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La evolución del diseño instruccional en cursos e-learning durante la pandemia: un análisis retrospectivo de las transformaciones

The reconfiguration of instructional design in e-learning courses during the pandemic: a retrospective examination of the changes experienced

A evolução do design instrucional em cursos de e-learning durante a pandemia: uma análise retrospectiva das transformações

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Resumen

El propósito de este artículo es analizar cómo la pandemia ha impactado el diseño instruccional de los cursos en línea y los cambios que se han generado en el ámbito de la educación. Además, se exploran las implicaciones que surgen de estos cambios para el futuro de la educación en línea, y se presentan recomendaciones para el diseño de cursos en línea. El estudio se llevó a cabo en la Facultad de Informática de la Universidad Autónoma de Querétaro, para lo cual se empleó una metodología con enfoque mixto que incluyó encuestas y entrevistas a 93 estudiantes para recopilar datos cuantitativos y cualitativos. Los resultados indicaron una transformación significativa debido a la pandemia en el diseño instruccional de los cursos en línea, con un enfoque mayor en la tecnología y la interacción virtual. Tanto los estudiantes como los docentes han tenido que adaptarse a estos cambios y han experimentado beneficios y

desafíos en su experiencia de *e-learning*. En cuanto a las limitaciones de este estudio, se pueden mencionar el tamaño de la muestra y la especificidad de la población estudiada, lo que restringe la generalización de los hallazgos a otras poblaciones y contextos.

Palabras clave: aprendizaje electrónico, diseño instruccional, educación, tecnología.

Abstract

The purpose of this article is to analyze how the pandemic has impacted the instructional design of online courses and the changes that have occurred in the field of education. Additionally, the implications arising from these changes for the future of online education are explored, and recommendations for online course design are presented. The study was conducted at the Faculty of Computer Science, Autonomous University of Querétaro, using a mixed-methods methodology that involved surveys and interviews with 93 students to gather quantitative and qualitative data. The results indicated a significant transformation in the instructional design of online courses due to the pandemic, with a greater emphasis on technology and online interaction. Both students and teachers have had to adapt to these changes and have experienced benefits and challenges in their online learning experience. However, it is important to note that the limitations of this study include the sample size and the specificity of the population studied, which restricts the generalization of the findings to other populations and contexts.

Keywords: E-Learning, instructional design, education, technology.

Resumo

O objetivo deste artigo é analisar como a pandemia impactou o design instrucional dos cursos online e as mudanças que foram geradas no campo da educação. Além disso, são exploradas as implicações decorrentes dessas mudanças para o futuro da educação on-line e são apresentadas recomendações para o design de cursos on-line. O estudo foi realizado na Faculdade de Informática da Universidade Autônoma de Querétaro, para o qual foi utilizada uma metodologia de abordagem mista que incluiu pesquisas e entrevistas com 93 estudantes para coletar dados quantitativos e qualitativos. Os resultados indicaram uma transformação significativa devido à pandemia no design instrucional dos cursos online, com maior foco na tecnologia e na interação virtual. Tanto os alunos como os professores tiveram de se adaptar a estas mudanças e experimentaram benefícios e desafios na sua experiência de e-learning. Quanto às limitações deste estudo, pode-se citar o tamanho da amostra e a especificidade da população estudada, o que restringe a generalização dos achados para outras populações e contextos.

Palavras-chave: e-learning, design instrucional, educação, tecnologia.

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Introduction

The covid-19 pandemic has had an unprecedented impact on education worldwide, as the social distancing measures implemented to contain the spread of the virus led to the closure of numerous schools and universities, forcing the search for quick solutions to ensure the continuity of the teaching-learning process. Due to this, online education emerged as a viable alternative and became a feasible and well-founded tool to keep students connected to their academic work (Aguirre-Caracheo, 2020), which increased the demand for educational platforms and resources. digital.

E-learning courses, since pedagogical strategies have had to be rethought and use appropriate technological tools to continue with the training of students (Vergara-Avalos, 2022). Consequently, educators have had to learn to use new platforms and applications, as well as implement teaching methods that encourage student participation and engagement through digital media to put knowledge into practice and improve the relationship during the process (Vergara-Avalos, 2020). In addition, additional needs have emerged, such as training in educational technology and the adaptation of content to make it accessible and meaningful in the virtual environment (Hernández-Valerio, 2021).

