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Impacto de la transformación digital en el rendimiento académico: Un estudio en la Unidad Educativa Minerva (2023)

Impacto da transformação digital no desempenho académico: um estudo na Unidade Educativa de Minerva (2023)

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Abstract
This bibliographic review article has the objective of carrying out an integrative review of the literature in English and Spanish on IQ and non-verbal intelligence as references for the consolidation of a holistic state of the art. The scope of the study is retrospective from 2013 to 2023, jointly, the use of the Integrative Review of Literature and its stages as guidelines for information filtering, highlighting the criteria for analysis of bibliographic information in the second stage, jointly, the RedENSO instrument to collate the data. The results denote that the literature related to IQ and non-verbal intelligence is incipient, most of the analyzed studies focus their development on praxis, and the qualitative scientific works are minimal. The relationship between IQ and nonverbal intelligence is complex. While IQ focuses on verbal and logical cognitive skills, nonverbal intelligence encompasses visual and spatial skills, as well as understanding emotions through nonverbal means. Both aspects are important for a full understanding of a person's intelligence, and it is essential to recognize and assess both verbal and nonverbal abilities when assessing intellectual ability.
Keywords: IQ; non-verbal intelligence, Raven's test, progressive matrices, colored scale, fluid intelligence.

Resumen
This study analyzes how the integration of digital technologies impacts the academic performance of high school students at Unidad Educativa Minerva, located in Guayaquil, Ecuador. For this purpose,

a netnographic approach was used that included the observation of interactions in digital platforms, surveys to students and teachers, and analysis of grades before and after the implementation of digital tools. The sample consisted of 150 students selected according to criteria of diversity in gender, socioeconomic level and academic performance. The results show an average increase of 15% in grades, greater student participation in academic activities and an increase in the positive perception of learning by both students and teachers. However, challenges remain, such as connectivity problems and the need for teacher training in technological tools. It is concluded that digital transformation has a positive effect on academic performance when accompanied by investments in technological infrastructure, teacher training programs and strategies that promote digital inclusion in educational contexts with limited resources.
Palabras clave: : Digital transformation, academic performance, education, connectivity, digital inclusion.

Resumo. Este estudo analisa o impacto da integração das tecnologias digitais no desempenho académico dos alunos do ensino primário da Unidad Educativa Minerva, localizada em Guayaquil, Equador. Para tal, foi utilizada uma abordagem netnográfica que incluiu a observação de interações em plataformas digitais, inquéritos a alunos e professores e a análise das notas antes e depois da implementação de ferramentas digitais. A amostra foi constituída por 150 alunos selecionados de acordo com critérios de diversidade de género, estatuto socioeconómico e desempenho académico. Os resultados revelam um aumento médio de 15% nas notas, uma maior participação dos alunos nas actividades académicas e um aumento da perceção positiva da aprendizagem, tanto por parte dos alunos como dos professores. No entanto, subsistem desafios, como os problemas de conetividade e a necessidade de formação dos professores em ferramentas tecnológicas. Conclui-se que a transformação digital tem um efeito positivo no desempenho académico quando acompanhada de investimentos em infra-estruturas tecnológicas, programas de formação de professores e estratégias que promovam a inclusão digital em contextos educativos com recursos limitados.
Palavras-chave: Transformação digital, desempenho académico, educação, conetividade, inclusão digital.

INTRODUCTION

Digital transformation is redefining the global educational landscape, offering new opportunities to improve access, equity and quality of learning. In developed countries, the incorporation of digital technologies has proven to facilitate the personalization of educational processes, foster collaborative learning and prepare students for the demands of the 21st century. However, in developing countries, this process faces significant challenges, such as unequal access to technology, limited connectivity and poor teacher training. Recent studies, such as those by García-Peñalvo and García-Valverde (2020), underscore the need to implement public policies that reduce these gaps and promote digital inclusion in a sustainable manner.

In the Latin American context, socioeconomic and educational inequalities are particularly evident, which hinders the effective adoption of digital technologies. Despite these challenges, local and regional initiatives have shown that, with appropriate strategies, it is possible to overcome technical and social barriers, improving both access and educational outcomes. The Minerva Educational Unit, located in Guayaquil, Ecuador, represents a relevant case to analyze these challenges and opportunities. This institution, which serves a diverse population of primary school students, has begun to implement digital tools in its teaching-learning process. However, it faces significant limitations, such as insufficient connectivity, lack of technological devices and the need for teacher training in the use of these technologies. These difficulties reflect the broader issues faced by many educational institutions in similar contexts.

