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Integration of technological resources in virtual teaching: Impact and challenges during COVID-19

Integración de los recursos tecnológicos en la enseñanza virtual: Impacto y desafíos durante COVID-19

RESEARCH ARTICLE

ABSTRACT

The COVID-19 pandemic promoted the integration of technological resources in virtual teaching, generating opportunities and challenges for education. The present research aims to determine to what extent teachers integrate technological resources in the virtual teaching-learning process during the COVID-19 pandemic, in educational district 08, Dominican Republic. A quantitative approach was used, with a cross-sectional design. The population under study consisted of 120 secondary school teachers; a sample of 40 teachers was selected from the population for convenience. The main results highlight that WhatsApp was the most used tool by teachers, with 95%. 95% consider that technology increases motivation in learning. It is concluded that the use of ICT in teaching is widespread among teachers, regardless of personal and professional characteristics, with WhatsApp being the most used tool during the pandemic.

Keywords: Integration of ICT, virtual education, teachers, technological resources, COVID-19 pandemic.

RESUMEN

La pandemia de COVID-19 impulsó la integración de recursos tecnológicos en la enseñanza virtual, generando oportunidades y desafíos para la educación. La presente investigación tiene como objetivo determinar en qué medida los docentes integran los recursos tecnológicos en el proceso de enseñanza-aprendizaje virtual durante la pandemia de COVID-19, en el distrito educativo 08, Dominicana. Se trabajó un enfoque cuantitativo, con un diseño corte transversal. La población objeto de estudio estuvo conformada por 120 docentes del nivel secundario, se seleccionó una muestra de 40 maestros de la población por conveniencia. Los principales resultados destacan que el WhatsApp fue la herramienta más utilizada por los docentes, con un 95%. El 95% considera que la tecnología aumenta la motivación en el aprendizaje. Se concluye que el uso de TIC en la docencia es generalizado entre docentes, independientemente de características personales y profesionales, siendo el WhatsApp la herramienta más utilizada durante la pandemia.

Palabras clave: Integración de las TIC, educación virtual, docentes, recursos tecnológicos, pandemia del COVID-19.

INTRODUCTION

In recent decades, education has undergone a significant transformation driven by the advancement of Information and Communication Technologies (ICTs). Virtual teaching, in particular, has gained unprecedented momentum, especially in the wake of the COVID-19 pandemic, which forced educational institutions around the world to rapidly migrate to online learning modalities. In this context, the effective integration of technological resources has become a key factor in ensuring the quality and effectiveness of virtual teaching in university settings (Barientos et al. 2022).

According to Johanna (2020), COVID-19 created serious problems in the educational system, forcing institutions to quickly adapt to an emerging pedagogical model to carry out teaching virtually. The Dominican Republic was no exception, having to face the urgent need to close educational centers and suspend face-to-face classes, which led to significant changes in the curricular plans and programs established by the Ministry of Education of the Dominican Republic (MINERD). These changes highlight the importance of an effective transition to digital education.

In this regard, Carneiro et al. (2021), state that the incorporation of ICTs in education has opened up great possibilities to improve teaching and learning processes. However, equipping schools with computers is not enough on its own; it is necessary to simultaneously address changes in school organization and in the digital skills of teachers. This involves, for example, training teachers in the effective use of technological tools and adapting curricula to integrate ICTs in a meaningful way. In addition, the authors reflect on the role played by ICTs and deepen the debate on their educational meaning, as well as fostering a digital culture that benefits the entire educational community.

TICSE 2.0 (2012) highlights that ICTs have a significant impact on student motivation in the classroom, which makes it necessary to implement new pedagogical methods. Teacher training is essential to effectively integrate ICTs into educational practices; therefore, training based on both theoretical and practical skills is required. This training will not only facilitate the effective use of technologies, but will also allow teachers to adapt to the changing needs of the contemporary educational environment, thus promoting more dynamic and relevant learning.

According to Sierra et al. (2016), teachers in Colombia consider ICTs to be essential for the continuous improvement of pedagogical processes, as they facilitate a broader development of knowledge. They also emphasize the need for an adequate ICT training plan for teachers. They also highlight that educational innovation through ICTs is a key factor in increasing the levels of development and competitiveness in the educational field.

In this sense, Mercedes and Bennasar (2020) describe an experience in the educational environment of the Dominican Republic, highlighting the importance of implementing pedagogical strategies based on ICT in various areas of knowledge and in educational institutions of all levels and modalities. Therefore, they recommend planning and implementing training courses on the use of ICT as tools to improve school activities. Similarly, the authors

state that both teachers and students have a wide range of possibilities to take advantage of these technologies in their teaching-learning process.

