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# Educational technology and academic performance in students of public educational institutions during confinement by COVID-19

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**SUMMARY**

**Introduction:** *The articulation between education and technologies is of great relevance to the changes in society. At the global level, various nations and their educational systems converge towards a cutting-edge technological proposal, so that technology is coupled in a pedagogical role within the teaching and learning process.* **Objective:** *Relate the use of educational technologies with an academic performance before and during confinement by COVID-19 in the subject of mathematics in elementary school students in the Colombian Caribbean Region.* **Methods:** *The sample consisted of 80 students, to whom the educational technologies questionnaire used during confinement was applied and the information on academic performance was provided by the registration and control office. The data analysis was carried out by applying descriptive statistics, the data before and during confinement was analyzed applying Student's T-test, and to establish the relationships between the variables, use of educational technologies, and academic performance, the Pearson correlation analysis was performed.* **Results:** *A moderate positive significant correlation was found between the assessment that the participants assign to technology and academic performance during confinement.* **Conclusions:** *Moderate and slight negative statistically significant correlations were found between student academic performance and the hours of use, as well as the tools for learning mathematics.*

**Key words:** *Educational technologies, academic performance, lockdown, COVID-19, students.*

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**RESUMEN**

**Introducción:** *La articulación entre educación y tecnologías es de gran relevancia para los cambios en la sociedad. A nivel global, diversas naciones y sus sistemas educativos convergen hacia una propuesta tecnológica de vanguardia, de modo que la tecnología se acople en un rol pedagógico dentro del proceso de enseñanza y aprendizaje.* **Objetivo:** *Relacionar el uso de tecnologías educativas con un desempeño académico antes y durante el confinamiento por COVID-19 en la asignatura de Matemática en estudiantes de primaria de la Región Caribe Colombiana.* **Métodos:** *La muestra estuvo conformada por 80 estudiantes, a quienes se les aplicó el cuestionario de tecnologías*

*educativas utilizado durante el confinamiento y la información sobre desempeño académico fue proporcionada por la oficina de registro y control. El análisis de los datos se realizó aplicando estadística descriptiva, los datos antes y durante el confinamiento se analizaron aplicando la prueba t de Student, y para establecer las relaciones entre las variables, uso de tecnologías educativas y rendimiento académico, se realizó el análisis de correlación de Pearson.* **Resultados:** *Se encontró una correlación positiva significativa moderada entre la evaluación que los participantes asignan a la tecnología y el desempeño académico durante el confinamiento.* **Conclusiones:** *Se encontraron correlaciones estadísticamente significativas negativas moderadas y leves entre el rendimiento académico de los estudiantes y las horas de uso, así como las herramientas para el aprendizaje de las matemáticas.*

**Palabras clave:** *Tecnologías educativas, desempeño académico, cierre de emergencia, COVID-19, estudiantes.*

## INTRODUCTION

Education has been subject to great changes in human society, which have led it to require a rethinking of methodological and strategic issues; this is how academic performance has been the object of analysis by various studies, in which educational technology is one of the main variables analyzed in this context.

When talking about technology as an educational strategy, it is important to review its incidence in the adolescent population, where technology-based hobbies are recurring and can be interpreted as an adverse aspect of the learning process. Carried out a study, the objective of which was to find out the impact of technologies on the academic performance of adolescents, which would allow judgments to be made about the different myths of technologies as classroom distractors. Using the HEGECO Instrument as a data collector, they found that nine out of ten students between the ages of 12 and 18 searched the Internet, viewed and / or shared audio and video files, consulted on wikis, and used instant messaging applications. The authors infer that the implementation of technology to mediate educational action favors academic performance (1).

Studied the impact of digital resources and the development of competence: analysis and synthesis, to identify educational action on these reading comprehension skills, and determine positive and negative aspects within them (2). Tools such as ED puzzle, Kahoot, and Educaplay, with which the authors managed to apply activities where, through a satisfaction survey validated by the UEM quality unit, they found greater satisfaction with the learning and teachers employed in the experimental group. Furthermore, indicating that the use of interactive online materials intervened favorably in the analysis and synthesis competences, bearing in mind that the study was carried out on an experimental group with the same initial level in said competences, finally showing an increase in this competence in the students, with respect to the initial level.

These results are verified statistically as shown by the research carried out by the authors (3) in which the role of ICT in academic performance was examined under an application with structural models, where through a statistical model determined the positive effects of ICT on performance, here the instrument that allowed the analysis of the data obtained was the structural equation model (SEM), through which they managed to conclude that there was a direct relationship between the use of ICT in the classroom and academic performance, in which there was an indirect effect that was not statistically significant, as is the case of the variable use of ICT outside the classroom. According to the estimator's test, the indirect effect - on academic performance - that this variable exerts through its incidence on teachers' performance is null (3).

