous and asynchronous interaction tools, which are based on a study plan and that allow the teaching and learning process to be carried out. Through these means, a large amount of information is generated, including student data, storage of materials, activities, forums, and registration records for each course. It is important to highlight that the persistence of this information is guaranteed through storage in databases, since in these spaces new experiences and knowledge are generated that stimulate the processes of analysis, reflection and appropriation of knowledge (Muñoz and Acosta, 2016).

Likewise, it is essential that virtual teachers take into account the characteristics, background, methodologies and studies on the platforms of virtual environments, as support tools in the teaching and learning processes in online courses. However, little attention has been paid to these aspects during planning, design, creation and implementation (Saza-Garzón, 2016).

The data generated by the use of VLEs can provide valuable information about the preferences and characteristics of students during their daily use (Lavigne *et al.* , 2015). This can allow detailed monitoring of their progress and individual requirements, which can be reflected in their daily activities (Hiraldo, 2013).

In this sense, schools and universities contain a large amount of data and information that is generated in each classroom and that is used to define institutional identity. The incorporation of ICT is crucial for the educational sector, and the growing trend of taking learning beyond the classroom has led to the implementation of EVA that allows the import of these new forms of teaching and learning (Aristizabal, 2016).

However, EVAs also face challenges that encompass technical aspects necessary for the proper organization and management of the databases, among other more specific ones related to the interpretation of the collected data. Given the complexity of these issues, this type of analysis is called *data mining*, and when applied in the educational context it is known as *educational data mining.* (Mohamad and Tasir, 2013). The application of educational data mining focused on the analysis of the activities of students and teachers in EVAs allows us to question whether the learning objectives of online courses are achieved (Cabero-Almenara and Palacios-Rodríguez, 2021).

IN this context, educational institutions have become aware of the importance of providing quality education to meet the needs of diverse students and adapt to global changes. This implies the need to propose innovative ways to guarantee and systematize quality in the different educational modalities that exist in higher education, whether face-to-face, online or mixed (Lebron *et al.* , 2021).

The quality of education in HEIs focuses on eight important factors: quality models based on *total quality management* (TQM), results-based quality, quality as a system, service quality from the perspective of stakeholders, the quality gap compared to international higher education, quality from the point of view of students, quality of *e-learning* systems , and the critical factors that determine the success of educational quality (Kundu, 2017) .

In search of quality, HEIs have chosen to work to achieve national and international accreditations that validate their programs and organizations. Accreditation is an important tool to ensure quality, as it demonstrates that an institution or program has been subjected to a rigorous external evaluation process (Kumar *et al.* , 2020). In Mexico, there are two quality accrediting bodies: the National Council of Science and Technology (CONACyT) and the Interinstitutional Committees for the Evaluation of Higher Education (CIEES).

Starting from the above panorama, pedagogy currently overloads the success of an online course according to the conception of the pedagogical material; However, educational models that analyze quality indicators in EVA involve innovative teaching profiles with digital competencies within the teaching and learning process (Lebron *et al.* , 2021).

Today, EVAs are tools that allow the development of online courses, which are available at all times thanks to the advantages offered by the Internet, without geographical restrictions. These technological resources provide a wide variety of learning strategies and *software* to create learning objects that are integrated into the online course (García *et al.* , 2017).

The design of a teaching strategy involves two aspects: teaching and learning. Currently, education based exclusively on teaching is not effective in promoting learning or the development of skills in students. Therefore, in the knowledge society, the importance of creating educational strategies focused on learning and the development of skills that encourage students to build their own knowledge is recognized, and to do so it is essential to take into account the characteristics of the students., that is, their cognitive and learning styles (Pescador, 2014).

The focus on the development of competencies is one of the key aspects in the university educational model, and its development is carried out progressively (Autonomous University of Querétaro [UAQ], 2019). Therefore, it is essential to monitor the process through the design of

didactic activities (Fernández, 2006). Within the framework of the competency-based learning approach, the protagonist of the educational process is the student, since it is his or her responsibility to exhibit the achievements acquired. This approach places a strong emphasis on the student's continuous progress throughout academic programs (Perilla, 2018). Once the student is able to demonstrate that they can perform an activity, they demonstrate progress. In this vision, it no longer only focuses on completing tasks and activities in a given time, but also emphasizes being *able to do* (Gonzáles Robles *et al* . , 2016).

During the learning process, it is crucial to carry out an adequate evaluation to measure the results obtained and determine if the planned objectives are being met. For this purpose, certain measures are established that allow us to verify whether the knowledge is being satisfactorily achieved by the students. Currently, most evaluation methods use a numerical scale with the purpose of expressing the skills or competencies acquired by students in various academic disciplines, which facilitates the understanding of the results (Lezcano and Vilanova, 2017).

The information obtained through evaluations is essential for making decisions in relation to the educational process that students follow, the teaching methods implemented by teachers and educational programs in general. For this reason, evaluations are of great importance for educational institutions, since they provide a solid basis for the continuous improvement of the educational system as a whole (Hamodi *et al.* , 2015).

The contribution of this research, therefore, is focused on generating new knowledge in the area of educational technology, based on the analysis of the data generated by students in the EVA and thereby achieving quality learning in an effective way. The analysis of user activity is important for building systems that help with learning, where cognitive gaps in students or adaptation difficulties when working in online environments can be identified (Feng and Heffernan, 2015).

Work on the use of ICT in education is a consolidated area of study that still has some new aspects of research. Currently, there are many investigations that focus on the analysis of the advantages of technologies in education. However, there is a little explored field in terms of how to analyze and design courses combining the appropriate technological and pedagogical advantages to strengthen learning. There is a mistaken impression that technologies alone improve learning, but what is really important is the methodology. On the other hand, technological and methodological changes do not have the same level of impact, so the cognitive transformation that would determine the use of a certain technology is not comparable (Gros, 2016).

During the international conference on *learning analytics and knowledge* was defined as *learning analytics* such as the measurement, collection, analysis and reporting of data about

students and their context to optimize learning by taking data from the environments in which they operate (Gašević *et al.* , 2015). In this way, the objective of turning students into more effective learners is raised by making use of the various data analysis techniques, which would allow the development of appropriate measurement strategies to exploit the data generated by virtual learning environments, with which the teacher will be able to better evaluate the learning process (Díaz, 2017).

It is important to keep in mind that, from a pedagogical perspective, a theoretical framework is established that guides educational practices, providing diverse visions on the different teaching and learning methods. At the same time, technopedagogical models advocate the coherent incorporation of technology in the educational process, taking advantage of its potential to enrich the quality and effectiveness of teaching (Ortega *et al.* , 2023). Likewise, teaching methodologies constitute an essential component when designing strategies, since they provide a structure and a set of techniques to organize and facilitate the acquisition of knowledge (Miramontes *et al.* , 2019). Finally, technologies play a crucial role in supporting the teaching-learning dynamic, encompassing tools such as online platforms, mobile applications, multimedia resources and learning management systems. By using these tools appropriately and creatively, motivation, access to information, collaboration and personalized adaptation of the learning process can be promoted (García *et al.* , 2020).

Research on online learning is increasingly relevant due to the growing popularity of online courses after the pandemic. Virtual learning environments have become an essential tool for online education, allowing students to learn at their own pace. However, the quality of learning can be affected by various factors, such as lack of interaction or lack of motivation. To address these challenges, the present research focuses on how to improve the quality of learning in online courses using virtual learning environments.