Therefore, educational institutions must develop concrete actions to promote the effective integration of technological resources in teaching practice. This involves implementing technological mediations that ensure the continuity of teaching-learning processes, especially in situations of health emergency. In addition, it is essential that these actions include ongoing training for teachers, as well as the evaluation and selection of digital tools that adapt to the specific needs of students and the educational context.

Taking into account the above mentioned, the purpose of this article is to determine to what extent teachers integrate technological resources into the virtual teaching-learning process during the COVID-19 pandemic, in educational district 08, in the Dominican Republic.

METHOD

The research was developed under a quantitative approach, with a cross-sectional design. The study was carried out in a single time period, where variables of interest were studied, through the application of a survey. The cross-sectional research design usually includes individuals with and without the condition at a given time (simultaneous measurement) and in this type of design; the researcher does not carry out any type of intervention (interference).

The population under study was 120 secondary school teachers, corresponding to Educational District 08-08. A sample of 40 teachers was selected from the population for convenience, equivalent to 30% of teachers who teach in Secondary Education. These teachers teach in 11 educational centers of the aforementioned District, the most represented being Milagros Celeste Arias (20%), Liceo Seminario San Pio X (20%), Escuela Flor del Campo (15%) and Centro Educativo Nelo Marte (8%).

Furthermore, 73% of the teachers were women, two thirds (63%) were between 25 and 40 years old and the rest were over 40. Almost half had a Bachelor's degree (45%) and 48% had a Master's degree. Two thirds (63%) had less than 10 years of service and the remaining 37% had more than 10 years.

The technique applied for the research was the survey and for its application a questionnaire of 23 questions was developed as an instrument which dealt with the integration of ICT in virtual teaching. It was built ad hoc for this study and contained 23 questions, of which 10 were multiple choices. The instrument was applied online, through the forms tool.

The instruments of this research were subjected to expert judgment by qualified and recognized experts with recognized research careers in this subject, with the necessary experience and knowledge to provide information on the validity of the instrument through assessments using a scale, where the relationship between the constructs, objectives, variables and research indicators was verified.

SPSS software, version 23, was used to process the information. Specifically, the following procedures were used:

Cross-tab analysis: The variables were analyzed using the cross-tab procedure, which allows examining the relationship between two or more categorical variables.

Chi-square test: Additionally, the Chi-square test was applied to determine if there is a statistically significant association between the variables analyzed.

Analysis of multiple choice questions: For questions with multiple choice options, the corresponding procedure was used within the SPSS software, which allows the analysis of this type of variables.

RESULTS

Table 1 presents the results of the Chi-square tests for each variable (sex, age, academic level, and years of service). The Chi-square values, degrees of freedom and p- value allow the evaluation of the statistical significance of the differences observed between the groups.

Table 1.

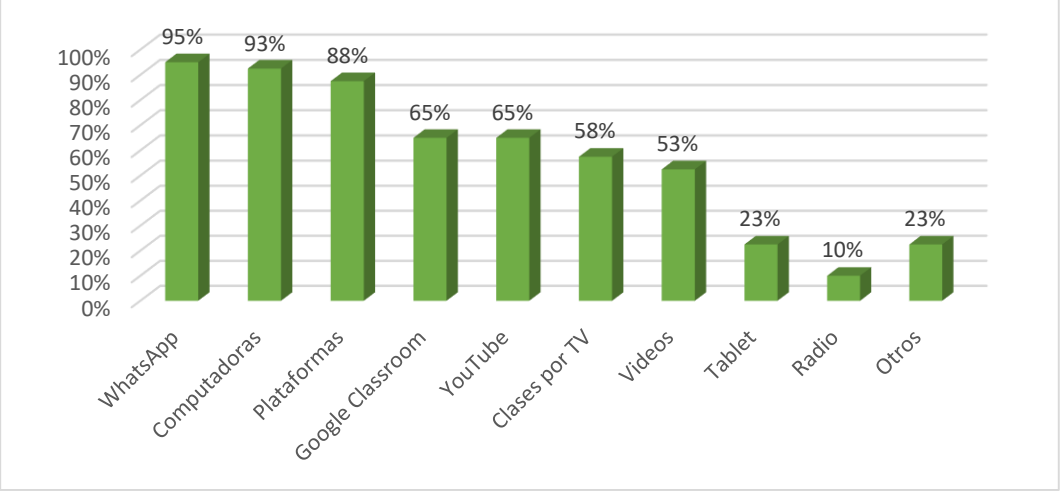
Chi-square test results by sociodemographic characteristics.