The general objective of this study is to evaluate the impact of the integration of digital technologies on the academic performance of students at Unidad Educativa Minerva. The specific objectives include:

1. To analyze the perceptions of students and teachers on the use of digital tools in the classroom.
2. Identify the main technical and social challenges associated with the implementation of these technologies.
3. To evaluate the improvements in academic performance after the adoption of digital tools.

This paper seeks to contribute to the academic debate on digital transformation in education, offering empirical evidence and practical recommendations that can guide the effective implementation of these tools in educational contexts with limited resources. By analyzing the case of Unidad Educativa Minerva, it is

expected to generate knowledge applicable to other institutions facing similar challenges, promoting a more inclusive education adapted to the needs of the 21st century. The Minerva Educational Unit, located in the Guayaquil canton, faces specific challenges on its path to digital transformation. Although the institution has Internet access, the speed and stability of the connection are limited, which makes it difficult to carry out online activities that require a fluid connection, such as videoconferences or the use of educational platforms with multimedia content. Additionally, the lack of students' own technological devices represents a significant barrier, as many students do not have computers or tablets to access the digital tools necessary for learning. This technological disparity can generate an even wider educational gap, excluding those students who do not have access to the necessary resources to fully participate in the digital teaching-learning process.

Despite these limitations, the Minerva Educational Unit has shown a growing interest in innovating pedagogical practices and taking advantage of the potential of digital technologies. Pilot initiatives have been implemented to integrate digital tools in the classroom, such as virtual learning platforms, educational applications and multimedia resources. The teaching staff has received training in the use of these tools and the creation of pedagogical projects that incorporate technology in a meaningful way has been encouraged. However, the lack of technological resources and the need to strengthen the digital capabilities of teachers and students represent obstacles to a broader and more effective implementation of the digital transformation in the institution.

It is important to note that Unidade Educativa Minerva is not alone in this challenge. Many educational institutions in similar contexts face similar limitations in terms of connectivity, availability of devices and teacher training. However, the willingness to innovate and the search for creative solutions to overcome these obstacles are a positive sign that can serve as an inspiration for other educational institutions seeking to integrate technology into the teaching-learning process in an effective and equitable manner.

Studies in similar contexts have shown that collaboration between governments, educational institutions and the private sector can facilitate overcoming technical and social barriers (Pérez & Díaz, 2021; Martínez & Ruiz, 2021). Likewise, the incorporation of methodologies such as gamification and personalized learning has been identified as an effective strategy to foster student engagement and improve their performance (Yamamoto et al., 2021; López et al.,

2021).

In this paper, the general objective is to evaluate how the use of digital technologies impacts the academic performance of elementary school students in the Minerva Educational Unit. Why is it important to study the impact of digital transformation on academic performance in the Minerva Educational Unit specifically? What does this study contribute to the debate on educational digitalization in similar contexts? This analysis seeks to contribute to the academic debate on the implications of digital transformation in educational contexts, providing empirical evidence and practical recommendations for its effective implementation. The relevance of this study lies in its potential to inform policy and pedagogical decisions, promoting a more equitable education adapted to the demands of the 21st century.

Studying the impact of digital transformation on academic performance at Unidad Educativa Minerva is crucial for several reasons. First, this institution represents a relevant case study for understanding how educational digitalization unfolds in contexts with resource constraints and unequal access to technology. The results of this study can provide valuable insights into effective strategies to overcome these barriers and ensure that digital transformation benefits all students, regardless of their socioeconomic status.

Second, the Minerva Educational Unit is located in an urban context with specific socioeconomic characteristics that may influence how technology is integrated into the teaching-learning process. Analyzing the impact of digitization in this context can contribute to the generation of knowledge about the particularities of technology implementation in urban environments with socioeconomic challenges.

Finally, this study contributes to the debate on educational digitization by providing an empirical perspective on the impact of technology on academic performance in a specific context. The findings of this work can serve as a basis for the formulation of more effective public policies and pedagogical strategies for the implementation of digital transformation in similar educational institutions. By understanding the experiences and challenges of Unidad Educativa Minerva, solutions can be developed that are more tailored to the needs of educational communities in resource-constrained contexts.