Method

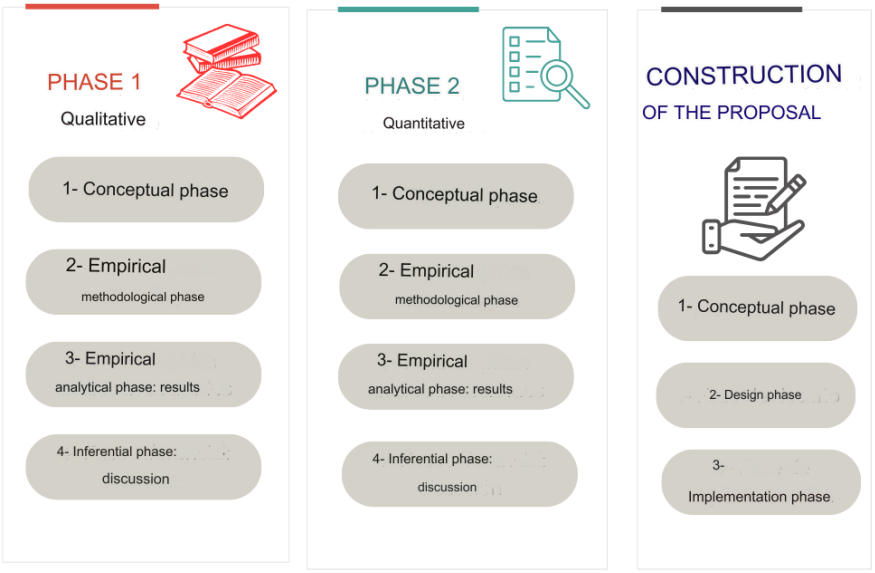
This research on the creation of techno-pedagogical evaluation strategies had a mixed approach, as elements of quantitative and qualitative research are combined to examine the research problem in depth. It is important to highlight that, as in other types of research, the literature review is a crucial step in the preparation of a mixed study (Hernández *et al.* , 2014).

Figure 1 shows the research methodology used: phase 1 corresponded to the qualitative method through a complete review of the literature related to the problem to establish a solid base of knowledge and understanding of the topic, as well as to identify the knowledge gaps in current

literature. Furthermore, this review helped to establish the three variables to be studied through the quantitative method, that is, competency-based learning model, pedagogical strategies and techno-pedagogical strategies.

In phase 2, the information from the previous stage was taken to design the evaluation instrument and analyze the population, and in phase 3, the construction of the proposal was carried out, involving teaching strategies, technological strategies and tools. *e-learning* for analysis.

Figure 1. Phases of the research methodology



Source: self made

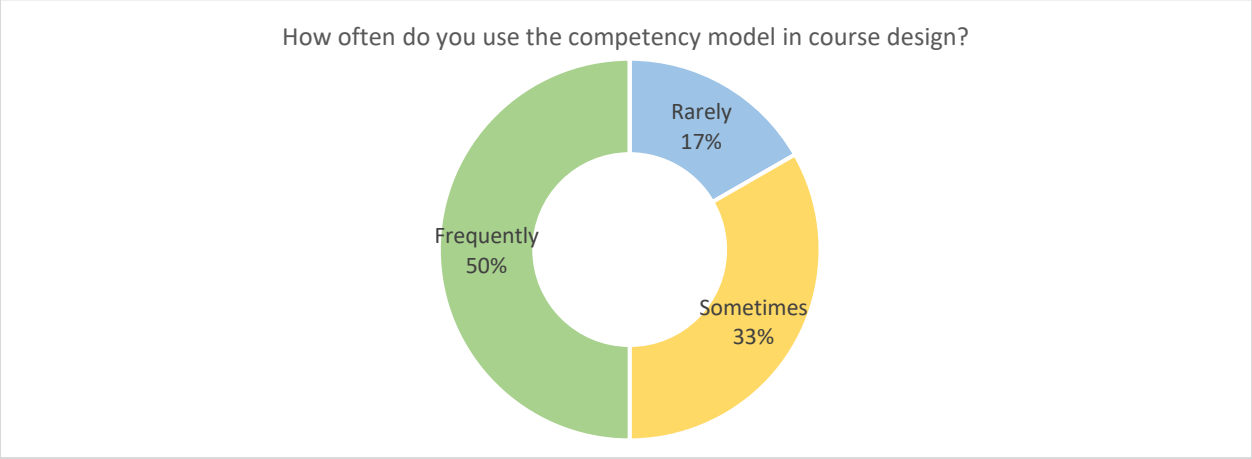
Results

Through a study carried out on 31 professors who teach classes in the virtual programs of the Faculty of Informatics of the Autonomous University of Querétaro, 33 indicators organized into three variables were analyzed that allow us to contextualize this problem. The first variable analyzes the use of a competency-based learning model through the activities carried out within the course design before its implementation in the EVA to carry out learning monitoring. The second variable evaluates the pedagogical strategies through the activities carried out within the design of the courses using pedagogical strategies based on competencies. Finally, the third variable examines the technopedagogical strategies through the activities carried out within the implementation of the courses on the platform. To analyze the reliability of the instrument used in the study, Cronbach's alpha coefficient was used, which obtained a value of 0.866, indicating that it is highly reliable.

Teachers' participation in this study was voluntary. In this sense, sensitive information was safeguarded, and they were informed about the purposes and data obtained from the instrument, which would be used only for academic purposes. The first section of the instrument was dedicated to the variable of using a *competency-based learning model*, where it was analyzed through the activities carried out for the design of courses, prior to its implementation in the EVA to carry out learning monitoring.

Figure 2 shows that, although 50% of teachers do not use the competency model regularly, there is another 50% who do frequently use the model.

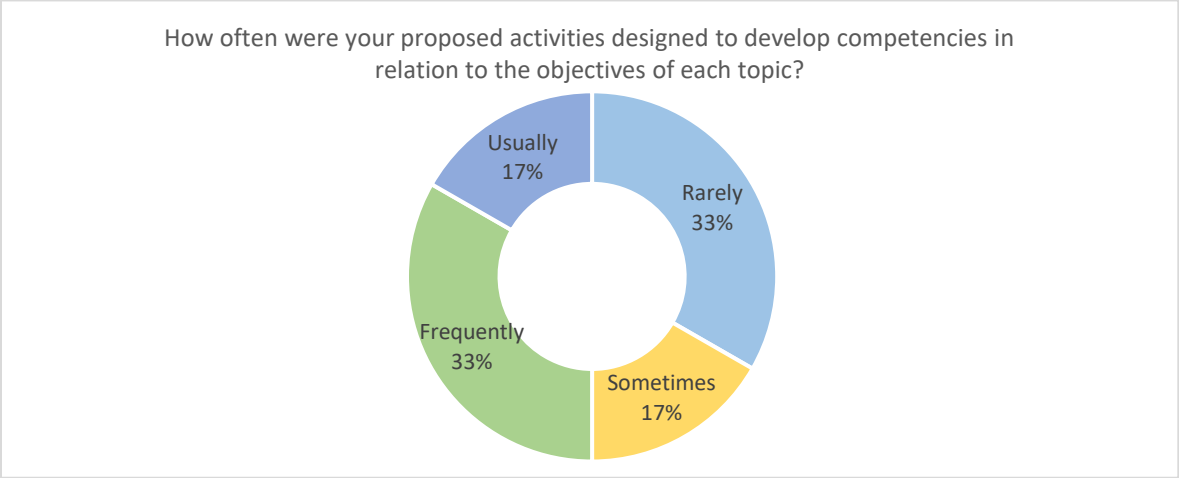
Figure 1. Use of the competency model



Source: self made

On the other hand, regarding the frequency with which the proposed activities are designed to develop competencies in relation to the objectives, only 17% do so very frequently and 33% do so frequently, while 33% do so frequently rarely as shown in figure 3.

