

**Impact of digital technologies on the educational inclusion of students
with disabilities**

***Impacto de las tecnologías digitales en la inclusión educativa de estudiantes
con discapacidad***

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ABSTRACT

This research analyzed the impact of inclusive digital technologies on the educational inclusion of university students belonging to different careers of a Bolivian university. The study was developed under a quantitative approach, with a pre-test and post-test pre-experimental design applied to a sample of 180 university students. The purpose of the research was to evaluate the variations produced in digital accessibility, academic participation, teacher-student interaction, autonomy in learning and technological satisfaction after an intervention based on inclusive digital tools. A structured questionnaire with a Likert-type scale validated by expert judgment and with a high reliability determined by Cronbach's Alpha ($\alpha = 0.91$) was used for data collection. The technological intervention included accessible virtual platforms, adapted digital materials, collaborative tools and technological resources aimed at strengthening educational inclusion processes. The results showed significant increases in all the dimensions evaluated during the post-test, highlighting improvements in digital accessibility and technological satisfaction. Statistical analyses using Student's t-test for related samples confirmed statistically significant differences between the pretest and the posttest ($p < 0.05$). It is concluded that inclusive digital technologies contribute positively to the strengthening of more accessible, participatory, and equitable university environments for students with disabilities within the Bolivian higher education context.

Keywords: inclusive education, digital technologies, educational accessibility, university students, disability.

RESUMEN

La presente investigación analizó el impacto de las tecnologías digitales inclusivas en la inclusión educativa de estudiantes universitarios pertenecientes a diferentes carreras de una universidad boliviana. El estudio se desarrolló bajo un enfoque cuantitativo, con diseño preexperimental de tipo pretest y posttest aplicado a una muestra de 180 estudiantes universitarios. La investigación tuvo como propósito evaluar las variaciones producidas en accesibilidad digital, participación académica, interacción docente-estudiante, autonomía en el aprendizaje y satisfacción tecnológica después de una intervención basada en herramientas digitales inclusivas. Para la recolección de datos se utilizó un cuestionario estructurado con escala tipo Likert validado mediante juicio de expertos y con una confiabilidad alta determinada mediante Alfa de Cronbach ($\alpha = 0,91$). La intervención tecnológica incluyó plataformas virtuales accesibles, materiales digitales adaptados, herramientas colaborativas y recursos tecnológicos orientados a fortalecer procesos de inclusión educativa. Los resultados evidenciaron incrementos significativos en todas las dimensiones evaluadas durante el posttest, destacándose mejoras en accesibilidad digital y satisfacción tecnológica. Los análisis estadísticos mediante la prueba t de Student para muestras relacionadas confirmaron diferencias estadísticamente significativas entre el pretest y el posttest ($p < 0,05$). Se concluye que las tecnologías digitales inclusivas contribuyen positivamente al fortalecimiento de entornos universitarios más accesibles, participativos y equitativos para estudiantes con discapacidad dentro del contexto de educación superior boliviano.

Palabras clave: educación inclusiva, tecnologías digitales, accesibilidad educativa, estudiantes universitarios, discapacidad.



1. INTRODUCTION

Educational inclusion is one of the main challenges of higher education institutions due to the need to guarantee equal opportunities, accessibility, and academic participation for students with disabilities. Inclusive education Padilla-Muñoz (2011) argues that educational inclusion implies eliminating pedagogical, social, and structural barriers that limit the effective participation of students within learning environments. From this perspective, universities have begun to incorporate digital technologies aimed at strengthening processes of accessibility and academic permanence.

The advancement of information and communication technologies has transformed traditional teaching models through virtual platforms, multimedia resources and digital tools adapted to different educational needs. Various studies show that ICTs favor more participatory and accessible educational experiences in inclusive contexts (Reyes Chávez & Prado Rodríguez, 2020). In relation to this, Romero Martínez et al. (2018) consider that inclusive technological tools allow content and teaching methodologies to be adapted according to the characteristics of students with disabilities.

In the university context, digital technologies have acquired relevance due to their ability to strengthen academic autonomy, communication, and access to educational resources. Cabezas Cerna et al. (2025) point out that accessible technological tools promote the active participation of university students with functional diversity through adaptive platforms and inclusive digital resources. These strategies contribute to reducing barriers related to access to information and academic interaction processes (Cepeda Navarrete et al., 2023).

Inclusive digital technologies have also favored the development of cognitive and communication skills in students with intellectual disabilities. Laabidi et al. (2014) highlight that learning technologies for people with disabilities represent a fundamental element to expand educational opportunities and strengthen academic inclusion. These tools facilitate more adaptive and accessible teaching processes within university environments (Cubillos-Bravo & Avello-Sáez, 2022).