On the other hand, (4) studied the perception that students have about the use of technological tools in their academic training process and how these affect academic performance. The results show that students with high and normal academic performance took ICT as a tool to improve and organize their academic process, plan tasks, carry out teamwork, and looking for support information. In conclusion, the authors establish that the positive perception of ICT in the learning process of students is related to obtaining excellent grades, the variable of which must be taken into account in all research of this type.

Investigated with high school students participating in digital programs, the objective of which was to study the effectiveness of digital programs with academic performance (5). The authors used online questionnaires developed in Google Drive to collect information, resulting in improvements in student academic performance through the implementation of digital programs; On the other hand, it was evident that the programs are an effective teaching tool. The study also allowed identifying the benefits and limitations that the use of digital classrooms brings in the teaching and learning process, mainly considering a better disposition of the students, favoring collaborative work, a greater understanding of the subjects, increased attention to student, and dynamism in-class activities.

For his part, studied the effects of the use of teaching strategies and educational resources mediated by information and communication technologies, selected through the diagnostic evaluation of the apprentice, on academic performance and motivation, this research It was carried out in Colombian contexts, and the participants were apprentices of the technologist's program of the CTPI center of the National Learning Service SENA, Regional Cauca, they used a quasi-experimental design, the findings indicate that approximately half of the participants have digital equipment in their homes and 60 % have an intelligent mobile device, and the vast majority of students use these tools for queries, navigation, and topics of interest; As a final result, improved performance was found in the Blended Learning modality, motivation of the experimental group, mainly because educational resources and various forms of audiovisual and multimedia content were developed (6).

In their study on academic performance and the use of information technologies in university students of the Faculty of Health Sciences (7), chose to divide the group of students belonging to the It shows, in two, applying google tools in one, and not in the other; also using as a data collection instrument the software statistical package for the social sciences (SPSS) in its version 22.0; When analyzing the results, they found that when comparing the scores of the two groups, the hypothesis was confirmed since the higher performance was observed in the group that used Google's virtual technological tools; Thus, the authors concluded that the use of ICT in the teaching of Medical Sciences promotes high academic performance in students. There are various works focused on the use of technologies at the service of education, some of them are those carried out by (1,2,8-12), works in which the variables related to the application of technology devices at the service of learning, the use of different strategies to enhance academic skills, the interaction with learning and the mechanisms of use of the teacher in front of the development of the classes; this diversification has allowed many adolescents to discover new forms of appropriation of knowledge, interaction with the environment, and approach to technology, making appropriate use of it.

Likewise, investigated the effects of an educational program based on the use of ICT on academic performance and student motivation in the subject of secondary education technology (13). After using a quasi-experimental method, pretest-posttest design with a control group, through questionnaires, it was concluded that initial university training could be significantly improved through a very practical subject, for example:

"A new Master of Secondary Education, in which students will be taught to create multimedia teaching materials for use with ICT in the classroom. This would bring ICT closer to future teachers, who would no longer see them as alien to their work and full of complexity. Their specific uses were analyzed in the field and the advantages that they imply in the performance and motivation of the students would be seen, which could contribute to the improvement of the current and future educational system" (13).

Continuing with the aspects that influence academic performance versus educational technology, it is necessary to mention the research work of (14), who in their study on ICT as tools in the teaching-learning process to optimize performance academic; they analyzed the behavior and reactions of teachers regarding technology and why some do not implement ICT. In this case, questionnaires aimed at both teachers and students were implemented, thus resulting in 77 % of teachers considering that ICT can fulfill a pedagogical function under good direction and planning, indicating that they agree that this help

to improve the classroom environment, with more interactivity, preventing the student from getting tired easily. The authors conclude that teacher training is necessary for the different educational centers, regarding new learning models, so as not to fall into the stagnation of education; these tools strengthen the teaching-learning process and help improve the professional level of the students.

Establishes that several factors are related to the academic performance of the adolescent in school performance, school activities, and the development of their learning (15). They have conducted focused research on the use of technologies and their application in education, and in general describe that the use and impact of information and communication technologies (ICT) allow achieving a cultural acceleration in the spaces in which the subject interacts, allowing improving the processes establishing a quality and equity (16-19).