For their part, students have also faced significant changes in their educational experience, which has impacted each one to discover their interests, way of being, and tastes.

As a result of what happened, it is crucial to reflect on the changes that have occurred in the instructional design of *e-learning courses*, as these modifications have demonstrated that online education has the potential to offer flexible and accessible opportunities for learning, although they have also stressed the need for careful planning and constant attention to design quality.

Therefore, the objective of this study is to provide a retrospective look at how instructional design in *e-learning courses has evolved* throughout the pandemic and how these transformations have affected online education. In addition, the implications of these changes for the future of online education will be discussed and recommendations will be offered for the design of *e-learning courses* in the future, for which the population of the Faculty of Informatics of the University was chosen. Autonomous of Querétaro.

Instructional design and *e-learning*

Online instructional design is a systematic process that involves the design, development, and evaluation of *e-learning environments* for the purpose of facilitating effective and efficient learning (Simonson *et al.*, 2019). This process encompasses the selection of objectives, the determination of teaching strategies and techniques, the choice and design of materials, as well as evaluation.

One of the main characteristics of online instructional design is its flexibility, as it allows students to access learning content and carry out activities at any time and place that is convenient for them (Garrison & Kanuka, 2004). This gives them the opportunity to work at their own pace and have greater control over their learning process. Additionally, online instructional design can incorporate a variety of learning resources and activities, such as videos, simulations, games, discussion forums, and interactive assignments, increasing student motivation and engagement (Morrison et al., *2011*).

However, online instructional design also presents challenges, as it requires careful planning and a sound pedagogical approach to ensure the success of the teaching-learning process. For example, it is crucial to take into account the diversity of students and their learning needs, as well as the context in which learning will take place (Merrill, 2002). Additionally, online instructional design must adapt to the available technology and potential technical limitations that may arise (Simonson *et al.*, 2019).

Regarding online instructional design models, there are several approaches used to guide the design process. One of the most popular is the ADDIE (analysis, design, development, implementation, evaluation) model, which focuses on a sequential and linear methodology that may not be suitable for online education projects that require agility and flexibility to adapt to the needs of the students.

On the other hand, the SAM model (accelerated learning model) focuses on an iterative and collaborative process that adapts to the needs of the students and the design team throughout the development of the course. This is especially useful for online education projects that require continuous adaptation to the changes and needs of students and the organization.

Additionally, the AGILE model (agile project management model) is a methodology based on agile project management principles that focuses on continuous communication and constant adaptation to changes in the instructional design process. This is ideal for online education projects that require a high degree of collaboration and rapid response to changes in the environment and student needs.

The choice of the appropriate model or methodology will depend on factors such as the objectives of the course, the needs of the students and the degree of flexibility and adaptation required during the course design and development process (Merrill, 2002; Morrison et al., 2011; Simonson *et al.*, 2019; Vergara-Avalos *et al.*, 2022). Online instructional design models and approaches can be useful to develop effective virtual education courses adapted to the needs of stakeholders, so that they can communicate without having an assigned space (Olivo *et al.*, 2022).

Tools and technologies for online education

Tools and technologies for online education have undergone significant evolution in recent decades and their use has become widespread throughout the world. These tools encompass *e-learning platforms*, online collaboration tools, data analysis tools, and emerging technologies such as virtual and augmented reality.

According to Hart (2019), *e-learning platforms* have been widely adopted in the educational field, hence they have become valuable tools for online educators. Additionally, a study by Mora and Martínez (2020) found that these platforms can improve the quality of online education and offer flexibility to students regarding their learning pace and schedules.

Thus, these platforms can be understood as systems that allow students to access online courses and educational materials through the Internet. In addition, they can incorporate features such as discussion forums, videos, interactive games, among others. Some of the most popular *e-learning platforms* are Blackboard, Moodle and Canvas.

Online collaboration tools allow students and teachers to work together in virtual environments, and include video conferencing apps (such as Zoom and Google Meet), project management tools (such as Trello and Asana), and document editing tools (such as Google Docs and Microsoft Teams).