The development of assistive technologies has generated new possibilities to strengthen educational inclusion within universities. López and Valenzuela (2015) argue that special educational needs require adaptive strategies aimed at guaranteeing participation and



equitable access within educational processes. In recent years, the growth of emerging technologies and systems based on artificial intelligence has expanded educational accessibility alternatives (Kooli & Chakraoui, 2025).

From another perspective, Pérez Saavedra and Tornero Roballo (2025) consider that emerging technologies represent an innovative alternative to strengthen inclusive educational processes through adaptive digital tools. These technological innovations make it possible to respond more efficiently to different educational needs present within the university context (Rajapakshe et al., 2026).

Digital accessibility is currently one of the most relevant components of inclusive university education. Zúñiga Bolívar and Hincapié Gallón (2021) showed that there are still physical and structural barriers that limit the effective inclusion of students with disabilities within university institutions. These limitations affect access to virtual platforms, educational materials, and academic interaction processes (Montiel Arreaga & Falquez Torres, 2024).

Various studies have shown that the integration of digital technologies favors processes of academic participation and inclusion. Valenzuela et al. (2020) highlight that digital technologies strengthen educational integration and participation of students belonging to vulnerable groups within university contexts. The use of accessible platforms and inclusive digital tools allows for more participatory and equitable educational environments (Laitón Zárate et al., 2017).

The strengthening of teachers' digital competencies represents another important factor for the development of inclusive practices mediated by digital technologies. López Cabrera et al. (2019) consider that the adoption of educational technologies depends significantly on teacher training processes, pedagogical innovation, and institutional support. From a social and educational perspective, inclusion requires understanding dimensions related to participation, equity, and recognition of diversity within university spaces (Iarskaia-Smirnova et al., 2024).

In Bolivia, universities face challenges related to technological accessibility, curricular adaptation, and attention to students with disabilities within increasingly digitized educational contexts. The need to strengthen inclusion processes through accessible technological tools has generated interest in developing research aimed at measuring the impact of digital technologies on university students belonging to different careers.



In this context, the present research aimed to analyze the impact of an intervention based on inclusive digital technologies through a pre-test and post-test design applied to 180 university students from a Bolivian university.

2. METHODOLOGY

This research was developed under a quantitative approach because it allowed measuring and comparing the impact of inclusive digital technologies on the educational inclusion of university students with disabilities through the statistical analysis of the data obtained during the research process. The study was oriented towards the collection of objective information related to accessibility, academic participation, educational interaction and perception of inclusion before and after the application of a technological intervention.

The type of research was applied, since it sought to generate knowledge aimed at solving problems related to educational inclusion within the university context through the use of inclusive technological tools. Likewise, a descriptive and comparative scope was developed because the characteristics of the phenomenon studied were analyzed and then the results obtained between the pre-test and the post-test applied to the participants were compared.

The research design corresponded to a pre-experimental study with pre-test and post-test measurement in a single group. This design made it possible to evaluate the changes produced after the technological intervention applied to university students belonging to different careers of a university in Bolivia. Initially, a pre-test was applied to diagnose the level of educational inclusion perceived by the students before the intervention. Subsequently, a process of implementation of inclusive digital technologies was developed and finally a post-test was applied in order to identify variations in the dimensions analyzed.

The population was made up of university students belonging to different academic careers of a Bolivian university. The sample was made up of 180 students selected through a non-probabilistic convenience sampling, considering criteria related to availability, voluntary participation and access to technological tools used during the research. The participants presented different academic characteristics and conditions related to educational accessibility and use of digital resources within the university environment.

The inclusion criteria were students officially enrolled in the university during the corresponding academic period, students who agreed to voluntarily participate in the



research, and students with regular access to institutional digital platforms and resources. Participants who did not complete the technological intervention activities or who submitted incomplete questionnaires during any of the phases of the study were excluded.

The technique used for data collection was the survey. A structured questionnaire with a Likert-type scale of five response options was used as an instrument: never, almost never, sometimes, almost always and always. The instrument was made up of 25 items distributed in five dimensions: digital accessibility, academic participation, teacher-student interaction, autonomy in learning and satisfaction with the use of inclusive digital technologies.

The digital accessibility dimension evaluated aspects related to ease of access to virtual platforms, adapted materials and accessible technological resources. The dimension of academic participation analyzed the level of student involvement in educational activities mediated by digital technologies. The teacher-student interaction allowed to value the communication and academic accompaniment during the educational process. Autonomy in learning assessed students' ability to develop academic activities using digital tools. Finally, the dimension of technological satisfaction examined the perception of usefulness and effectiveness of the inclusive technologies implemented.