Variable	Chi-square	Degrees of Freedom	p -value
Sex	1.892	6	0.929
Age	2.308	6	0.889
Academic Level	1.296	6	0.972
Years of Service	1.512	6	0.959

Regarding the analysis of the technological resources most used by teachers during the Covid-19 pandemic in virtual teaching, it was revealed that the most used tool was WhatsApp, with 95%. This was followed in order of frequency by computers, with 93%, and digital platforms, with 88%. On the other hand, the least used resources were the radio, with only 10%, and tablets, with 23%. The results are presented in Figure 1.

Figure 1.

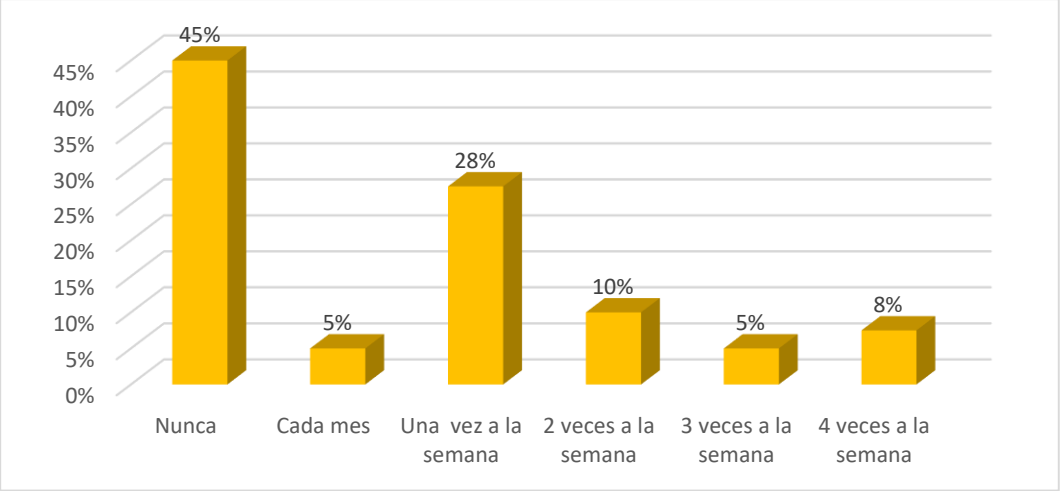
Technological resources most used by teachers during the Covid-19 pandemic.



As it can be seen in Figure 2, the vast majority of teachers (45%) have never received training in courses related to the use of technology in teaching. The second group (28%) reported that they received training once a week, followed by 10% who received it twice a week. 5% reported other less common frequencies. The results show that the current frequency of technological training for teachers is low, which shows the need to strengthen and expand these continuing education opportunities to improve the integration of ICTs in teaching-learning processes.

Figure. 2.

Frequency of technological training for teachers.



Regarding the participants' criteria on the use of ICT, it is clear that teachers make very frequent use of ICT in their academic work, with 83% using them always and 15% using them almost always. These findings highlight the importance that technology has acquired in teaching-learning processes.

As it can be seen in Table 2, none of the characteristics analyzed show significant differences in the use of ICT by teachers. All p values are greater than 0.05, confirming that sex, age, academic level and years of service do not significantly influence the frequency of technology use in teaching. The results reveal that the use of ICT by teachers is a widespread practice, regardless of their personal and professional characteristics.

Table 2.

Differences in the use of ICT according to teacher characteristics.

Feature	Chi-square value (χ2)	p value	Significant Difference
Sex	0.005	0.944	No
Age	0.104	0.747	No
Academic Level	0.016	0.899	No
Years of Service	0.72	0.396	No

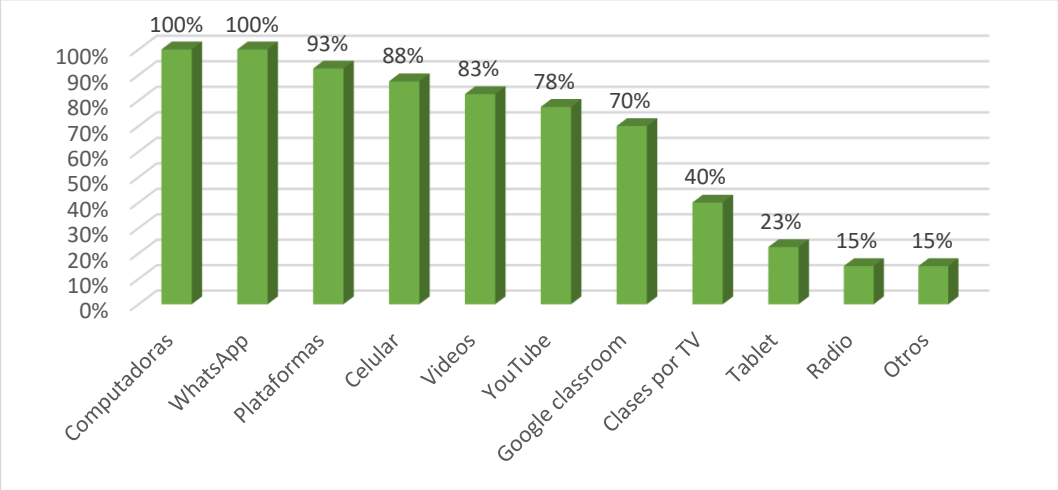
Regarding the mastery of technological resources by teachers, it can be seen that 43% said that their mastery was Excellent, while 33% said it was Good and 25% said it was Very Good. As it can be seen, almost half, equivalent to 43%, said they had mastery of technological