On this topic, a study by Khalil and Ebner (2014) highlights that online collaboration tools—such as video conferencing applications, project management tools, and document editing tools—are essential for online education. These make it easier for students and teachers to work together in real time, share information efficiently and improve collaboration, as evidenced in a study by Johnson *et al.* (2021), who found that these tools contribute to improving collaboration and learning among online students.

Finally, emerging technologies, such as virtual and augmented reality, are transforming online education by offering more immersive and realistic learning experiences, allowing students to practice practical skills in simulated and safe environments before facing real situations (Bersin, 2018).

Impact of the pandemic on online education

The pandemic's effect on online education has generated mixed results. On the one hand, it has proven to be an effective solution to guarantee educational continuity during this period of crisis (García-Saiz, 2020), but, on the other hand, it has posed significant challenges for students, teachers and educational institutions.

One of the biggest challenges has been ensuring equity in online education, as many students lack access to devices and reliable connection to fully participate in this type of teaching (Jansen *et al.*, 2018), which has resulted in disparities in access to education. Likewise, students' motivation and commitment to e-learning has been a challenge that could have an unfavorable impact on their academic performance, according to Sandoval-Muñoz (2018).

On the other hand, online teaching requires specific skills and knowledge, which has become a difficult task for many teachers and administrators who were not prepared for this type of modality (Pérez and Ramírez, 2017). Additionally, lack of adequate training and resources has hampered effective implementation of online education.

However, the pandemic has contributed to greater acceptance of online education as an effective form of crisis training (García and Rodríguez, 2020), as it can provide flexibility and personalized learning opportunities for students. In general, the pandemic has had a significant impact on online education, whether with its positive or negative aspects (Olivo *et al.*, 2023).

E-learning evaluation

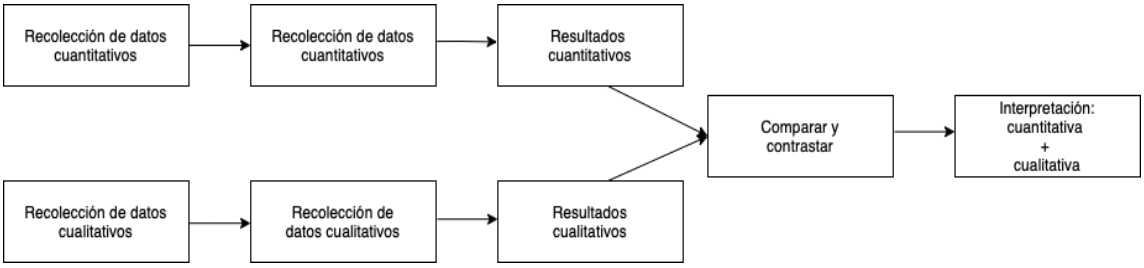
E-learning evaluation plays a fundamental role in ensuring the quality and effectiveness of online education (Garrison *et al.*, 2004), which covers formative evaluation, summative evaluation and authentic evaluation (Medel-San Elías *et al.*, 2023). The first evaluation is used to measure the progress and continuous learning of students, as it provides feedback that helps students improve their learning process (Cavazos and Torres, 2016). Summative assessment is used to measure the level of student achievement at the end of a learning period (Cacheiro, 2018), while authentic assessment focuses on the application of knowledge and skills in real situations, which may involve projects, tasks and peer evaluation (Moreno *et al.*, 2018). This form of evaluation is especially relevant in *e-learning environments*, where evaluating the practical application of knowledge can be more challenging (Muñoz-Repiso and Fuentes-Cabrera, 2021).

Likewise, it is important to keep in mind that online assessment also poses unique challenges (Pérez, 2019), which can lead to academic fraud (Johnson, 2016). Additionally, it must be ensured that online assessment is equitable and accessible to all students, regardless of their technical skills or personal circumstances (Johnson, 2016).

Materials and methods

This research was carried out following a mixed methodology, inspired by the proposal of Creswell and Plano (2011), which integrates both quantitative and qualitative approaches. This approach was strategically selected to address the complexity inherent to the phenomenon studied and to obtain a comprehensive understanding of the key aspects related to our research object. Convergent triangulation is based on the premise that quantitative and qualitative data can complement each other, which strengthens the validity and reliability of research results (Figure 1).