The study carried out by (20), in which they verified the increase in the academic performance of the students through the implementation of information and communication technologies; efficacy was found in the use of a blog in science education; For data collection, they used to pretest and posttest and a questionnaire to inquire about the usefulness of the blog. The analysis of the results showed little significant differences in both groups for the results of the pretest, and on the contrary, it showed very significant differences for the posttest study, thus indicating the results that the experimental group that had worked on the blog presented higher scores in the posttest than the control group.

Developed a risk identification posture in the use of education-based technologies (7,21-22), describes the impact of ICT in education, recognizing the value of devices that are appropriate in the classroom, achieving positive results in school performance, learning, and adaptation (23). Are some of the authors who in their research describe how the use of mobile phones and applications can be used in favor of academic performance, achieving development of skills in reading, mathematics, social and more basic sciences, physical activity through the implementation of ICT in teaching (13,24-29). Strategies that are confirmed by (5-6,30-32) finding that the academic performance of participating high school students in the use of virtual classrooms is favored.

It is important to mention that, although the majority of the investigations register positive results of the implementation of educational technology compared to academic performance, it is of utmost importance to analyze the variables used in each investigation, since in the educational field it is still necessary to consolidate many aspects related to whit the implementation of technology in education, especially in teaching and training methods for this type of teaching, since the students are mostly digital natives and the teaching function must maintain its guiding and facilitating profile.

The above shows the possibilities offered by using educational technologies in the teaching and learning process and how these tools have become the first option to continue with the educational processes remotely and virtually in the teaching and learning process in the different educational levels due to the COVID-19 pandemic.

It should be noted that, for the Colombian case, the student population that is enrolled in Public Educational Institutions are mostly from strata 1 and 2 and reside in vulnerable sectors and others in dispersed rural areas (33), which that makes it difficult for them to have technological equipment and connectivity to receive classes remotely or virtually and represents the main barrier to access to this study option that has been proposed during the pandemic to prevent the spread of the coronavirus.

## METHOD

A correlational quantitative approach was used because it aims to examine or show the relationship between variable or variable results. Salkind (1998 as cited in Bernal, 2010) states that one of the important points regarding correlational research is to examine relationships between variables or their results, but at no time does he explain that one is the cause of the other. In other words, the correlation examines associations, but not causal relationships, where a change in one factor directly influences a change in another.

**Participants**

The project activities were carried out with students from the fifth grade of the Andrés Escobar Escobar Educational Institution (IEANEE), distributed as follows 5A with 30 students, 5B with 30 students, and 5C with 40 students, for a total of 100 students, of which 60 % of students are female and 40 % male, aged between 9 and 12 years. The total sample selected was 80 fifth grade students.

The selection of sampling oriented from the sampling frame (finite) and quantitative research that determines the group according to characters from the probabilistic type formula, corroborated under the statistical program Decision Analyst STATS 2.0, application procedure, and reliability level of the sample of 95 %.

The sample was calculated using the following formula:

$$n = \frac{NxZa^2xpxq}{d^2x(N-1) + 2_a^2xpxq}$$

**Instruments**

To identify the educational technologies used by IEANEE fifth-grade students, the authors developed a questionnaire on google, which included informed consent and consent for parents to authorize student participation in the study, and the latter confirmed the intention to participate. The questionnaire collects the following information:

Sociodemographic characteristics of the students such as sex, age, socioeconomic status.

- Access to connectivity or internet service.
- Use of educational technologies. The level of use of technologies such as YouTube, search engines (google academic), blogs, Classroom, Zoom, Hangouts Meet, Whatsapp will be evaluated.
- Frequency of use, hours a day.
- Use of technologies to support mathematical learning.

Personal assessment of technologies to support the academic process during confinement by COVID-19.

The questions used were of the multiple-choice type, with a single answer, which allows the data to be collected and organized accurately to be statistically assessed in their respective analysis and observation, bearing in mind that the research was relational with a quantitative approach.

To measure the academic performance, the marks of the mathematics area corresponding to the first and second academic period of the year 2020 were requested from the IEAEE registration and control area of the students under study.

**Process**

The directors of the Educational Institution (EI) under study were contacted to present the project and its scope, request permits to carry out the research. Subsequently, parents were contacted through telephone calls, with the information provided by the registration and control areas of EI, parental permits were requested for their children to participate in the study and sign the informed consent and finally, the informed consent of the students was requested to participate in the research. Once this procedure was completed, the instruments were applied virtually, after explanation in a group way through a virtual meeting through zoom. Once the information was obtained, it was organized in Excel tables and the descriptive and inferential statistical analysis was developed.