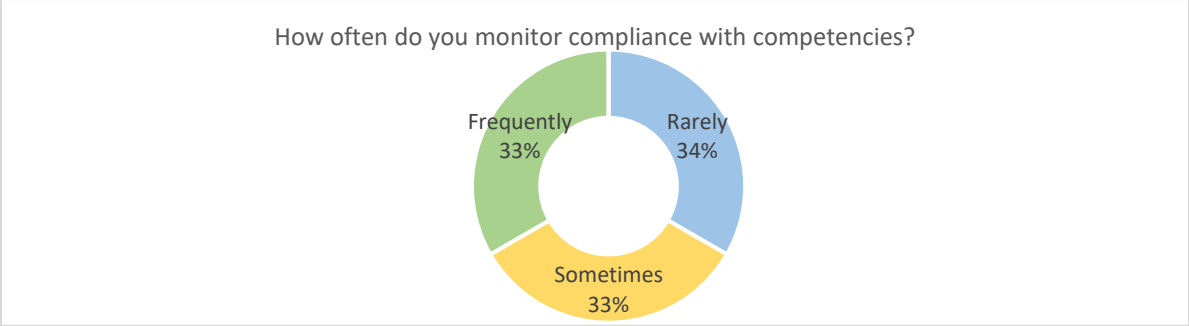
Figure 2. Activities and competitions



Source: self made

In Figure 4 it can be seen that the frequency with which compliance with the competencies is monitored is 34% for rarely, 33% for occasionally and 33% for frequently, which has a direct relationship with the indicator. former.

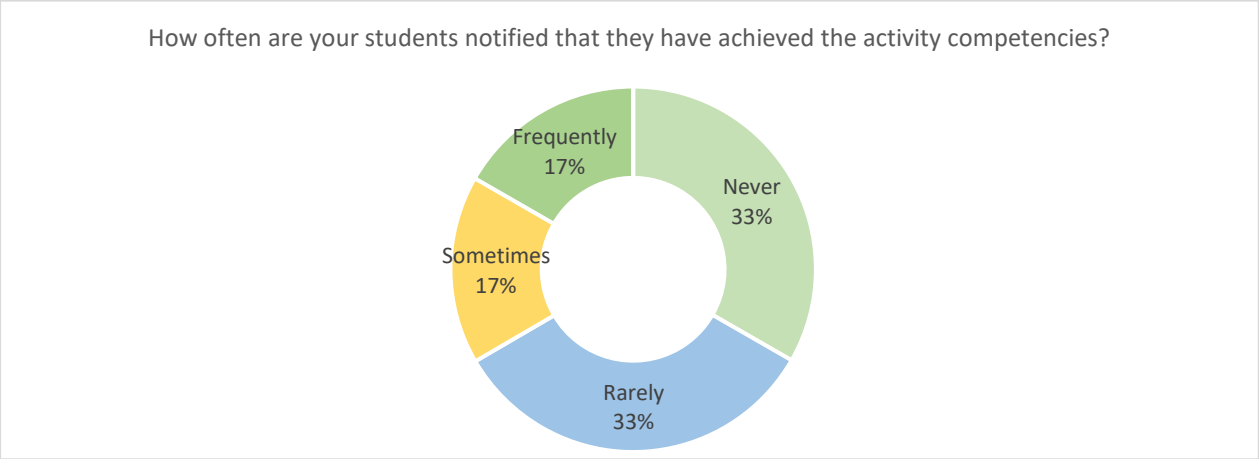
Figure 3. Monitoring of competencies



Source: self made

On the other hand, Figure 5 shows the frequency with which students are notified that they have achieved the competencies. In this sense, only 17% are shown frequently, while 33% represent never and rarely, respectively. This lack of monitoring of learning does not allow the objectives and quality of learning to be correctly achieved.

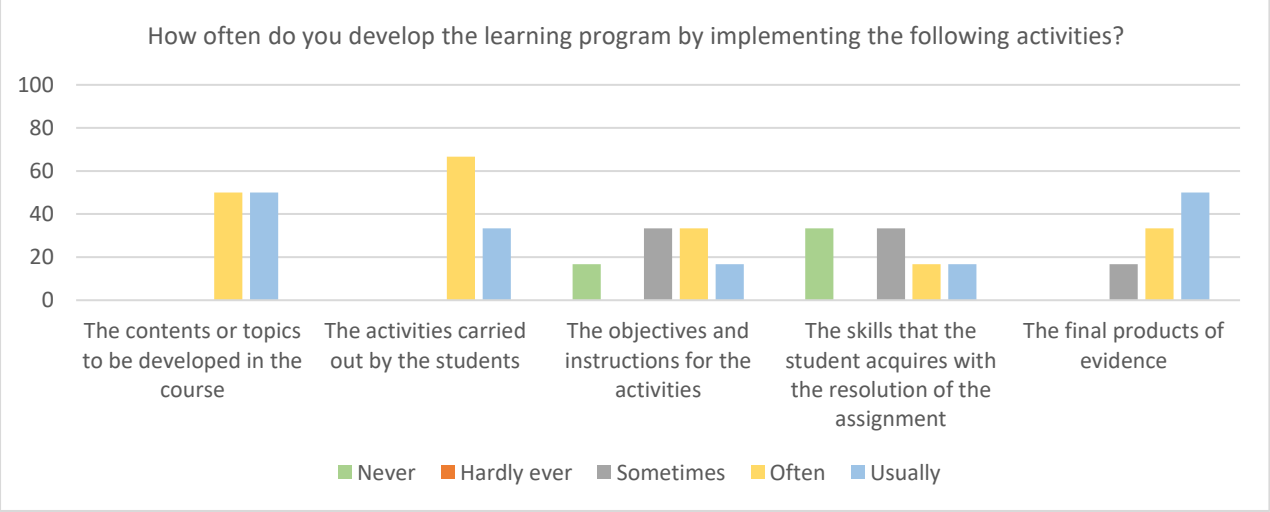
Figure 4. Competency feedback



Source: self made

The second section of the instrument was dedicated to the *pedagogical strategies variable*, through the activities carried out within the design of the courses using pedagogical strategies based on competencies. Figure 6 shows the frequency with which the learning program is developed by implementing activities. In this aspect, some deficiencies are found in terms of the development of objectives and instructions for the activities, as well as in the development of competencies for the activities and the final products for evidence.