Figure 1. Mixed convergent triangulation methodology



Source: Creswell and Plano (2011)

For this, a study was carried out using a mixed methodology proposed by Creswell and Plano (2011) to investigate the experiences of 67 university students from the Faculty of Informatics of the Autonomous University of Querétaro (Mexico) in *e-learning courses* during the covid-19 pandemic. This sample was selected due to the size of the Faculty of Computing enrollment.

To collect quantitative data, an online survey was used through Google Forms, which consisted of 12 questions with a 5-point Likert scale, and addressed 5 variables: student experience in *e-learning courses*, instructional design, tools. technologies used, communication with teachers and satisfaction with *e-learning*.

In addition, in-depth interviews were conducted with a selected group of participants with the aim of obtaining qualitative information about their experience in the instructional design of *e-learning courses*. The selection of participants was carried out through simple random sampling, which included students from different semesters and academic programs, which allowed us to obtain a representative and generalizable sample of the faculty population.

The online survey was distributed to selected university students via a link, and they were given two weeks to complete it. On the other hand, the in-depth interviews were carried out virtually, through video calls, and were recorded and transcribed for subsequent analysis.

The quantitative data obtained were analyzed using descriptive statistical techniques, such as the calculation of frequencies, percentages and means. These techniques allowed us to

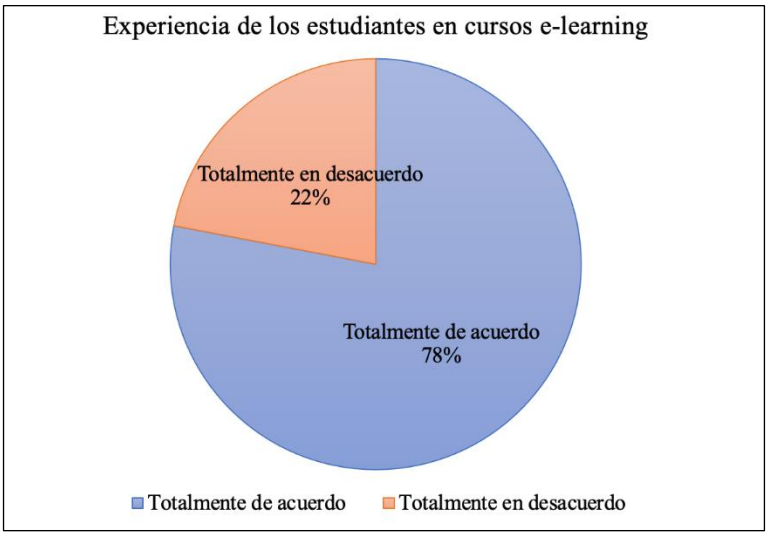
identify the most common patterns in the students' responses and obtain an overview of the survey results.

On the other hand, the qualitative data were analyzed through content analysis, which allowed the identification of themes and patterns in the participants' responses. The combination of quantitative and qualitative data analysis techniques provided a complete and detailed view of the transformation of instructional design in *e-learning courses* during the pandemic, as well as the experiences of students in these courses. This mixed methodology guaranteed the validity and reliability of the findings.

Results

Analyzing the data obtained through the online survey applied to 93 students of the Faculty of Informatics, relevant results were found in several variables. Regarding the experience of students in *e-learning courses*, it was observed that 78% of those surveyed had previous experience in this type of courses, while the remaining 22% had not participated in them previously. This suggests that the majority of students already had some familiarity with *e-learning* (figure 2).