resources. The results show that the majority of teachers consider that they have a good command of technological resources, which is a favorable aspect to promote the integration of ICT in teaching-learning processes. However, the need to continue working on the development of digital skills in teachers is also evident.

Regarding the participants' appreciation of the use of various technological resources, it can be observed in Figure 3 that the evaluations were very high. All subjects claim to have used computers and WhatsApp, with 93% of digital platforms and, in third place, 88% of cell phones. The least used resources were the Radio (15%), Tablets (23%) and TV classes (40%), according to the teachers' responses. In addition, it was observed that teachers have greater command of technological resources, with WhatsApp standing out with 93%, followed by digital platforms and, in third place, 88% of cell phones.

Figure 3.

Use of technological resources by participants.



Regarding technological resources, it can be seen in Figure 4 that 98% of participants indicated that they used these resources to search for information. In addition, 95% said they used technological resources for educational games, 78% revealed that they used them to check emails. Meanwhile, 63% used technological resources to carry out tasks. It is evident that the results support that the most common activities were searching for information and using educational games, followed by checking emails and carrying out tasks.

Figure 4.

Educational use of technological resources.

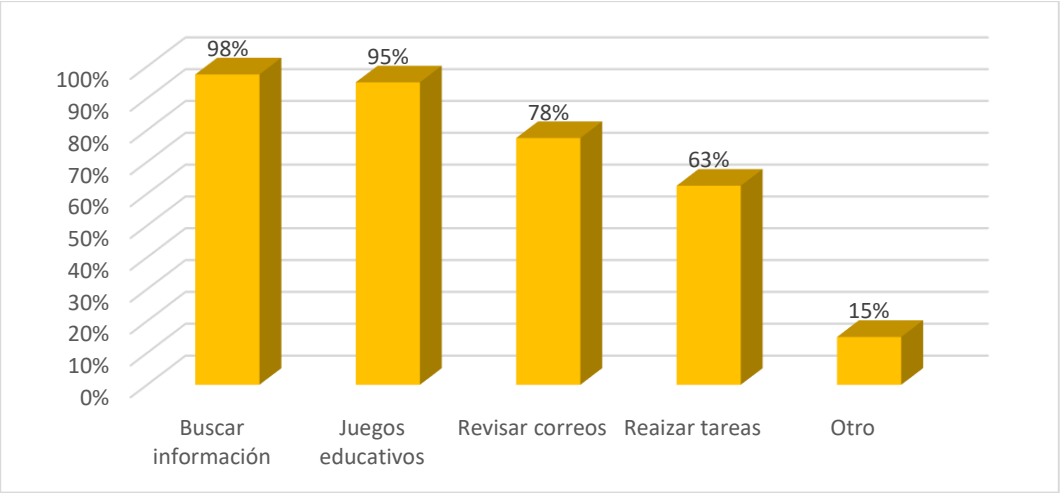
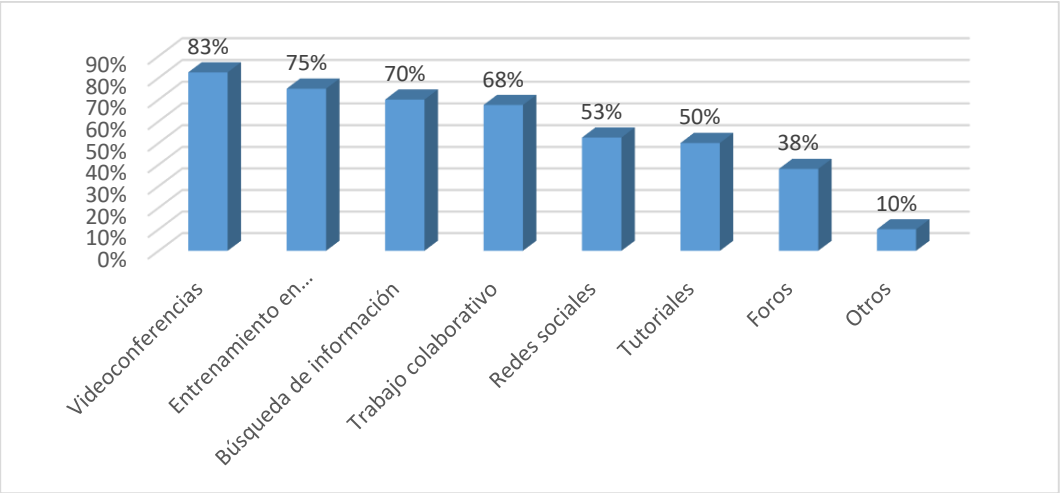


Figure 5 shows the activities carried out through technological resources. 83% of respondents voted for videoconferences, 75% for training on platforms (75%), while 70% voted for searching for information. For 38%, it was forums and tutorials (50%).