The instrument was subjected to a validation process through expert judgment made up of specialists in inclusive education, educational technology and research methodology. The observations made made it possible to improve the clarity, relevance and coherence of the items established within the questionnaire. Subsequently, a pilot test was developed with university students who were not part of the final sample, in order to verify understanding, application time and internal consistency of the instrument.

The reliability of the questionnaire was determined using Cronbach's alpha coefficient, obtaining a value considered adequate to guarantee stability and internal consistency in the answers obtained. This procedure ensured the statistical reliability of the instrument applied during the pre-test and post-test phases.

The technological intervention lasted eight weeks and consisted of the implementation of inclusive digital tools aimed at strengthening the processes of accessibility and academic participation of students. During this period, accessible virtual platforms, adapted multimedia materials, digital readers, automatic subtitles, collaborative tools and technological resources



designed to promote interaction and inclusive learning within the university environment were used.

Data collection was carried out in two moments. In the first phase, the pre-test was applied before starting the technological intervention to identify the initial level of educational inclusion perceived by the participants. In the second phase, the post-test was applied at the end of the intervention in order to compare the results and determine the variations produced after the implementation of inclusive digital tools. The Statistical Package for the Social Sciences (SPSS) version 26 was used to process the information. Descriptive statistical procedures were applied using frequencies, percentages, means and standard deviations to analyze the behavior of the variables studied.

The research respected the ethical principles related to confidentiality, anonymity and voluntary participation of students. All participants were informed about the objectives of the study and agreed to collaborate through informed consent. The data collected were used only for academic and scientific purposes, ensuring the protection of the participants' personal information throughout the research process.

3. RESULTS

The results obtained allowed to identify significant differences in the dimensions related to educational inclusion after the implementation of inclusive digital technologies in university students of different careers. The comparison between the pre-test and the post-test showed improvements in digital accessibility, academic participation, teacher-student interaction, autonomy in learning and technological satisfaction.

Before the final application of the instrument, a reliability analysis was carried out using Cronbach's alpha coefficient in order to verify the internal consistency of the questionnaire used in the research. The statistical analysis yielded the following result: $\alpha = 0.91$

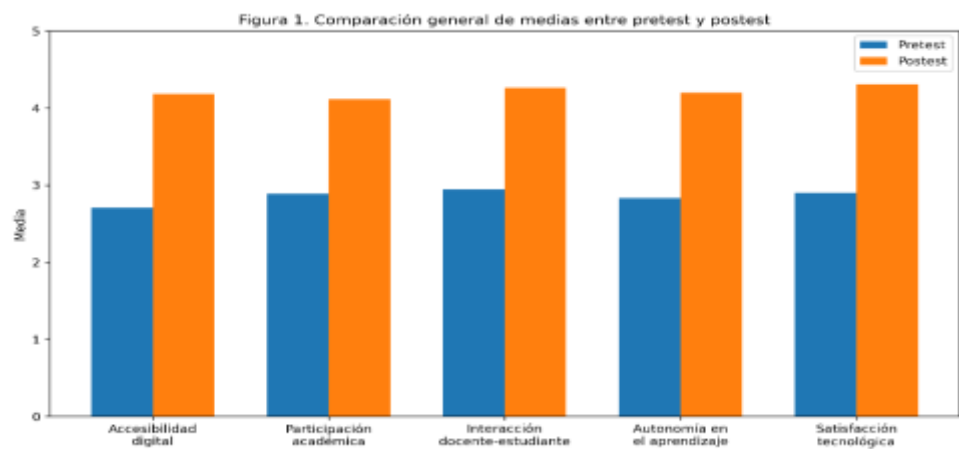
The value obtained evidenced a high reliability of the instrument, indicating adequate coherence between the items that made up the dimensions evaluated. This result made it possible to guarantee stability and precision in the measurement of the variables related to educational inclusion and inclusive digital technologies applied to the participating university students.

General comparison between pre-test and post-test



Descriptive analyses showed increases in all dimensions evaluated after the technological intervention. Digital accessibility presented an average of 2.71 in the pre-test and 4.18 in the post-test. Academic participation went from 2.89 to 4.11, while teacher-student interaction increased from 2.95 to 4.26. Likewise, autonomy in learning increased from 2.83 to 4.20 and technological satisfaction reached a final average of 4.31 compared to 2.90 initially obtained. Figure 1 presents the general comparison of means obtained before and after the intervention based on inclusive digital technologies.