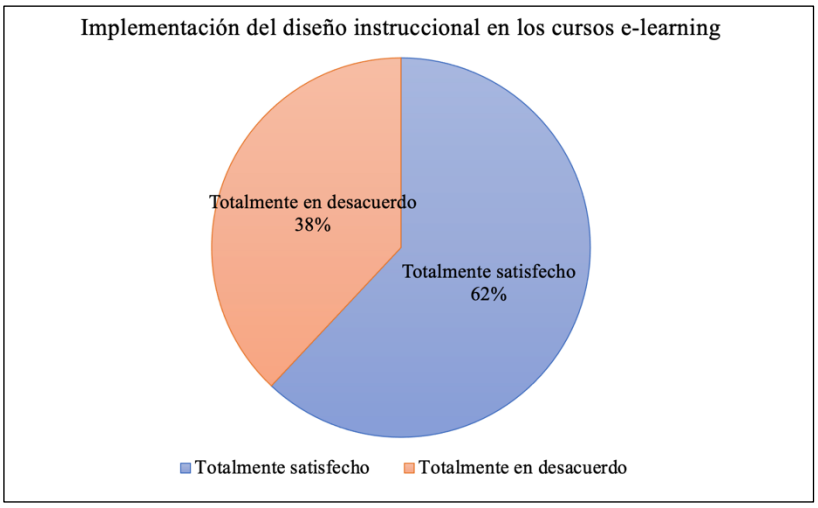
Figure 2. Experience in *e-learning*



Source: self made

Regarding the instructional design, 62% of students expressed satisfaction with the design of the online courses, while 38% expressed dissatisfaction. These results indicate that there is a need to improve the instructional design of courses to better meet the expectations and needs of students (figure 3).

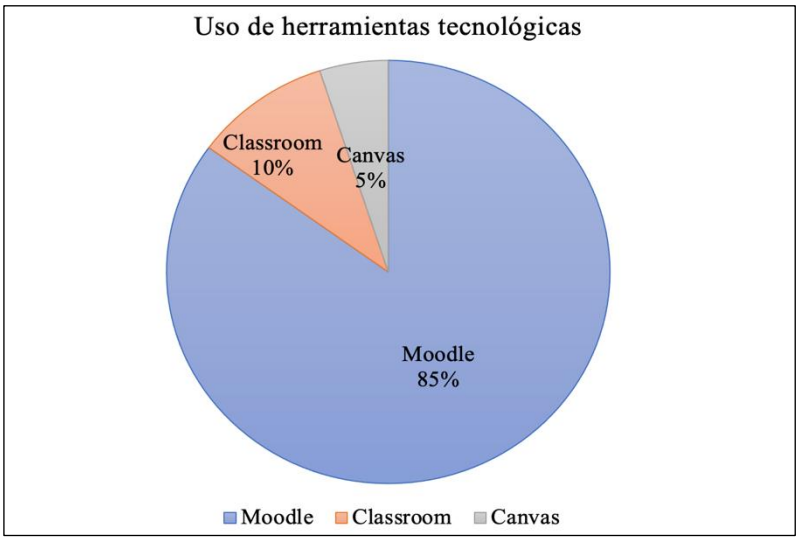
Figure 3. Instructional design in courses



Source: self made

Regarding the technological tools used, it was observed that 85% of the students used the Moodle platform, while the remaining 15% used other platforms. This highlights the popularity of Moodle in the student community of the Faculty of Informatics, hence it is the official educational platform of the Autonomous University of Querétaro (figure 4).

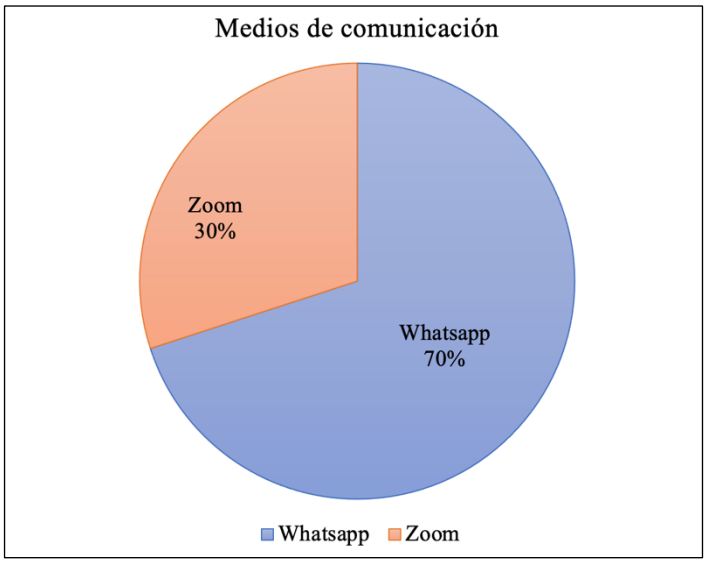
Figure 4. Technological tools



Source: self made

In relation to communication with the teacher, 70% of the students mainly used WhatsApp, while the remaining 30% used other tools such as the Zoom platform. This indicates that WhatsApp continues to be the most commonly used channel for direct communication between students and teachers in *e-learning courses* (figure 5).