Figure 5.

Activities carried out with technological resources.



The analyses carried out show that the academic level of the participants is a relevant factor in the use of technological resources. For the Chi-square tests, the categories "Sometimes" and "Almost always" were unified due to expected frequencies lower than 5. There were no significant differences by sex, age or years of service, but there were between academic levels (undergraduate and graduate), with $\chi 2$ (1) = 5.507, p = .019. Figure 6 shows that participants with a graduate degree had more mentions in the "Always" category. These findings reveal that the academic level is a relevant factor in the use of technological resources.

Figure 6.

Use of technological resources by academic level.

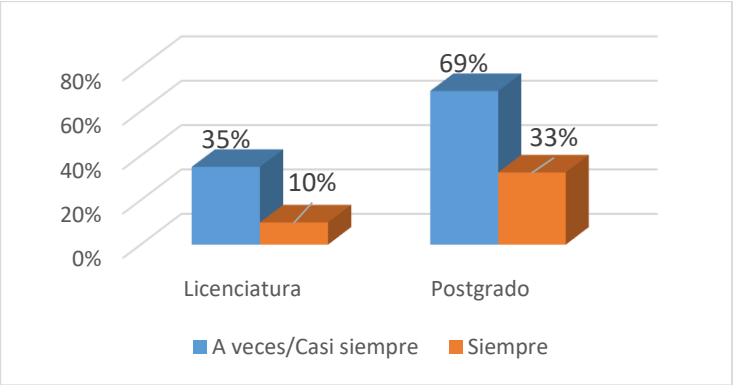
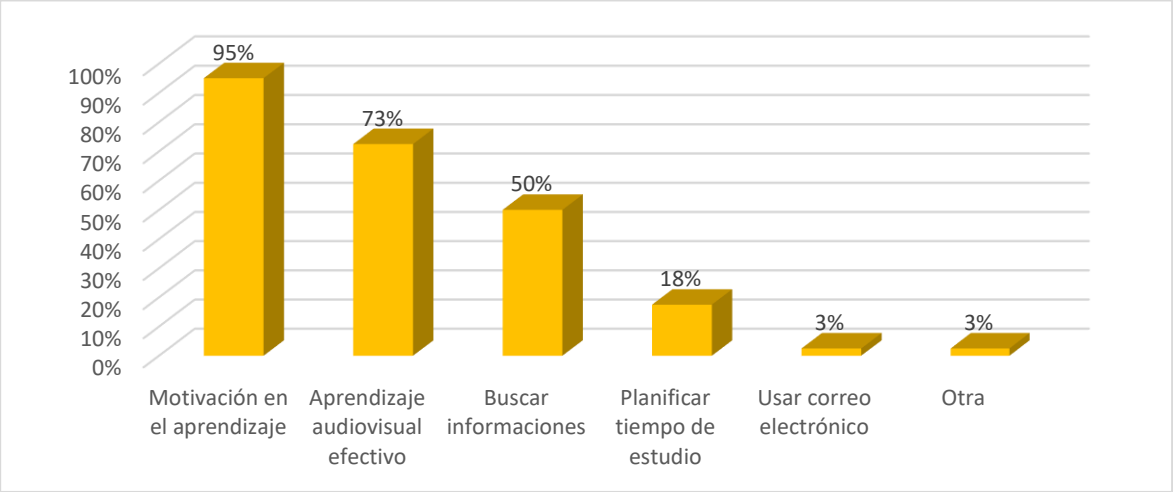


Figure 7 shows the various benefits of using technological resources by participants. The main benefit mentioned was "motivation in learning" with 95%, while 73% of the subjects voted for effective audiovisual learning. Meanwhile, 50% voted for information searching. These results indicate that participants consider that the use of technological resources has a positive impact on motivation and learning, as well as facilitating the search for information.

Figure 7.