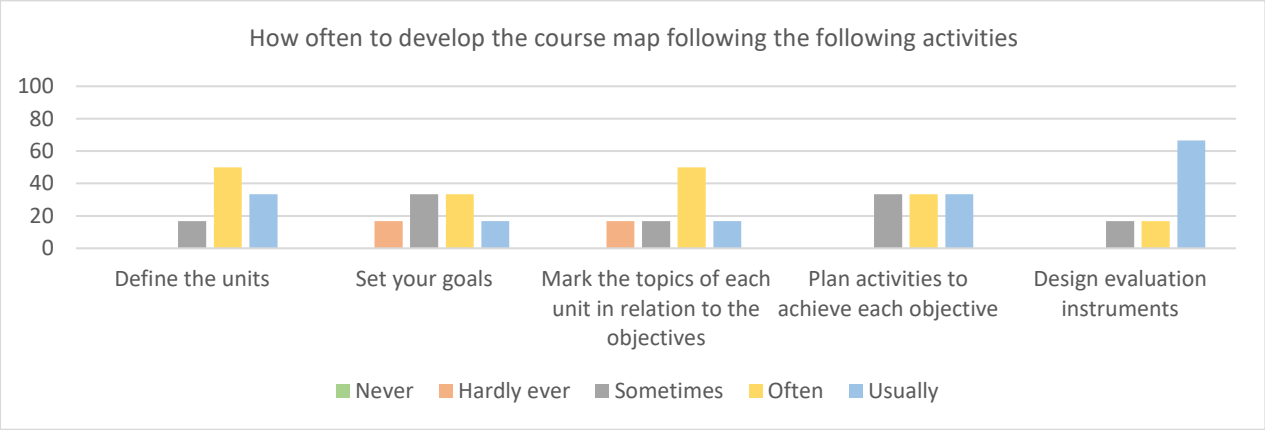
Figure 5. Learning program development



Source: self made

Likewise, Figure 7 shows the frequency with which the course map is developed. Here some deficiencies in clarity are observed in establishing and relating the objectives to the topics of each unit.

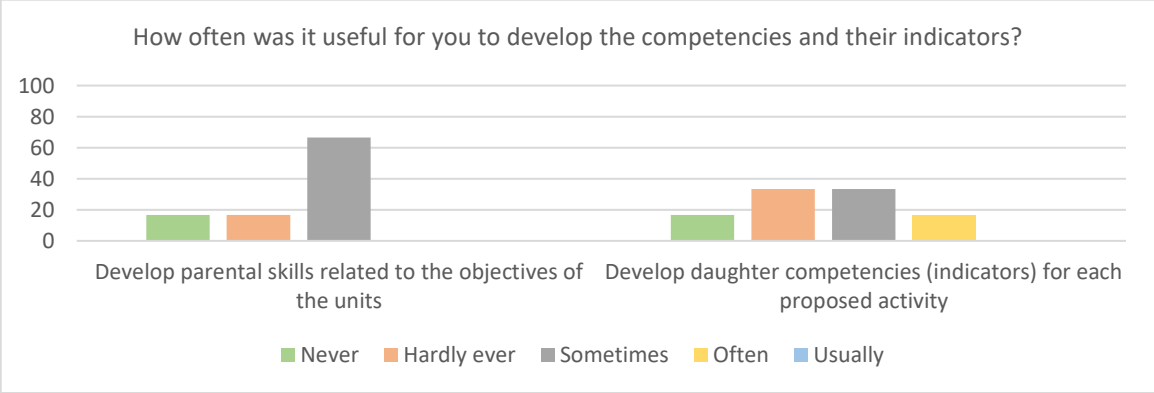
Figure 6. Course map development



Source: self made

Finally, the benefit that teachers had when developing the competencies and their indicators was analyzed. Figure 8 shows the development of parent competencies related to objectives, and daughter competencies related to activities was unattractive. Analyzing these results and the previous variable, it is noted that there is no pedagogical clarity in the development of the course that allows its correct use.

Figure 7. Development of skills and indicators

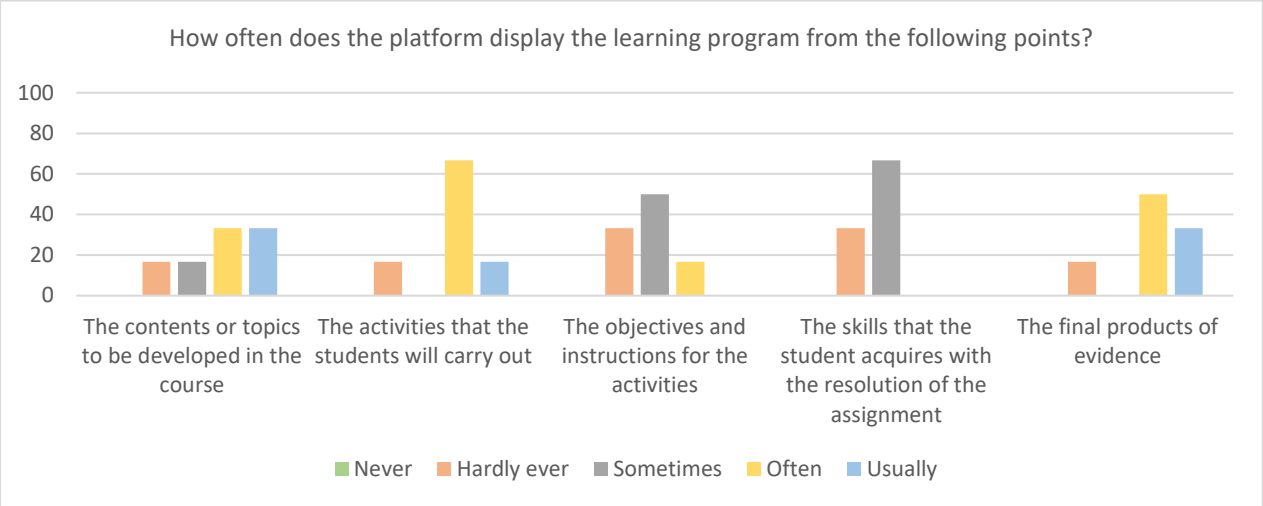


Source: self made

The third section of the instrument presents the last variable: *technopedagogical strategies*, which are analyzed through the activities carried out within the implementation of the courses on

the platform. These indicators are presented in Figure 9, where it is observed that the competencies that the student will acquire with the resolution of the assignment are very infrequently shared in the course program. This shows how unclear the teachers present the courses within the educational platforms.