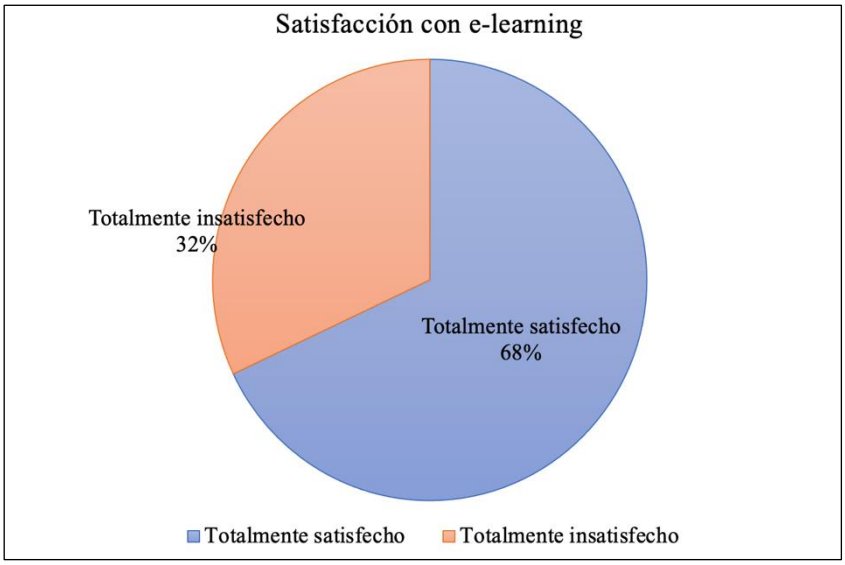
Figure 5. Means of communication with the teacher



Source: self made

Regarding satisfaction with *e-learning*, 68% of students were satisfied, while 32% expressed dissatisfaction. This suggests that there is still room for improvement and addressing the concerns of some students (figure 6).

Figure 6. Satisfaction with *e-learning* implementation



Source: self made

The in-depth interviews revealed additional themes related to the students' experience in the instructional design of *e-learning courses*. Some students mentioned the need for more interaction with their peers and teachers, as they sometimes felt isolated in the online environment. The importance of having a clear and well-organized structure in the courses was another recurring theme, since this helped them feel more motivated and committed to e-*learning*.

In addition, the importance of an adequate design of activities and evaluations was highlighted, which would allow them to effectively demonstrate what they had learned. Constructive and timely feedback from teachers was also valued as a key factor in improving the learning process.

Therefore, the quantitative results indicated widespread satisfaction with the instructional design and technological tools used in the *e-learning courses*. However, qualitative findings revealed perceived limitations in the instructional design, especially the lack of interaction and personalized feedback. However, there was a convergence between the quantitative and qualitative results regarding the importance of effective communication with the teacher in *e-learning*, which highlights its relevance for student success.

Discussions

In the theoretical context, it was mentioned that the pandemic has generated a greater demand for online courses, which has resulted in an increase in the creation and use of virtual learning platforms. According to Picciano (2017) and Bates (2019), *e-learning* has seen steady growth in higher education, and the pandemic has further accelerated this trend. However, our findings indicate that students from the Faculty of Informatics of the Autonomous University of Querétaro have faced difficulties during their adaptation to online courses during this period.

On the other hand, several authors suggest that the instructional design of online courses should focus on interaction and collaboration between students and teachers to achieve meaningful learning. Garrison *et al.* (2000) and Palloff and Pratt (2013) have highlighted the importance of interaction in *e-learning* and have developed instructional design models focused on said interaction. Our results support this idea, as many interview participants mentioned that interaction with their peers and faculty was critical to their success in online courses during the pandemic. Therefore, it can be highlighted that the use of technology is vital so that the actors involved feel motivated to learn and discover new topics (Medel-San Elias, 2023).