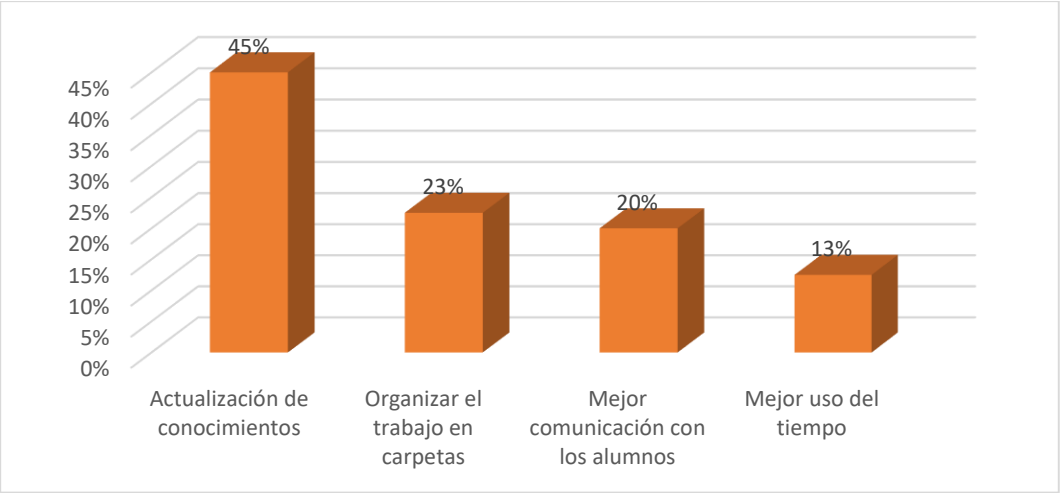
Main benefits of using technological resources.



Regarding the incorporation of ICT into academic activities, Figure 8 shows that it was perceived by participants as a valuable tool. The most prominent response category, with 45%, was "Updating knowledge", while 23% voted for the category "Organizing work in folders", and 20% of the subjects favored the category "Better communication with students". These outcomes support the importance of promoting the effective use of technologies in the educational field.

Figure 8.

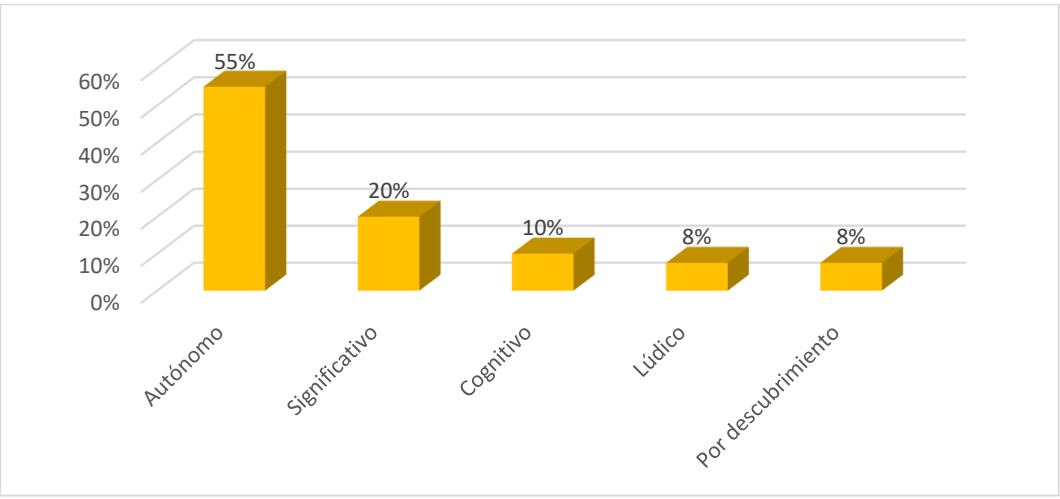
Incorporation of ICT in academic activities.



As for the types of learning that participants consider that ICT can provide the following results stand out: autonomous learning with 55%, 20% corresponds to meaningful learning, while cognitive learning was supported by 10% of the interviewed people. And in the case of playful learning, eight percent (8%), as in discovery learning with eight percent (8%) too. The results show that autonomous learning is valued by teachers. In addition, they consider that ICT can foster a greater capacity to manage their own learning process in students, which is a key aspect for the development of skills and competencies in the digital age, see figure 9.

Figure 9.

Teachers' perceptions of the types of learning provided by ICT.



Regarding the participants' criteria on the benefits of integrating ICTs in the teaching-learning process, the results highlight that 60% reveal that they are favorable, 35% affirm that they are favorable, while 3% affirm that they are unfavorable and 2% acknowledge that they are very unfavorable. The outcomes reveal the positive attitude of teachers as a key factor in advancing the integration of ICTs in teaching.

