

MENDIVE



REVISTA DE EDUCACIÓN

Original article

Computer center in a primary education classroom

Centro de cómputo en un aula de educación primaria

Centro de computação em uma sala de aula de escola primária

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Received: April 28, 2024

Accepted: November 19, 2024

ABSTRACT

The article presents the results of an action-research project that highlights the capacity of teachers to innovate in their daily educational practice, facing the economic, social and cultural inequalities that limit access to technological resources. Its objective was to demonstrate how, through collaboration between teachers and principals, the implementation of technological resources in a primary classroom can transform the educational experience and motivate students. Using an action-research methodology, technological devices available at the school were managed, which were installed in the classroom to the surprise and enthusiasm of the students. Educational activities were designed that encouraged active interaction with technology and promoted their learning. Despite the limited results in institutional dissemination, the project showed the positive impact of technological integration in challenging educational contexts, highlighting the creativity and effort of teachers to overcome environmental barriers and guarantee quality education. This study highlights the importance of providing greater institutional support to include technologies in schools, especially in disadvantaged regions, where teacher commitment makes a difference in the learning of new generations.

Keywords: computing; primary education; motivation; pandemic.

RESUMEN

El artículo expone los resultados de una investigación-acción que resalta la capacidad del magisterio para innovar en su práctica educativa cotidiana, enfrentando las desigualdades económicas, sociales y culturales que limitan el acceso a recursos tecnológicos. Su objetivo fue demostrar cómo, a través de la colaboración entre docentes y directivos, la implementación de recursos tecnológicos en un aula de primaria puede transformar la experiencia educativa y motivar a los estudiantes. Mediante una

metodología de investigación-acción, se gestionaron dispositivos tecnológicos disponibles en la escuela, los cuales fueron instalados en el aula para sorpresa y entusiasmo de los estudiantes. Se diseñaron actividades educativas que fomentaron la interacción activa con la tecnología y promovieron su aprendizaje. A pesar de los limitados resultados en la divulgación institucional, el proyecto evidenció el impacto positivo de la integración tecnológica en contextos educativos desafiantes, destacando la creatividad y el esfuerzo de los docentes para superar las barreras del entorno y garantizar una educación de calidad. Este estudio subraya la importancia de proporcionar mayores apoyos institucionales para incluir tecnologías en las escuelas, especialmente en regiones desfavorecidas, donde el compromiso docente marca la diferencia en el aprendizaje de las nuevas generaciones.

Palabras clave: computación; educación primaria; motivación; pandemia.

RESUMO

Este artigo apresenta os resultados de um projeto de pesquisa-ação que destaca a capacidade dos professores de inovar em sua prática educacional diária, enfrentando as desigualdades econômicas, sociais e culturais que limitam o acesso aos recursos tecnológicos. Seu objetivo foi demonstrar como, por meio da colaboração entre professores e gestores, a implementação de recursos tecnológicos em uma sala de aula do ensino fundamental pode transformar a experiência educacional e motivar os alunos. Usando uma metodologia de pesquisa-ação, os dispositivos tecnológicos disponíveis na escola foram gerenciados e instalados na sala de aula, para surpresa e entusiasmo dos alunos. Foram elaboradas atividades educacionais que incentivaram a interação ativa com a tecnologia e promoveram seu aprendizado. Apesar dos resultados limitados em termos de alcance institucional, o projeto evidenciou o impacto positivo da integração da tecnologia em contextos

educacionais desafiadores, destacando a criatividade e o esforço dos professores para superar as barreiras ambientais e garantir uma educação de qualidade. Este estudo ressalta a importância de fornecer maior apoio institucional para incluir tecnologias nas escolas, especialmente em regiões desfavorecidas, onde o comprometimento dos professores faz a diferença no aprendizado das novas gerações.

Palavras-chave: computação; ensino fundamental; motivação; pandemia.