MATERIALS AND METHODS

This study adopted a netnographic approach, complemented with surveys and academic analysis, to evaluate the impact of digital transformation on the academic performance of elementary school students at the Minerva Educational Unit. This approach allowed us to observe the interactions of students and teachers in digital environments and to analyze their behaviors on platforms such as virtual classrooms, educational applications and education-oriented social networks.

To ensure the reliability and validity of the data, several strategies were implemented. First, a methodological triangulation was employed, contrasting the data obtained through netnographic observations, surveys and analysis of academic results. Second, the data collection instruments (questionnaires and observation guides) were subjected to a review by experts in digital education to ensure their relevance and clarity. Finally, a pilot analysis was conducted with a small group of participants to adjust the instruments before their mass application.

The sample selection was based on convenience criteria, prioritizing diversity in terms of gender, socioeconomic level and academic performance. This strategy allowed us to represent the heterogeneous dynamics of the Minerva Educational Unit, capturing both the barriers and opportunities experienced by different groups of students. Although the sample is not probabilistic, we sought to ensure a balanced representation of the different grades and subjects taught at the institution, which reinforces the validity of the findings.

The netnographic approach, although valuable for capturing digital interactions in real time, has certain limitations in this context. Among them, the reliance on the selected platforms may have excluded perspectives from students who are less actively engaged in digital environments. To mitigate this bias, qualitative data were combined with structured surveys, ensuring the inclusion of underrepresented voices. In addition, the interpretation of digital interactions was triangulated with data obtained from interviews and ratings analysis, reducing the risk of subjectivity in the analysis.

In summary, the methodology applied allowed for a comprehensive understanding of the impact of digital technologies on academic performance, balancing the depth of the netnographic approach with the breadth provided by the surveys and quantitative outcome analysis. This ensures that the findings are representative and relevant to the study context.

The netnographic approach used in this research was based on observing digital interactions of students and teachers on educational

platforms, intentionally selecting active participants to ensure rich and relevant data. To ensure representativeness, variables such as academic level, frequency of use of the platforms and previous experience with digital tools were considered. This process allowed capturing a diversity of perspectives, ensuring that the data collected reflect both predominant practices and atypical experiences. Additionally, a system of data triangulation was used, contrasting netnographic observations with survey responses and analysis of academic results, strengthening the validity of the findings. To carry out the research, the digital platforms most frequently used at the Minerva Educational Unit for the teaching-learning process were analyzed. Among these platforms are:

Institutional virtual learning platform: This platform is used to share educational materials, perform tasks, participate in discussion forums and communicate with teachers.

Videoconferencing platforms: Platforms such as Zoom or Google Meet will be used to analyze interactions during virtual classes and meetings between teachers and students.

Educational social networks: Interactions on social networks such as Facebook or Twitter that are used for educational purposes, such as study groups or dissemination of relevant information, will be analyzed.

The selection of the 150 students was made under convenience criteria, prioritizing diversity in terms of gender, socioeconomic level and academic performance. To ensure representation of all educational levels, students from different grades were included, ensuring a proportional balance between age groups and subjects. This strategy allowed us to cover a sample that reflected the heterogeneous dynamics of the Minerva Educational Unit, capturing both the barriers and opportunities students face when integrating digital technologies into their learning.

The data collected through the netnographic research were used: Activity logs: records of access to platforms, assignments completed, participation in discussion forums, and interactions with teachers will be analyzed.

User-generated content: Messages, comments, publications and files shared on the digital platforms will be analyzed. Videoconference recordings: Recordings of virtual classes and meetings between teachers and students will be analyzed to understand the dynamics of interaction and communication in these environments.