Figure 1.
General comparison of means between pre-test and post-test



Note. The figure represents the differences obtained in the dimensions evaluated. Own elaboration.

The interpretation of the results showed a significant increase in all the dimensions analyzed. The greatest changes were registered in technological satisfaction and digital accessibility, which shows that the implementation of inclusive digital tools favored access to educational resources, virtual platforms and academic activities adapted to the needs of the participating students.

Increased results after technological intervention

The comparative analysis allowed us to identify that all dimensions showed positive increases after the implementation of inclusive digital technologies. Digital accessibility obtained an increase of 1.47 points, while technological satisfaction presented an increase of 1.41 points. Autonomy in learning increased by 1.37 points and teacher-student interaction

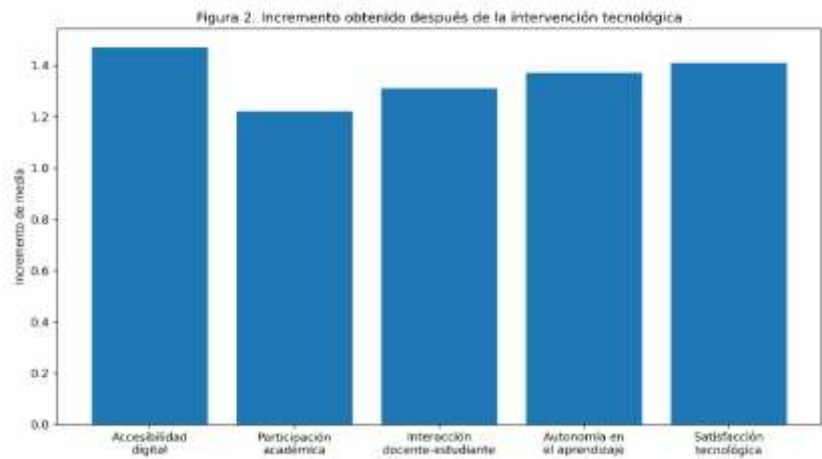


registered a growth of 1.31 points. Finally, academic participation showed a positive difference of 1.22 points between the pre-test and the post-test.

Figure 2 shows the increase obtained in each dimension evaluated after the technological intervention.

Figure 2.

Increase obtained after the technological intervention



Note. Pre-test and post-test in the dimensions related to educational inclusion and inclusive digital technologies. Own elaboration.

The interpretation of the figure made it possible to identify that inclusive digital technologies generated relevant improvements in accessibility and student satisfaction, evidencing that the tools implemented strengthened the conditions of learning and academic participation within the university environment. Similarly, the improvements observed in teacher-student interaction and academic autonomy reflect a greater integration of students during the development of educational activities mediated by digital technologies.

Comparative trend of results

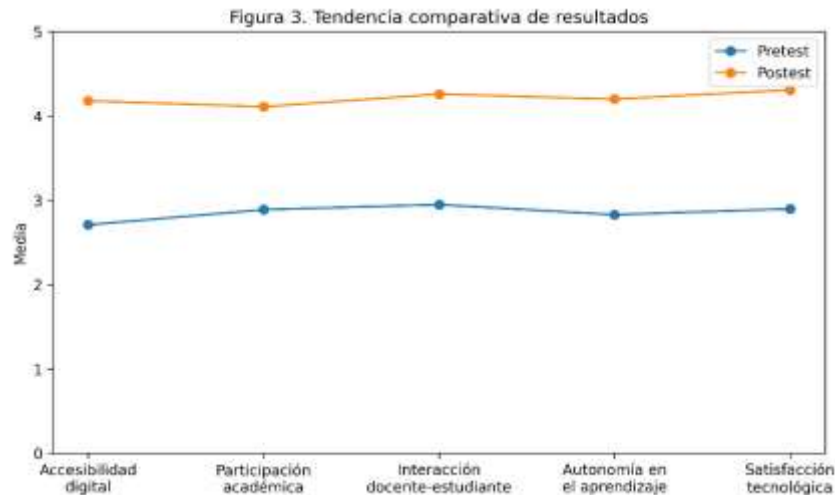
The general results showed an upward trend in all the dimensions evaluated after the application of the technological intervention. Students manifested higher levels of academic participation, educational interaction, and autonomy in learning through the use of accessible platforms, adapted materials, and inclusive digital tools implemented during the study.

Figure 3 shows the comparative trend of the results obtained in the pre-test and post-test.

Figure 3.

Comparative trend of results between pre-test and post-test.





Note. Behavior of the dimensions evaluated before and after the implementation of inclusive digital technologies in university students. Own elaboration.