INTRODUCTION

The incorporation of Information and Communication Technologies (ICT) in education has experienced a process of global expansion and consolidation in recent decades, standing out for its ability to transform teaching and learning methodologies. According to UNESCO (2020), ICTs offer new opportunities to improve educational quality, allowing students to access innovative educational resources, promoting equity and contributing to the development of key competencies in the 21st century. However, the effective integration of these technologies into the educational systems of different countries has been marked by structural challenges, such as insufficient infrastructure and lack of teacher training, especially in contexts of inequality.

The context of the COVID-19 pandemic, which affected more than 1.5 billion students worldwide, accelerated the need for educational systems to adapt to new technologies. In particular, social distancing and school closures forced educational authorities to implement rapid digital solutions, enabling a transition to distance education.

According to UNESCO (2020), during the pandemic, around 90% of the world's students saw their in-person classes interrupted,

revealing the urgency of ensuring equitable access to ICTs. This radical change not only created a challenge in terms of access to technology, but also in the training and pedagogical adaptation of teachers, who had to modify their approaches to continue meeting educational objectives. In Mexico, the situation was exacerbated by deep inequalities in access to technology. According to the National Institute of Statistics and Geography (INEGI, 2021), only 44% of rural households in the country have access to the Internet, which has exacerbated the digital divide and made educational continuity difficult in many vulnerable sectors.

The situation in Mexico reflected a duality in the use of ICTs, where urban areas with greater technological infrastructure were able to quickly adapt to the distance education model, while rural and marginalized communities faced serious difficulties in accessing the necessary digital resources. Although the Mexican government launched programs such as "Learn at Home" to mitigate the consequences of school closures, limited access to devices and a quality connection prevented many students from taking advantage of these initiatives. The lack of teacher training in the use of digital platforms and the limited experience in handling technological tools by students were also significant barriers in this process.

In this context, the "Estado 30" primary school implemented a project to integrate computers in the fifth-grade classroom, seeking to offer students the opportunity to improve their technological skills and close the existing digital gap. This school, like many others in the country, faces great challenges related to technological infrastructure and access to quality educational resources, but nevertheless embarks on the implementation of this project as a way to adapt to new educational demands. The situation of this institution reflects the common difficulties in many marginalized rural and urban schools, where access to ICT and continuous teacher training are key factors to improve learning.

The use of technological devices such as computers, cell phones and tablets is presented as a viable solution to improve student performance and motivation. These tools not only facilitate access to information quickly and efficiently, but also allow the creation of a more dynamic and collaborative environment in the classroom. The integration of ICT offers new ways of teaching and learning, as demonstrated by studies that underline its impact on the development of digital skills and on improving students' creativity. However, this integration must be accompanied by an appropriate pedagogical approach that allows students not only to use technology, but also to understand how to apply these tools in a critical and reflective manner.

The aim of this research is to demonstrate how the implementation of technologies in the classroom, supported by collaborative work between teachers and managers, can transform the educational experience and motivate students, even in adverse conditions, contributing to more dynamic and accessible learning.

MATERIALS AND METHODS

The research was carried out at the "Estado 30" primary school, located in the new city center of La Paz. The intervention took place in the fifth-grade classroom, where a total of six computers were installed, five of which were placed inside the classroom and two of them with Internet access, allowing students to explore online applications to complement their activities. The purpose of this intervention was to promote the use of technologies within the educational environment, giving students the opportunity to become familiar with the use of digital tools and enhance their learning through interactive applications.

The technological equipment consisted of six desktop CPUs, with features suitable for school use, although non-state-of-the-art. The

computers were purchased by the school with support from management and locally available resources. The two computers with Internet access allowed online searches, access to additional educational resources and interactive activities through educational platforms. The other four computers, although functional, did not have Internet access, which limited the type of activities that could be carried out, although they were still used for activities in pre-installed educational programs, such as Paint and calculators.

The intervention method was action research, in which different pedagogical strategies were applied to evaluate the impact of technologies on student learning. The activities were designed to be interactive and encouraged student participation, both in the use of computers and in group collaboration. Teachers organized tasks that included the use of basic applications, such as the Paint program, where students made drawings related to the topics covered in class (animals, plants, historical figures, among others), and the use of the calculator to solve mathematical problems. Students also worked on writing projects and slide presentations using word processors.