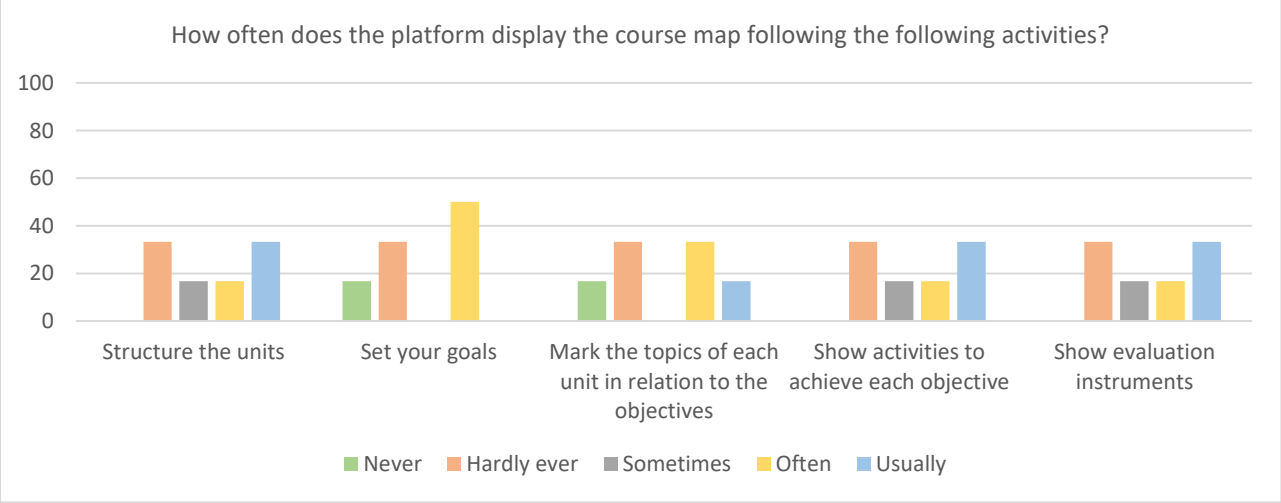
Figure 8. Platform learning program



Source: self made

The poor organization of the content on the platform is also evident thanks to the analysis of the indicators presented in figure 10, where the results of the frequency with which the course map and its activities are shown on the platform are observed.

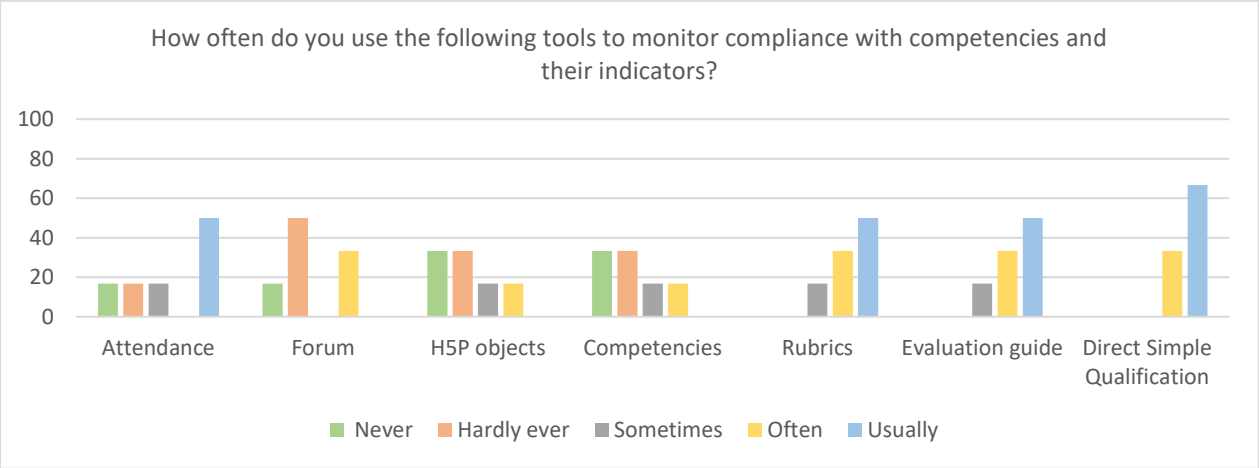
Figure 9. Course map on platform



Source: self made

Finally, Figure 11 shows the results of the frequency with which the tools of the educational platform are used to monitor competencies and their indicators. In this sense, the tools that teachers use the least are attendance lists, forums, H5P objects and competencies, which is mainly due to lack of knowledge about their implementation on an educational platform.

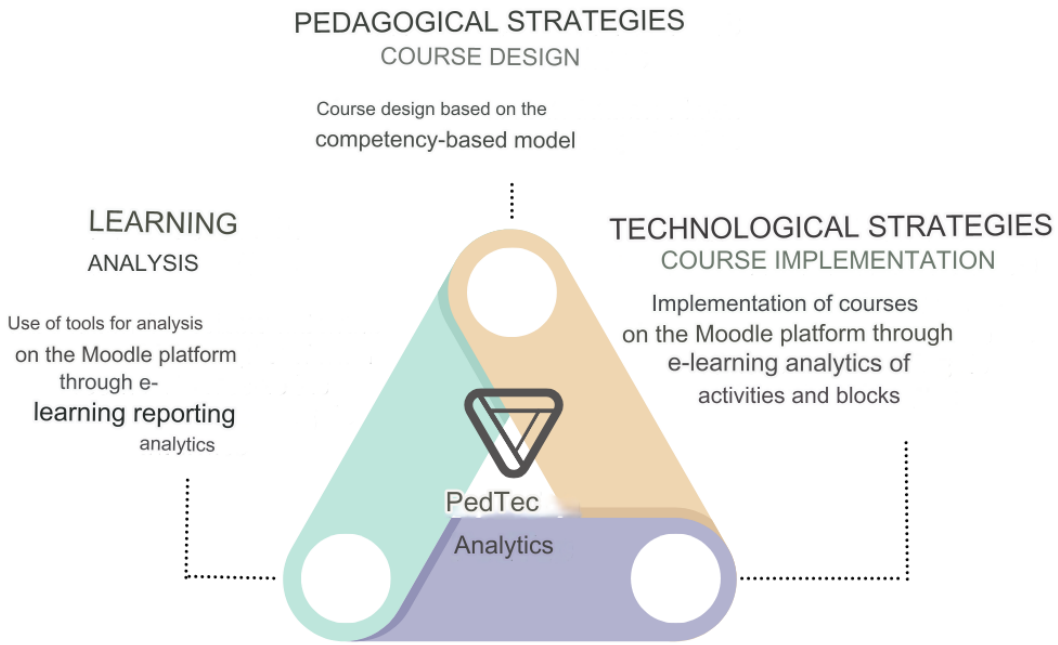
Figure 10. Tools for platform evaluation



Source: self made

At the end of the quantitative phase, the proposal was designed, which was named PedTec Analytics, and focused on three fundamental axes that aimed to guarantee the quality of learning. As seen in Figure 12, the first axis focuses on pedagogical strategies that take competency-based learning as a model for course design; The second axis considers the design of technological strategies and implementation in platform courses using activity and block *e-learning tools;* Finally, the third axis takes the tools available on the platform for data analytics through reports to analyze activity data and evaluate their performance during online training.