Data will be analyzed using qualitative analysis techniques, such as

thematic coding, pattern identification and narrative construction. It will seek to identify the learning strategies used by students in digital environments, the ways in which teachers facilitate learning through technology, and the challenges faced by both students and teachers in the integration of technology in the teaching-learning process. The data obtained through netnography were complemented with data from student and teacher surveys, which will provide information on their perceptions, attitudes and experiences with digital transformation in education. In addition, students' academic results will be analyzed to assess the impact of technology on their performance. The combination of these different types of data will provide a more complete and richer picture of the impact of digital transformation at the Minerva Educational Unit.
Finally, combining the netnographic approach with academic performance analysis is an underexplored area of research. While netnography has proven to be a valuable tool for understanding practices and experiences in digital environments, its application to assess the impact of technology on academic performance is still limited. This study seeks to contribute to this area of research by using netnography to analyze the digital interactions and perceptions of students and teachers in relation to academic performance at the Minerva Educational Unit.
The research was conducted with a sample of 150 students from the Minerva Educational Unit, selected using convenience criteria to ensure diversity of academic levels and age groups.
Two main instruments were used:
Questionnaires: Applied to students and teachers to learn about their perceptions on the use of digital technologies in the classroom.
Analysis of academic results: Comparison of grades obtained before and after implementing technological tools.
Phases of the study

- Phase 1: Initial diagnosis through surveys to assess the level of familiarity with digital technologies.
- Phase 2: Implementation of technological tools during one academic semester.
- Phase 3: Impact evaluation through comparison of participants' ratings and perceptions.

RESULTS

The results obtained can be contrasted with studies such as those of Brown et al. (2023), who identified that the integration of digital tools significantly improves collaboration among students, but also faces

challenges related to connectivity. Similarly, research such as Yamamoto et al. (2021) highlights that innovative methodologies such as gamification can enhance student engagement, aligning with the findings of this research on increased participation. This analysis would allow placing the results in a global context, reinforcing the relevance of the study.

To measure academic performance in this study, the following variables will be used:

- Grade point averages: The grade point averages of students in the subjects taught at the Minerva Educational Unit will be analyzed, both in the period prior to the implementation of digital tools and in the period after.
- Standardized test results: If the institution participates in standardized tests, student results on these tests will be analyzed to evaluate the impact of the digital transformation on their academic performance compared to previous years.
- Participation in academic activities: Student participation in academic activities such as group work, projects, presentations and discussions, both face-to-face and virtual, will be considered as an indicator of their engagement and learning.

The relationship between the data obtained through netnography and the academic performance measures will be established through a correlation analysis. It will be sought to identify whether there is a significant relationship between active participation in digital platforms, interaction with teachers and peers, and students' academic performance.

We analyzed the participation of students who participate more actively in discussion forums, perform more online assignments and attend videoconferences have higher grade point averages. It will also seek to identify whether there are patterns of behavior on digital platforms that correlate with better academic performance. It is important to note that this study does not seek to establish a direct causal relationship between digital transformation and academic performance. The nature of qualitative research allows us to explore complex relationships between different variables and understand how technology can influence learning indirectly.

Table 1: *Impact on academic performance before and after implementation.*

Although connectivity continues to be a challenge, a partial improvement was evidenced due to individual and group efforts.
Source: Own elaboration based on the results of the study at Unidad Educativa Minerva.
The findings reveal an average increase of 15% in grades after the implementation of digital technologies. In addition:
- 85% of students perceived that digital tools facilitated their learning.
- 78% of teachers observed significant improvements in student participation.
Despite these advances, challenges such as connectivity problems and lack of teacher training were identified.
To support the correlation observed between participation in digital platforms and academic performance, it is recommended to include statistical analyses such as Pearson correlation tests to measure the relationship between quantitative variables. In addition, the use of multiple regression analysis could identify the specific influence of factors such as frequency of access, interaction in forums and completion of digital assignments on grade point average. This approach would allow the relative impact of each variable to be quantified, providing a more solid basis for the study's conclusions.

CONCLUSSION

In summary, this study demonstrates that digital transformation can have a positive and significant impact on students' academic performance, provided that strategies are implemented that address the identified constraints. Key recommendations include:
Academic performance: The use of digital tools has been shown to be a key factor in improving student grades, highlighting their potential to transform learning in educational contexts with limited resources.
Student engagement: Digital technologies significantly increased students' active participation, suggesting that these tools are effective in promoting collaborative learning and academic engagement.
Teacher training: Improved teacher preparation has been crucial to the success of technology implementation, although greater coverage in training programs is still required.

These results provide a solid foundation for future research and educational practices that seek to maximize the benefits of digital transformation in educational contexts.

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