For the development of this intervention, teachers received basic training on the use of technology in the classroom, which enabled them to guide students effectively. Regular training and feedback sessions were held for both teachers and students to ensure that the use of computers was appropriate and that their potential was being fully exploited.

Data collection methods included direct observation, student surveys, and teacher interviews. Observations were conducted during classroom sessions in which students were using computers, paying particular attention to their level of interaction with the devices, their motivation, and the development of technological skills.

Surveys were administered at the end of each cycle of activities, with the aim of measuring

student satisfaction and teacher perception of the impact of technology on learning.

This approach allowed for continuous evaluation and adjustment of activities to the needs of students, optimizing the use of technologies in the classroom, and allowed for obtaining relevant data on the benefits and limitations of using ICT in a school with limited resources.

This methodological approach was based on the theory of active learning, which recognizes that the use of technologies can encourage participation, improve understanding of content and develop skills that are essential in today's world, especially in the context of the pandemic, which forced many institutions to quickly adapt to new technological demands.

RESULTS

The results obtained in this study are presented in detail, according to the different methods applied in the research process. Analyses were carried out through three main approaches: direct observation in the classroom, surveys of students and interviews with teachers. Each of these methods provided specific data that, together, offer a comprehensive view of the impact of the educational strategies implemented in the teaching context. The results obtained from each of these methods are presented below.

First, analysis of direct observations revealed that most students responded positively to the implementation of interactive activities in the classroom. Greater participation and motivation were observed in classes that integrated technological tools, such as computers and audiovisual resources, which allowed students to develop more autonomous and reflective learning.

Students showed significant interest in activities that fostered collaboration and teamwork, demonstrating the potential of these

methodologies to strengthen social and cognitive skills. Furthermore, observations reflected an increase in students' concentration and quality of responses when teachers set high expectations, reaffirming the impact of the Pygmalion effect on their academic performance.

As for the surveys conducted with students, the results were equally positive. A high percentage of respondents (approximately 75%) stated that classes using technology improved their understanding of the content. In addition, students expressed greater interest in learning when classes included practical and visual elements that facilitated the understanding of complex concepts. The survey also indicated that most students positively valued the interaction with their peers and teachers through virtual platforms, although some pointed out the difficulty in accessing technology during the pandemic, which sometimes limited their participation in online activities.

On the other hand, the interviews conducted with teachers provided a deeper insight into the challenges and achievements during the educational process. Teachers mentioned that, despite initial difficulties, the integration of digital tools allowed for greater flexibility in the design of lessons and facilitated individualized attention to students. However, some teachers pointed out the need for further training in the use of educational technology, since some of the available resources were not optimally used, due to a lack of experience in their use. Despite these challenges, teachers stated that adaptation to new methodologies was carried out gradually, which allowed for improved teaching quality and connection with students, especially in the context of remote teaching.

In summary, the results obtained through the methods used in this research reflect that the use of interactive and technological strategies in the classroom, supported by high teacher expectations, contributes significantly to the academic development of students. However, areas for improvement were also identified, particularly in teacher training and equitable

access to technologies, which must be addressed to maximize the benefits of these strategies in the future.

The computer center at the "Estado 30" elementary school was installed with six computers in the classroom, two of which had Internet access. This infrastructure was possible thanks to the support and collaboration of the school management teams of the two shifts, as well as the efforts made by the parents, who obtained, through their contacts, antennas at reduced prices to ensure the connection to the network. The implementation of this technology in the classroom provided the opportunity for students to access digital tools that favored their learning and the exploration of new ways of interacting with educational content.

Throughout the school year, various projects and activities were designed with the aim of making the use of computers meaningful for students, particularly in the musical and artistic fields. Activities included visits to museums, science fairs and research centers such as the Northwest Biological Research Center, as well as the screening of documentaries and educational films at the cinema. These experiences were complemented by the use of computers to research the topics covered and delve deeper into the content from a digital perspective.

The origin of this initiative dates back to the author's participation in a training course in Mexico City, where the "Enciclomedia" program was presented and its benefits for student learning were discussed. In addition, the "School in the Cloud" project, implemented in India in the late 1990s, which promotes autonomous learning through the use of technologies, was discussed in depth.