Figure 11. Construction of the PedTec Analytical proposal

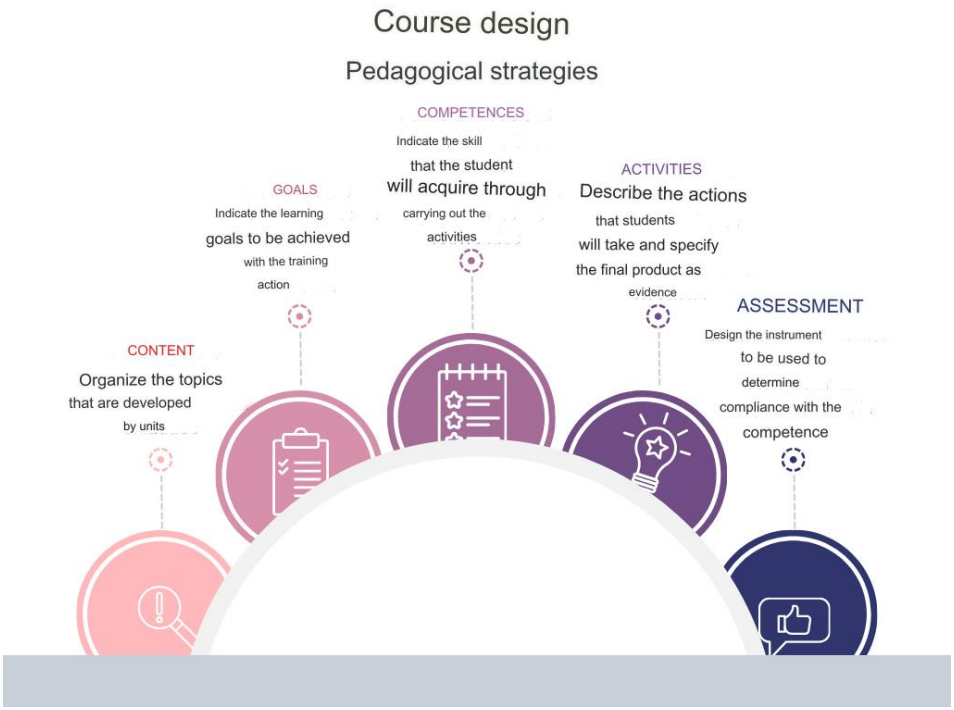


Source: self made

The proposal was implemented in two groups of the subject Project Management Seminar I, during the 2022-2 semester, of the Doctorate in Innovation and Educational Technology of the Faculty of Informatics of the Autonomous University of Querétaro, from where the design of the course through its pedagogical strategy. Figure 13 guides the design of the course by organizing the topics by units: each topic establishes an objective; each objective is linked to a competence and these to one or several activities that have specific instructions that are evaluated through instruments.

Figure 13. Teaching strategy

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467



Source: self made

The course design contains nine topics divided into two units. An objective was established for each topic, from which a parent competency was proposed, and from it daughter competencies to acquire by carrying out specific instructions. Figure 14 presents a competency framework where a subject program was developed that includes the points of the teaching strategy and a competency framework.

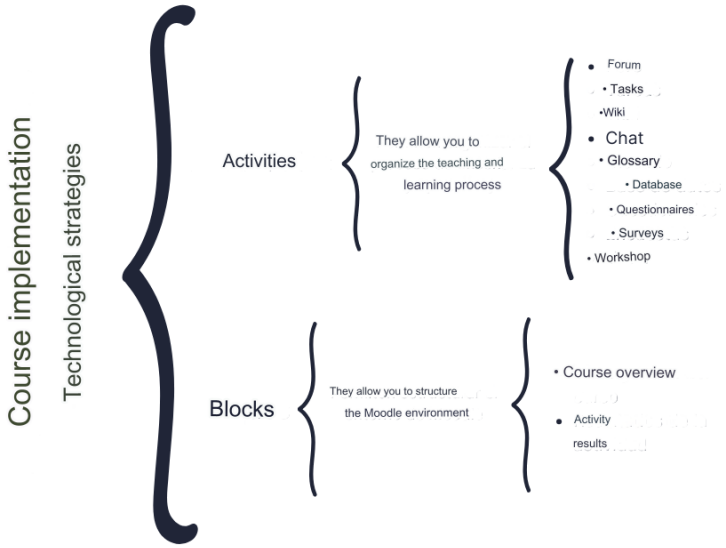
Figure 14. Competency framework by topic

COMPETENCES FOR EACH TOPIC OR UNIT			
Topics or Units	Theme objectives	Skills to develop with the topic	Competency achievement indicators
1. Topic 1 Educational public policies in Mexico	1.1. Recognize public educational policies that establish the project framework for intervention that	1.1.1 Identify the public educational policies that regulate education in Mexico	1.1.1.1 Identify the articles of the Constitution that regulate education in Mexico 1.1.1.2 Recognizes the articles of the General Education Law that are related to your intervention project
2. Institutional regulations	2.1. Identify the public and/or private policies of the organization in which they are developing their intervention project	2.1.1. Distinguish the public and/or private policies in force in the organization in which they are developing their intervention project.	2.1.1. Distinguishes public and/or private policies that directly affect the development of your intervention project.

Source: self-made

After having designed the course, it was implemented by applying technological strategies based on the analysis of *e-learning data* that are classified into activity tools and blocks. The activities include tools that allow you to organize the teaching and learning process and are essential to achieve the proposed objectives. Blocks, on the other hand, serve to structure the Moodle environment. Figure 15 shows the classification of the tools proposed in the strategy.

Figure 15. Classification of tools for technological strategy



Source: self made

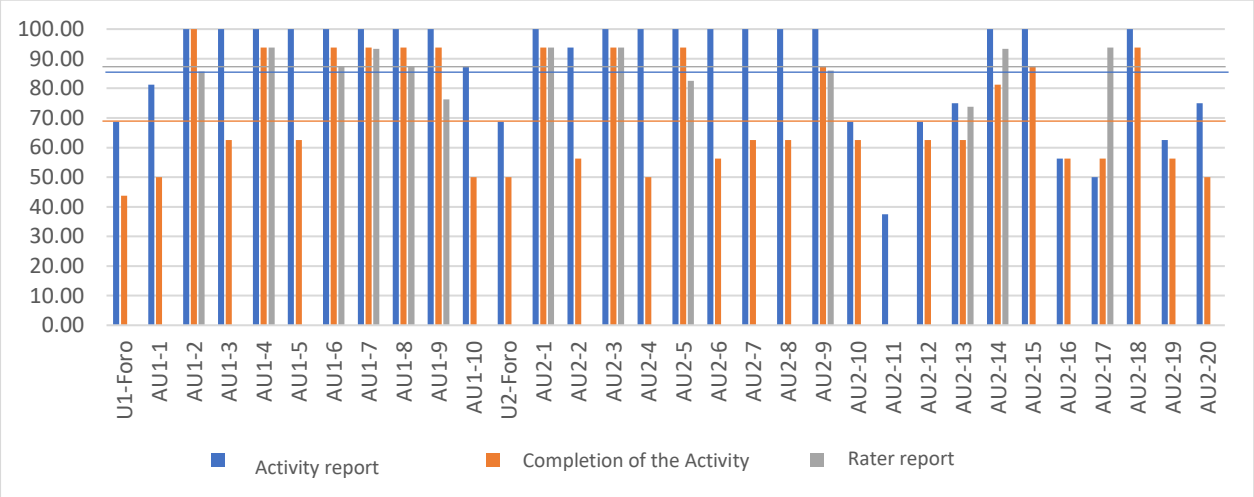
e-learning reporting tools were used, which provide data, information and statistics on the records, activities, and selected users with various filters to narrow down the results obtained. The tools to which we had access to process the information for the two groups were the activity reports, the completion of the activity and the rater's report. The activity reports show by activity in the course the number of users who accessed and the number of total views. The activity completion shows the students who completed it, and the grader report shows each student's grade for each activity, as well as the overall averages.

The information obtained by the platform was subjected to a statistical analysis process using Excel as supporting *software.* From the data obtained by the various reports, a data matrix was created where the main variables were identified, that is, activity report, activity completion and qualifying report. Each variable will have a behavioral relationship with the tools of each activity. These will also be classified by the variable indicators. In the activity report variable, the indicators of number of users and number of views are presented; In the activity completion

variable, its main indicators were the number of users who started and the number of users who finished, and finally for the rater report variable we have the overall rating of the activity.