The general interpretation showed that all dimensions showed a positive evolution after the technological intervention. The upward trend observed in the averages shows that inclusive digital tools contributed significantly to the strengthening of accessibility processes, academic communication, student participation and technological satisfaction within the university context evaluated.

Finally, the statistical analyses carried out using Student's t-test for related samples showed statistically significant differences between the scores obtained in the pre-test and the post-test in all the dimensions analyzed ($p < 0.05$). These results allowed us to conclude that the intervention based on inclusive digital technologies produced positive effects on the educational inclusion of the participating university students.

4. DISCUSSION

The results obtained in this research showed that the implementation of inclusive digital technologies produced significant improvements in digital accessibility, academic participation, teacher-student interaction, autonomy in learning and technological satisfaction in university students belonging to different careers. The variations identified between the pre-test and the post-test reflect the positive impact of the digital tools implemented during the intervention.

The findings related to digital accessibility coincide with those proposed by Educational Technology Puentes Orozco et al. (2026), who argue that technological



accessibility is an essential component to guarantee equal opportunities within education. The results of this study showed that accessible platforms and adapted materials favored more inclusive educational conditions for participating students (Rizk & Hillier, 2022).

The positive perception related to technological satisfaction coincides with what was stated by Romero Figuera (2024), who argues that ICT and inclusive communication represent fundamental elements to strengthen more accessible and participatory university educational models. The satisfaction shown by the students after the intervention reflects favorable acceptance of the digital resources implemented during the research process (Reeves-Huapaya et al., 2025).

The results related to academic autonomy showed that inclusive digital technologies strengthened independent learning capacities in university students. Zambrano Sánchez et al. (2026) consider that digital technologies represent relevant tools to improve accessibility and inclusive learning processes. These improvements also coincide with research aimed at the analysis of inclusive educational technologies within different educational levels (Ranzato et al., 2025).

The results obtained allowed us to recognize challenges related to technological implementation and institutional sustainability. Murillo-Jiménez et al. (2025) identified barriers related to insufficient infrastructure, institutional limitations, and poor technological integration within inclusive education. During the development of the research, the need to continue strengthening technological resources and teacher training to consolidate permanent inclusive processes within the university context was evidenced (Maia Ferreira et al., 2015). The improvements observed in academic participation and educational interaction are related to Tiwari et al. (2015), who state that teachers' perceptions and beliefs directly influence the implementation of inclusive practices within educational institutions. The results obtained showed that academic accompaniment and the use of accessible digital platforms favored more effective educational communication processes in university students with disabilities. The findings of this research demonstrated that inclusive digital technologies represent an effective alternative to strengthen educational inclusion, academic accessibility, and student participation within the Bolivian university context. The improvements recorded after the intervention show that the implementation of adapted technological tools can contribute



significantly to the development of more accessible, participatory, and equitable educational environments for students with disabilities.

5. CONCLUSIONS

The present research showed that the implementation of inclusive digital technologies produced positive effects on the educational inclusion processes of university students belonging to different careers of a Bolivian university. The results obtained by comparing pre-test and post-test demonstrated significant improvements in digital accessibility, academic participation, teacher-student interaction, autonomy in learning and technological satisfaction after the applied intervention.

The findings reflected that inclusive digital tools facilitated access to virtual platforms, adapted educational materials and accessible technological resources, contributing to the strengthening of more equitable academic conditions for participating students. The increase observed in the dimension of digital accessibility showed that the incorporation of adapted technologies made it possible to reduce difficulties related to virtual browsing, access to content and participation within the university environment.

The research also showed that inclusive digital technologies favored academic participation and educational interaction between students and teachers. The improvements registered in communication, collaboration and academic accompaniment showed that the accessible virtual platforms and technological tools implemented strengthened the processes of student integration within the activities developed during the intervention.

Another relevant aspect identified during the study was the strengthening of autonomy in learning and the technological satisfaction of the participants. Students manifested greater levels of independence to develop academic activities through inclusive digital resources, reflecting a positive perception regarding the usefulness and functionality of technologies applied within the university context.

The results obtained allowed us to recognize that inclusive digital technologies represent an effective strategy to promote educational inclusion in university students with disabilities. However, the research also evidenced the need to continue strengthening processes related to teacher training, institutional accessibility, and technological infrastructure to ensure the sustainability of inclusive practices within higher education.



The application of inclusive digital tools contributed to the development of more participatory, accessible and equitable educational environments, demonstrating that the integration of adapted technologies can significantly favor teaching and learning processes in university contexts. These findings provide relevant evidence on the potential of digital technologies to strengthen educational inclusion within the Bolivian and Latin American context.

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