School context

The school is located in the new city center of La Paz, in an area close to shopping malls, government institutions, and sports facilities. However, many of the students come from homes with limited resources, and it is common

for children to be brought to the school by their grandparents or by mothers who work at home. In this context, the pandemic and the closure of schools exposed the difficult social and economic conditions of these families, many of whom only had access to the Internet through cell phones, limiting their ability to complete assigned tasks. Despite having Wi-Fi or mobile data at home, the devices were generally used by parents or older siblings, which affected the active participation of children in the educational process.

Family structure also contributed to diversity in the classroom, as some students lived with their grandparents, others with one of their parents, and still others in foster homes. This situation generated a great diversity of family contexts and, therefore, a variety of realities in terms of the availability of resources and support for learning.

The situation of the students reflected that, although technological devices were scarce, the work submitted by the children showed the intervention of other family members, who assumed the role of facilitators in the learning process.

At the technical council meetings, many teachers pointed out the lack of commitment of some students to online classes, as well as the poor delivery of work, which was attributed to the lack of adequate means and conditions at home. In response to these difficulties, the need arose to find solutions and strategies that would allow students to resume their learning effectively. In this sense, it was proposed to manage the available resources more efficiently, seeking to provide the necessary conditions for students to be able to work and achieve the expected learning outcomes.

Challenges for learning recovery

The effects of the pandemic on education were profound and lasted throughout the two years that students were out of the classroom. Although many teachers made efforts to stay in

touch with students through social media, virtual platforms, and other digital tools, it was observed that more than 50% of students showed significant delays in the learning expected for their grade. This was due to the lack of access to adequate tools and limited intervention by family members, who, in some cases, helped children complete their homework, but without a deep understanding of the content.

Despite the efforts and willingness of 80% of students, who maintained communication throughout this period, the return to in-person classes revealed a significant deficit in their knowledge, which led to the implementation of remedial plans to address the most priority content. This challenge was aggravated by the diversity in family structures and household limitations, which affected equity in access to educational resources.

Using computers in the classroom

Despite the difficulties, the use of computers in the classroom proved to be a key tool in facilitating learning. Students used computers for a variety of purposes, such as word processors to create presentations and slides, solving problems with the built-in calculator, and organizing their activities using calendars. In addition, the Paint program was used to make drawings on various content, such as the solar system, animals, and storybook characters, which contributed to making learning more attractive and visual.

The implementation of the educational proposal, based on minimally invasive teaching, was also integrated into the classroom, fostering a self-organized learning environment. Students, guided by the teacher, conducted online searches on topics such as the solar system and its natural satellite, viewing related videos and documentaries. This methodology allowed students to take an active role in their learning, researching and collaborating to share their findings and broaden their understanding of the world around them.

The use of computers in the classroom was a valuable strategy to promote learning during the pandemic, but it also faced significant limitations related to access to technological resources in students' homes.

Despite the challenges, a more dynamic and collaborative learning environment was created, which motivated students to interact with technology and become more actively involved in their education. This process has not only been an opportunity to improve the use of technological tools, but also to reflect on the need to adapt pedagogical strategies to the realities and needs of students in diverse contexts.

DISCUSSION

The role of the teacher in contemporary education goes beyond the simple transmission of knowledge. Teachers not only know the context in which their educational activities take place, but they also become agents of change within their community. This transformation is not limited to academic content, but extends to the teacher's ability to involve students and their families in an active and collaborative learning process.

The educator's social and ethical commitment is reflected in the constant interaction with the community, in which parents and students respond energetically to the teacher's effort and dedication. This mutual commitment creates an environment in which significant progress in student learning is evident, especially when teachers succeed in cultivating students' intrinsic motivation.

This phenomenon is closely related to the Pygmalion effect, a concept developed by Rosenthal and Jacobson (1968), which maintains that teachers' expectations regarding their students' performance can directly influence their performance.

The research conducted by these authors showed how teachers' beliefs, both explicit and implicit, have a significant impact on students' academic success, especially when these expectations are high. In this way, the teacher acts not only as a transmitter of knowledge, but as a catalyst for students' potential, allowing them to reach levels of performance that might otherwise have been beyond their reach.