Figure 16 shows the results obtained by group 1 in relation to the students' visits to the different activities. It can be seen that in the activities where a grade was assigned, 100% visits were obtained. This suggests that students felt an obligation to make at least one visit to fulfill course requirements. On the other hand, in activities where obtaining a grade was not required, a drop in the percentage of visits was observed. The mean for the activity report variable is 85%, the activity completion variable is 69%, while the rater report variable is measured at 87%. Therefore, the activities that are presented below these bands are alerts where it is important to pay attention and find strategies and tools that promote motivation in them.

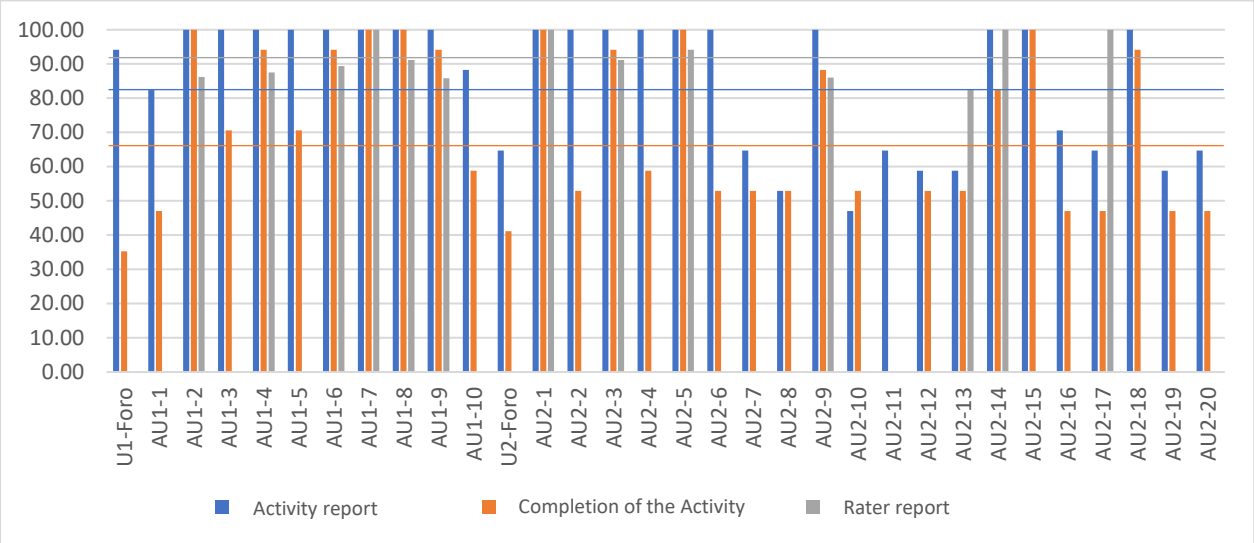
Figure 16. Results of the analysis of group 1



Source: self made

The results obtained by group 2 are similar to those of group 1, which can be seen in figure 17. In fact, an activity in which no grade is assigned is the forums. The mean for the activity report variable is presented at 83%, the activity completion variable is 67%, while the rater report variable is measured at 92%. In this activity, you can observe the phenomenon in which not all students visit the forum, and of those who visit it, not all participate in it. This suggests that, although forums can be a valuable tool for learning, allowing interaction and communication between students, it may be necessary to explore additional ways to encourage their use.

Figure 17. Results of the analysis of group 2



Source: self made

In general, it is important to keep in mind that student motivation can be influenced by factors such as their level of interest in the topic, the quality of teaching, the level of difficulty of the activities, among other reasons. Therefore, it is advisable to consider these aspects when designing activities and tools to encourage student participation and motivation.

Discussion

Undoubtedly, the covid-19 pandemic has significantly transformed education globally. This forced the adaptation of educational systems to ensure the continuity of learning and meet the needs of students. Although the pandemic appears to be in a more controlled phase, the changes it caused have generated significant challenges for education, not only in the future, but also today, offering high quality that meets the changing needs of students.

In this context, online learning has become an important part of education, and its quality varies depending on the content, the ability of teachers to teach in virtual environments, and the technology available. Therefore, it is essential to develop strategies that allow designing adequate resources to improve the quality of online learning.

In this research, an exhaustive analysis, both qualitative and quantitative, was carried out to determine the internal validity of the results obtained. It was found that it was essential to establish a set of strategies that combined pedagogical and technical aspects to design online courses that would allow monitoring the quality of learning through the use of analysis tools. In this sense, the corresponding reliability analysis was carried out using appropriate techniques, which made it possible to certify the validity of the results obtained. The findings revealed that

during the implementation of these strategies, the virtual environment platforms were not being used to the maximum due to lack of knowledge of the tools they offer and lack of understanding about how to implement them effectively.

It cannot be stated with certainty that the results obtained are the same for all classes, since they depend on the way in which each teacher has designed their classes and the digital skills they possess in relation to the platform. However, the methodology used could be generalized, since the tools and instruments provide a guide for the design, implementation and analysis through electronic learning.

Even so, among the limitations that arose in the development of this research is the need to deepen the individualized analysis of the activities by category to make it known to teachers, so that they can incorporate it into their pedagogical design.

Regarding the results obtained, it is important to highlight that they agree with similar research, one of them developed by the Faculty of Engineering of the Universidad Anáhuac México Sur, where a training model in techno-pedagogical strategies for University teachers. The objective was to develop teachers' technological skills so that they could create, store and reuse content, and use educational *software* and content management platforms. The training model proposed in Díaz Alcántara's research (2010) was made up of three areas: pedagogical, technological, and informative-methodological. In each of these areas, specific activities were established to fulfill their main objectives. However, the main difference with the present research is that the data obtained from the activities are evaluated to determine if they are adequate to achieve the learning objectives.

Likewise, a post-pandemic study by Balladares-Burgos and Valverde-Berrocoso (2022) reviews the incorporation of technology in education and pedagogy to develop teachers' digital skills, an aspect that it shares with the results of this study. investigation. However, this work differs from the present one in that the model used is based on a TPACK guide for the techno-pedagogical training of university teachers.

Finally, it can be indicated that this study has shown that didactic and technological strategies can significantly improve the evaluation of learning in online courses. Teachers have improved their digital skills by using various tools in virtual environments, allowing for a more effective and high-quality learning experience for students. Although an analysis of the impact of the activities on the platform and the interaction of students with them has been carried out to determine if they meet the established learning objectives, new questions arise about how to engage

and motivate students in activities that can They do not have a benefit for the accreditation of the course, but they are important for comprehensive training.

Conclusions

In conclusion, this study has shown that the implementation of joint didactic and technological strategies can significantly improve the evaluation of learning in online courses. In this sense, the digital capabilities of teachers have been favored with the use of various tools in virtual environments, which has allowed them to offer a more effective and high-quality learning experience for students.

Furthermore, it is important to highlight the importance of ensuring the achievement of learning objectives through guided course creation that focuses on achieving learning that permeates its quality. To achieve this, teachers must commit to continuing to develop and update their pedagogical and technological skills.