DISCUSSION

Sociodemographic factors significantly influence preferences for learning methodologies in virtual education. There is an agreement with Rodríguez et al. (2018), in their research they highlight that the socioeconomic stratum is an interesting but complex challenge, since it involves considering multiple variables beyond those traditionally studied, such as the students' environment. In this sense, Díaz-Barriga (2013) emphasizes that virtual education transforms teaching by allowing self-directed and flexible learning. Infante et al. (2020), point out that experiential learning, mediated by technological resources, enriches students' interaction with content in virtual environments. Understanding these factors is essential to design effective methodologies in virtual education.

This experience is in line with Rodríguez et al. (2023), who mention an educational experience in the COVID-19 stage. In their results, they highlight that teachers positively evaluated the use of the WhatsApp instant messaging application. They also state that this technological tool has the potential to favorably influence the improvement of the dynamism of distance teaching-learning processes.

For their part, González and Guerrero (2021) mention an educational experience in Cuba, where they underline the need to implement various teaching strategies to ensure the continuity of the training process through digital platforms and technologies, in response to the health emergency caused by COVID-19. The authors highlight the use of WhatsApp as an effective teaching resource, which has proven to be a valuable instrument to promote collaborative learning and the development of skills, which favors interaction between students and teachers in a virtual environment. They also highlight that the use of these teaching alternatives allowed the training process to continue.

According to the study by Ticona (2018), it exposes a significant relationship between the use of technological resources and teachers work performance. Teachers consider that the integration of technological tools is beneficial to carry out academic activities effectively.

According to the study by Ticona (2018), it discloses a significant relationship between the use of technological resources and teachers work performance. Teachers consider that the integration of technological tools is beneficial to carry out academic activities effectively. In addition, it is important to highlight that the implementation of ICT in the educational field not only depends on the availability of devices, but also on the adequate teachers training in their use.

There is coincidence with Guanilo et al. (2022), who indicate that there is a significantly positive relationship between the use of ICT and the teachers' job performance in a Peruvian university. In addition, the descriptive analysis reveals that 50% of teachers reach an efficient level in the use of ICT, while 70.5% do so in their job performance. On the other hand, it is stated that good use of ICT, which includes all the tools involved, contributes to improving teachers' job performance.

According to Suarez et al. (2022), the integration of ICT in the educational field requires that teachers develop new skills and competencies to effectively use these tools in their teaching practice. This integration goes beyond the simple technical management of technological

resources, since it demands that teachers incorporate the tools in a meaningful way and aligned with their teaching methods.

According to Quizhpilema and Moscoso (2022), they mention an exhaustive study regarding online activities and resources implemented by teachers during the COVID-19 pandemic. The authors highlight the use of platforms such as Google Meet and Zoom, which became key tools for virtual teaching. In addition, they state that the use of WhatsApp was also effective in sharing educational resources, allowing teachers to stay in touch with their students and facilitate access to learning materials.

Regarding teacher training in the use of ICT in teaching, Gutiérrez et al. (2023) highlight the importance of training teachers in the use of ICT in the current educational context. The increasing digitalization and the need to adapt teaching to an ever-changing technological environment require educators to be well prepared to use these tools effectively. The study mentions that many teachers lack experience in the use of ICT, which underlines the need to establish a comprehensive model of academic exchanges. This approach allows teachers to carry out good practices, based on the principles of info-pedagogy, promoting a more effective learning environment.

The author of this article coincides with García et al. (2023), who report having achieved good results in teacher training. Their findings showed that teachers are highly prepared in the use of technologies, frequently incorporating them into their teaching activities and in the evaluation of their subjects; but they need to continue strengthening their digital skills. In this sense, Díaz et al. (2022) mention an experience of teacher training in the use of technological tools, such as emails and virtual platforms, carried out during the COVID-19 stage. They highlight that academic skills showed a notable change, suggesting that technologies are not only sources of knowledge, but allow teachers to develop new skills and generate processes of change in the educational context.

The outcomes of this study coincide with those of Cabanilla et al. (2020), who underline the crucial importance of digital competence in teachers. These authors highlight that as knowledge about digital tools expands, in areas such as information management, content selection and creation, and communication, digital competence is strengthened. In fact, digital competence has been incorporated as an essential component of teaching competence at all educational levels.

On the other hand, Sáez (2022) mentions a study in the area of Social Sciences in Argentina, where he states that teachers use the media instrumentally and deploy strategies that combine technical solutions. In this sense, these strategies focus on developing skills to search for and select information from reliable sources, while proposing long-term solutions that encourage a reflective view. This indicates that, in addition to training, it is essential to develop a critical capacity that allows teachers to effectively integrate technology into their educational practice.

Acosta et al. (2022) describe an experience in an educational institution in Ecuador. According to their findings, 85% of participants considered the gamification elements to be

easy to use. The authors also highlight that the strategies implemented during virtual classes facilitated the understanding of all the content established in the syllabus.