Additionally, it was noted in the theoretical framework that online assessment presents unique challenges, such as controlling the environment and equity in assessment. Lonn and Teasley (2009) and Toppin and Adlard (2015) highlight the importance of ensuring a fair and equitable evaluation environment, as this can significantly affect evaluation results. To address these challenges, various online assessment strategies and tools have been developed, such as remote proctoring and screen monitoring, which allow assessors to control the students' assessment environment. Additionally, the inclusion of multiple-choice questions and open-

ended questions can contribute to equitable assessment by providing different options for students to demonstrate their knowledge and skills. However, it is important to note that these strategies are not foolproof and can pose their own challenges.

In conclusion, the results of this research reveal that the pandemic has had a significant impact on higher education and the way students learn. For example, the transition to online courses has presented challenges for many students, including a lack of interaction and collaboration, difficulty maintaining motivation and concentration, as well as the need to adapt to new technologies and learning platforms. However, key factors for success in online courses during the pandemic have also been identified, such as interaction and collaboration between students and teachers. These factors must be considered when designing online courses with the goal of ensuring that students can be successful in their learning process.

Finally, it is important to mention that this research has faced some complications, such as the difficulty in obtaining a representative sample of the population and the limitations of access to students due to the pandemic. Furthermore, the study has focused on a single faculty of a specific university, which limits the generalization of the results to other educational institutions.

Therefore, for future research, it would be interesting to replicate this study at different colleges and universities in order to gain a more complete understanding of how students are experiencing the transition to online courses during the pandemic. It would also be important to further study the factors that influence student success in online courses and how effective courses can be designed that promote meaningful learning and interaction between students and teachers. It is essential to continue research to ensure that students can be successful in their learning in this ever-evolving environment.

Conclusion

In conclusion, this study has provided valuable information about the experience of students at the Faculty of Informatics of the Autonomous University of Querétaro during the transition to online courses during the pandemic. Results have shown that while demand for online courses has increased and virtual learning has become a growing trend in higher education, students have faced challenges in adapting to this new format.

Likewise, the importance of interaction and collaboration between students and teachers has been observed, both in the instructional design and in the general success of online courses, and specific difficulties in online evaluation have been identified, which highlights the need to ensure a fair and equitable environment for students.

Although students have expressed some concerns and difficulties, the majority have expressed satisfaction with their *e-learning experience*. This indicates that, despite the challenges, online courses can be effective and satisfying when approached appropriately, although it is important to take into account the limitations of this study, such as the representative sample and the focus on a single university faculty. Still, these findings provide a solid foundation for future research and the design of more effective online courses that promote student interaction, collaboration, and success.

Ultimately, this study meets the main objective because it provides a retrospective look at how instructional design in *e-learning courses has changed* throughout the pandemic and how these transformations have affected online education, although further research must be done. and improving educational practices in this constantly evolving environment. Ultimately, higher education must adapt to current changes and challenges, which means taking advantage of the opportunities offered by online courses to provide meaningful and satisfying learning experiences for students.

Future lines of research

With this research, the need to develop new assessment tools and practices that allow accurately measuring the progress and skills acquired in virtual contexts can be highlighted. Secondly, it is suggested to investigate the long-term impact of the pandemic on online education, especially academic performance, student well-being, and the continued adoption of virtual platforms. Likewise, longitudinal studies would be valuable to understand how online education has changed the educational landscape.

Additionally, it is recommended to explore the development of adaptive instructional design models that personalize learning to meet the individual needs of students. These models could dynamically adjust content and activities based on student progress and performance.

Likewise, the importance of researching and promoting inclusion and accessibility in online education is highlighted to guarantee equal opportunities for students with disabilities or technological limitations. Likewise, it is recommended to explore how the integration of emerging technologies, such as virtual and augmented reality, can improve the quality and experience of learning in virtual environments.

Finally, the need to investigate student satisfaction in online courses is highlighted to identify the key factors that influence their positive or negative perception of the educational experience. These lines of research offer a broad perspective to enrich online education and

promote effective virtual course design, which will ensure an enriching and successful educational experience for students in the digital age.

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