The constant and detailed diagnosis of the conditions in which students find themselves is another crucial aspect that allows teachers to adapt their pedagogical strategies to the reality of each group. This constant evaluation allows them to identify the areas that require immediate intervention, as well as the resources and methods that best fit the needs of the students.

According to Bourdieu (1990), the cultural and social capital that a teacher can generate through his or her work, as well as his or her ability to understand and transform the educational context, are fundamental to promoting significant change in student learning. From this base, teachers design projects that benefit not only the school group, but also the community in general, thus contributing to comprehensive educational development.

The impact of the COVID-19 pandemic represented an unprecedented challenge for teachers, who had to quickly adapt to new ways of teaching and communicating, using digital technologies and virtual platforms.

This forced change in educational methodology brought with it both obstacles and opportunities. Despite the difficulties, teachers demonstrated a deep commitment to maintaining educational continuity. The need for collaborative work and the willingness to innovate became the pillars of teaching during this period.

This process allowed us to recognize fundamental aspects of education, such as the importance of interaction and emotional support for students, elements that were vital in a

context of global uncertainty. In this sense, the smiles of children and the work with those most in need acquired a renewed value, reflecting a change in the priorities of education, towards a more humane, inclusive and sustainable one.

The return to classrooms after lockdown brought with it a series of learning-related challenges, which not only affected students, but also teachers themselves. Many students experienced delays in their learning, resulting from the prolonged interruption of their studies. However, efforts to maintain communication during the pandemic, although limited in some cases, were essential to mitigate the effects of this disruption. Despite technological barriers and social difficulties, more than 50% of students showed willingness and effort, which allowed a remedial plan to be implemented after returning to face-to-face classes to address the priority content of each grade.

The experience during the pandemic also highlighted the need to transform traditional teaching and the way in which educational resources are used. Carretero *et al.* (2024) highlight that around 60% of students have access to a computer in a school computer lab, while 8% do not have this access at their educational center; this reinforces that, although the transition to virtual teaching was abrupt, it also opened the door to a renewal of pedagogy, in which digital technologies play a fundamental role. Teachers, in many cases, were forced to learn new tools in order to teach classes, which entailed additional effort. However, this continuous learning process for educators also represents an opportunity to improve educational practices in the long term.

The use of computers in the classroom, for example, became an essential resource for teaching various subjects. In the classroom, teachers used these tools to facilitate the creation of presentations, interactive exercises, and visual explorations of complex concepts, such as the solar system or the anatomy of living beings.

Sugata Mitra's (2021) proposal, known as the School in the Cloud, is based on the premise that children can learn autonomously when given access to technology and encouraged to be curious. This proposal was implemented in the classroom, and students, having access to computers, were able to research and create, not only following the teacher's instructions, but also driven by their own desire to learn.

Finally, the implementation of these strategies has allowed children to find multiple ways to use computers to reinforce their knowledge in different areas. However, it has been identified that the success of this approach depends on the correct integration of resources, materials and activities, as well as the teacher's ability to coordinate these elements effectively.

According to Mitra's proposal (2021), the teacher should act as a facilitator who stimulates learning through curiosity, promoting more active and participatory teaching. In this sense, teachers have found that the use of digital tools, combined with traditional methods such as teamwork and the use of complementary bibliography, can significantly enrich the educational process.

Below are the articles on computer centers in primary education classrooms, in APA 7 format, with a brief summary and discussion for each one.

The implementation of computer centers in primary education classrooms has been a topic of growing interest in recent years. These centers not only facilitate digital inclusion, but also improve students' technological skills and academic performance (Parra *et al.* 2022; Torres, 2021).

For example, Ruiz *et al.* (2024) highlight the effectiveness of laboratories as an accessible solution for schools with limited resources. This approach not only reduces the digital divide, but also promotes a more efficient and sustainable use of technological resources. It also supports the application of block programming workshops

in order to incorporate the basic skills of computational thinking (Enriquez *et al.*, 2021; García, 2024).