The author agrees with Barrera (2020), whose findings indicate a notable increase in the use of videoconferencing as a result of the COVID-19 pandemic. He also points out that teachers were forced to train in various areas, adapting tools and developing teaching materials to optimize teaching at all educational levels. This experience has been mostly positive, although weaknesses have been identified in the technological equipment of teachers and students.

Vázquez et al. (2021) refer to an experience in virtual teaching through videoconferencing during the COVID-19 era, in the health sector. They claim that it effectively replaced face-to-face classes, and also mention having achieved good interaction between participants. In this sense, Reynoso (2020) states that videoconferencing is an effective educational tool in higher education, especially in Health Sciences, which overcomes geographical barriers and encourages synchronous interaction.

Teachers' academic level is a crucial factor that deserves attention in the analysis of the use of technological resources in the educational field. As the level of educators training increases, a tendency towards greater integration of technologies in their teaching practices is observed. This study coincides with Zempoalteca et al. (2018), stating that as the level of training increases, a greater integration of ICTs in teaching practices is observed. They also point out that academic training influences pedagogical competence and the effective incorporation of technological tools in teaching-learning.

Regarding the main benefits of using technological resources, Cevallos et al. (2020) state that the use of technology facilitates teaching work, promoting constant communication between educational actors. The implementation of ICT, both inside and outside the classroom, is essential for students and acts as a motivating tool. Rodríguez et al. (2023), state that digital tools, when used as high-level motivational techniques, can generate greater enjoyment of learning and a sense of reward for the contributions made by students; therefore, their use can be essential to improve motivation and the educational experience.

In line with this research, a study carried out by de Gómez et al. (2024) highlights audiovisual learning, stating that it is a valuable tool for students, as it offers them complementary material adapted to their learning difficulties. They also highlight that it allows them to prepare the subject with greater autonomy and increase their chances of success.

Similarly, in the same way of audiovisual learning, Giannakos et al. (2016) argue that video-based learning has great potential when applied in a pedagogically appropriate manner and specifically designed to facilitate teaching and learning. It is also essential to analyze the impact of video on the overall student experience, since the way in which smart learning is integrated can significantly improve the didactic potential of video systems.

According to Christer and Acevedo (2016), these authors also show evidence of good results regarding knowledge management in the educational context. They highlight that this is achieved through the training of teachers so that they can create, capture, share and apply their

knowledge effectively. This allows them to improve their pedagogical practice, make informed decisions and adapt to the changing needs of students and the educational system in general.

Regarding autonomous learning and teacher assessment, the findings of Peinado (2020) are consistent with those of teachers in their study of distance learning. Condori et al. (2023) also present significant results in relation to autonomous learning. One of the most notable discoveries was the identification of a large number of investigations focused on strategies that use ICT. They also highlight the use of technological means, which favor the development of autonomous learning.

Regarding the benefits of integrating ICTs in the teaching-learning process, Ferrio et al. (2009) highlight that one of the main advantages of using ICTs is the possibility of carrying out complementary activities and accessing a wide variety of educational resources. This allows teachers to have reference and support materials, thus enriching the teaching-learning process in accordance with the planned methodological systems. On the other hand, the authors point out that ICTs facilitate interaction with information, becoming useful tools to support learning.

Cedeño and Zambrano (2023) share a similar criterion when stating that the incorporation of ICTs in educational practice provides a wide range of benefits, evidenced by the solid relationship between the use of these technologies and the teaching-learning process. In their findings, they suggest that integrating ICTs transversally into the curricular content of subjects is an essential educational need, since it facilitates the comprehensive development of students, improves teaching performance and raises the quality of education. In short, the integration of ICTs is presented as a key element to transform and enrich the educational process as a whole.

CONCLUSIONS

The study develops Ureña allowed us to show that the use of technology in teaching is a widespread practice among teachers, with no significant differences based on characteristics such as sex, age, academic level or years of service. During the COVID-19 pandemic, the most used tools were WhatsApp, computers and digital platforms, while the least used resources were the radio and tablets. These findings highlight the ICT growing relevance in the teaching-learning processes.

It was confirmed that despite the widespread use of ICT in teaching, a low frequency of technological training was identified among teachers, with 45% of teachers without training in this area, while the majority of participants considered themselves to have a good command of technological resources. In addition, it was observed that teachers with postgraduate studies use technological resources more frequently compared to those with undergraduate training.

The study identifies several benefits of using technological resources, highlighting motivation in learning, effective audiovisual learning and facilitating information searches. The incorporation of ICTs in academic activities is valued positively, especially for their contribution to updating knowledge and improving communication with students. In particular, autonomous learning emerges as a key benefit.

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