Addressing the current challenges of online education and ensuring quality education are crucial objectives that we must address. By collaborating closely, both teachers and technological tools can harness the potential of online education and offer students an enriching educational experience. However, we must keep in mind that applying technology for learning requires an appropriate combination of pedagogy, didactics and tools for educational purposes. Therefore, it is essential that educational institutions invest in the training and development of digital skills of teachers in order to offer high-quality online education.

Future lines of research

This work presents two lines of future projects: on the one hand, the design and implementation of teacher training courses focused on the application of techno-pedagogical strategies is proposed. These courses will allow teachers to develop their own educational programs, choosing the appropriate tools to achieve learning objectives. In addition, they will focus on establishing effective monitoring of student progress, making use of the varied evaluation resources offered by virtual learning environments. The main objective of this initiative is to overcome the challenges that virtual education presents in the academic field.

The second line arises in relation to data analysis, since the next step is to advance from traditional statistical analysis to the application of data mining techniques. This will allow not only to describe the information collected, but also to explore it in depth to discover relevant data and

make predictions about different groups. Data mining provides the ability to make the most of data sets, which can generate valuable knowledge and reveal hidden patterns that can be instrumental in decision making.

References

Aristizabal F, JA (2016). Learning data analytics (ADA) and educational management. *Educational Management* , *6* (2), 149. https://doi.org/10.15517/rge.v1i2.25499

Balladares-Burgos, J. and Valverde-Berrocoso, J. (2022). The TPACK technopedagogical model and its impact on teacher training: a review of the literature. *RECIE. Caribbean Journal of Educational Research* , *6* (1), 63–72. https://doi.org/10.32541/recie.2022.v6i1

Cabero-Almenara, J. and Palacios-Rodríguez, A. (2021). The evaluation of virtual education: e-activities. *IRIED. Ibero-American Journal of Distance Education* , *24* (2), 169. https://doi.org/10.5944/ried.24.2.28994

Díaz Alcántara, O. (2010). Technopedagogical training: DIY for technophobes. *Apertura* , *10* (13), 108–121.

Díaz, JJ (2017). Analysis of social learning in higher education: background and future lines of action Social. *Hekademos Educational Magazine , 22* , 93–104.

Feng, M., & Heffernan, N. T. (2015). *Informing Teachers Live about Student Learning: Reporting in Assistance System* . www.assistment.org

Fernández, A. (2006). Active methodologies for the formation of skills. *Educatio XXI century , 24* , 35-56.

García Soto, GY, García López, RI and Lozano Rodríguez, A. (2020). Quality in online higher education: a theoretical analysis. Education Magazine, 44, 29. https://doi.org/10.15517/revedu.v44i2.39714

García, R., Hernández, A., Díaz, H. and Morales, G. (2017). Virtual learning environments: a comparative analysis in a postgraduate center. TECTZAPIC Magazine of Scientific and Technological Dissemination, 3(1). http://www.eumed.net/rev/tectzapic/2017/01/ambiente-virtual-aprendizaje.html

Gašević, D., Dawson, S., and Siemens, G. (2015). Let's not forget: Learning analytics are about learning. TechTrends, 59(1), 64-71. https://doi.org/https://doi.org/10.1007/s11528-014-0822-x

Gonzáles Robles, A., Figarella García, FF and Soto Sonera, JS (2016). Problem-based learning to develop critical literacy and citizenship skills at the elementary level. Research News in

Education, 16(3), 34.

Gros, B. (2016). Challenges and trends regarding the future of research on learning with digital technologies. Distance Education Magazine (RED), 10(50). https://doi.org/10.6018/red/50/10

Hamodi, C., López Pastor, VM and López Pastor, AT (2015). Means, techniques and instruments for formative and shared evaluation of learning in higher education. Educational Profiles, 37(147), 146-161. https://doi.org/10.1016/j.pe.2015.10.004

Hernández, R., Fernández, C. and Baptista, M. del P. (2014). Research Methodology (6th ed.). McGraw Hill.

Hiraldo, R. (2013). Use of virtual learning environments in distance education. Edutec, 1–14.

Kumar, P., Shukla, B., & Passey, D. (2020). Impact of accreditation on quality and excellence of higher education institutions. Operational Research, 41(2), 151–167.

Kundu, G.K. (2017). Quality in higher education from different perspectives: A literature review. International Journal for Quality Research, 11(1), 17–34. https://doi.org/10.18421/IJQR11.01-02

Lavigne, G., Gutiérrez, G., McAnally-Salas, L. and Organista, J. (2015). Log Analysis in a Virtual Learning Environment for Engineering Students. RUSC. Universities and Knowledge Society Journal, 12(3), 113. https://doi.org/10.7238/rusc.v12i3.2162

Lebron, CAV, Cuevas, MS, Ortega, GR and Pérez, SEA (2021). Teaching competencies, an innovation in virtual learning environments in higher education. Opening, 13(2), 6–21. http://doi.org/10.32870/Ap.v13n2.2061

Lezcano, L. and Vilanova, G. (2017). Learning evaluation instruments in virtual environments. UNPA Technical Scientific Report, 9(1) 1–36.

Miramontes, MA, Castillo, KY and Macías, HJ (2019). Learning strategies in distance education. Journal of Information Technology Research, 7(14), 199–214. https://doi.org/10.36825/RITI.07.14.017

Mohamad, S.K. and Tasir, Z. (2013). Educational Data Mining: A Review. Procedia - Social and Behavioral Sciences, 97, 320–324. https://doi.org/10.1016/j.sbspro.2013.10.240

Muñoz, A. and Acosta, L. (2016). Virtual learning environments and learning analytics in the initial training of teachers at the Higher Normal School of Pasto. https://recursos.educoas.org/sites/default/files/5105.pdf

Ortega, D., Ortega, F. and Acosta, C. (2023). Taxonomy of trends for learning and teaching in virtual environments. People and Education Editorial.

Perilla, JSA (ed.) (2018). Competency-based learning: an eclectic educational approach from and

for each context. Sergio Arboleda University.

Fisherman, B. (2014). Towards a knowledge society? Med Magazine, 22(2), 6. https://doi.org/10.18359/rmed.1194

Saza-Garzón, ID (2016). Teaching strategies in web technologies for virtual learning environments. Praxis, 12(1). https://doi.org/10.21676/23897856.1851

Autonomous University of Querétaro (UAQ) (2019). The university educational model. Autonomous University of Queretaro.

Contribution Role	Author(s)
Conceptualization	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (equal) Edith Olivo García (support)
Methodology	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (support)
Software	Does not apply
Validation	Raquel Mondragón Huerta (main) Edith Olivo García (support)
Formal Analysis	Raquel Mondragón Huerta (main) Edith Olivo García (support)
Investigation	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (support)
Resources	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (support) Edith Olivo García (support)
Data curation	Raquel Mondragón Huerta (main) Edith Olivo García (support)
Writing - Preparation of the original draft	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (equal) Edith Olivo García (support)
Writing - Review and editing	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (support) Edith Olivo García (support)
Display	Raquel Mondragón Huerta (principal)
Supervision	Raquel Mondragón Huerta (principal)
Project management	Raquel Mondragón Huerta (principal)
Fund acquisition	Raquel Mondragón Huerta (main) Ma. Teresa García Ramírez (same)Edith Olivo García (same)