Candia (2021) and Enríquez *et al.* (2021) highlight the importance of incorporating educational technology in classrooms, pointing out that the integration of computer tools can transform the learning experience and foster greater student engagement with educational content. Fraga *et al.* (2024) add that the design of appropriate work environments, which include advanced technologies, can support the development of digital skills from an early age.

Teacher training is another crucial aspect pointed out by Torres Quintero (2021). Adequate teacher training is essential to maximize the positive impact of computer centers in the classroom. Medina *et al.* (2022) also advocate for a sustainable approach, arguing that sustainability in technology education is not only necessary for the environment, but it prepares students to be responsible with technology in the future.

Candia's (2021) studies highlight that computing centers not only improve technological skills, they can also have a significant impact on bridging the digital divide, especially in disadvantaged communities. Furthermore, Torres (2021) highlights the role of these centers in promoting educational equity, ensuring that all students have access to the technological tools necessary for their academic development.

Finally, Mejía *et al.* (2024) show how the use of devices can be an innovative and economical solution to equip classrooms with computer technology, providing a solid foundation for digital learning, in which science, research and scientific dissemination in primary school children are more inclusive.

At the "Estado 30" primary school, the use of computers began with the installation of five CPUs in the fifth-grade classroom, which generated great expectations and motivation in the students, who were eager to participate in

technological activities. The teachers, aware of the importance of this tool, designed activities that not only involved the use of the mouse and keyboard, but also promoted creativity and the development of cognitive skills. Through programs such as Paint, students were able to make drawings related to class content, which favored their learning while developing motor skills; in addition, they also used applications, such as the calculator, to solve mathematical problems, which allowed them to practice basic operations such as addition, subtraction, multiplication and division.

The project of integrating technologies in the classroom reflects an attempt to improve student learning by adapting to the needs of the context. However, the underlying problem is how to make the use of technologies effective in an environment with limited resources and with students who, for the most part, lack prior experience in using computers. Therefore, the objective of this research is to demonstrate how the implementation of technologies in the classroom, supported by collaborative work between teachers and administrators, can transform the educational experience and motivate students, even in adverse conditions, contributing to a more dynamic and accessible learning.

This effort at technological and pedagogical adaptation, in the context of current challenges and the aftermath of the pandemic, raises key questions about how to ensure that all students, regardless of their location or socioeconomic status, have equal opportunities to benefit from advances in the use of ICTs in education. The project to integrate technologies in the classroom reflects an attempt to improve student learning by adapting to the needs of the context. However, the underlying problem is how to make the use of technologies effective in an environment with limited resources and with students who, for the most part, lack prior experience in the use of computers.

In short, the implementation of computer centers in primary education classrooms not only

promotes digital inclusion and improves academic performance, but also prepares students for a future where technology will play a central role. The combination of sustainable strategies, adequate teacher training and the design of technological learning environments are key to the success of these initiatives.

In this new millennium, there are labor, economic, assistance and cultural conditions that are responsible for taking advantage of the use of technology in all its areas; therefore, it is essential that education moves towards these new scenarios, where the use of cell phones, computers, electronic tablets and other devices allow enriching the work carried out by teachers through projects and strategies, dynamics that use these resources to generate student learning.

It is necessary to recognize the diversity of students who attend schools every day, where the conditions and barriers to learning they face are a challenge for teachers, principals and educational authorities, who are committed to offering and serving each of the children and adolescents who attend schools every day to receive excellent education.

Today, consolidating the computer center within the classroom is a small but significant achievement, which leads us to continue looking for ways to innovate and develop creativity in each student, through the use of content, platforms and applications, both on the Internet and on computers, which facilitate student learning.

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Conflict of interests:

The authors declare not to have any interest conflicts.

Authors' contribution:

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.

Cite as

Arce Peralta, F. J., Avilés Lucero, H., Valdez Ceseña, M. D., Corral Trigueros, J. E. (2024). Computer center in a primary education classroom. *Mendive. Journal on Education*, 22(4), e3854. <https://mendive.upr.edu.cu/index.php/MendiveUPR/article/view/3854>



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