**Data analysis**

The data analysis was performed by applying descriptive statisticians, measures of central tendency, variability (analysis of frequency, percentage, standard deviation and mean), subsequently to establish significant statistical differences between the means of the measurements before confinement and During the confinement, the student T-test was applied to a sample and finally, the Pearson correlation coefficient statistician was applied to establish the statistical relationships between the variables: use of educational technologies and academic performance.

**Ethical aspects**

In the present investigation, the appropriate handling of the information was taken into account to take care of the ethical considerations of this type of study. Among the ethical aspects under consideration are: study endorsed by the ethics committee of the Cuauhtémoc University of Mexico, informed consent and assent, by directors of the institution, parents and research participants, the principle of autonomy with voluntary and anonymous participation, highlighting the confidentiality of the information provided.

## RESULTS

Sociodemographic characteristics of the participants

Table 1

Age of the participants

| | Age | Frequency | Percentage | Valid Percentage |
|---|---|---|---|---|
| | 8 | 8 | 10.0 | 12.5 |
| **Valid** | 9 | 32 | 40.0 | 50.0 |
| | 10 | 34 | 42.5 | 53.1 |
| | 11 | 2 | 2.5 | 3.1 |
| | 12 | 0 | 0.0 | 0.0 |
| | 13 | 4 | 5.0 | 6.3 |
| | **Total** | 80 | 100.0 | 100.0 |

Source: Analysis obtained through descriptive statistics.

Tables 2 and 3, descriptively show the ages of the participants, showing the minimum and maximum ranges, for which we have 8 years as the minimum age and 13 years as the maximum age, we observe the mean which is 10 and the deviation with a value of 2,121. The table specifically shows the frequency of each of the ages found in the participants; obtaining the highest frequency at the age of 10 years. These data helped determine the dominant age group among the sample participants. The data found is presented graphically below.

The sample, corresponding to 80 participants, was applied to the instrument and it was obtained that 50 % corresponds to the female sex and another 50 % to the male sex, being a total of 40 female students and 40 male students.

Regarding the socioeconomic stratum, the data found is shown in table number 4; it is evident that the most frequent stratum is 1, in which 70 students of the sample belong, which represents 87.5 % of the total of the participants, as well as a total of 8 students belonging to stratum 2 corresponding to 10 %, and 2 students for 2.5 % respectively.

Regarding the specific variables of inquiry for this study, different aspects related to the access and use of the Internet by the investigated students were assessed, in this sense, most of the participants reported having access a few times.

Table 2

Age (mean and standard deviation)

**Descriptive statistics**

| | N | Minimum | Maximum | Mean | Typical deviation |
|---|---|---|---|---|---|
| **Age** | 80 | 8 | 13 | 10.00 | 2 121 |
| **N Valid (according to list)** | 80 | | | | |

Source: Analysis obtained through descriptive statistics.

Table 3

Sex

| Sex | | Frequency | Percentage | Valid Percentage |
|---|---|---|---|---|
| Valid | Female | 40 | 50.0 | 50.0 |
| | Male | 40 | 50.0 | 50.0 |
| | **Total** | 80 | 100.0 | 100.0 |

Source: Analysis obtained through descriptive statistics.

Table 4

Socioeconomic stratum of the participants

| | Socioeconomic stratum | Frequency | Percentage | Valid Percentage |
|---|---|---|---|---|
| **Valid** | 1 | 70 | 87.5 | 218.8 |
| | 2 | 8 | 10.0 | 25.0 |
| | 3 | 2 | 2.5 | 6.3 |
| | 4 | 0 | 0.0 | 0.0 |
| | 5 | 0 | 0.0 | 0.0 |
| | 6 | 0 | 0.0 | 0.0 |
| | **Total** | 80 | 100.0 | 100.0 |

Source: Analysis obtained through descriptive statistics.

Table 5

Internet access

| Internet Access | Frequency | Percentage |
|---|---|---|
| Never | 22 | 27.5 |
| Rarely | 40 | 50.0 |
| Frequently | 18 | 22.5 |
| Permanently | 0 | 0.0 |
| Total | 80 | 100 |

Source: Analysis obtained through descriptive statistics.

Table 6

Internet use

| Internet use | Frequency | Percentage |
|---|---|---|
| Online Games | 0 | 0 |
| Social networks and communication | 16 | 20.0 |
| Entertainment. Movies | 10 | 12.5 |
| Academic Search | 43 | 53.75 |
| Academic videos | 11 | 13.75 |
| Total | 80 | 100.00 |

Source: Analysis obtained through descriptive statistics.

Once the use of the network was investigated, the results indicate that 53.75 % of the participants use the internet to carry out academic searches, while 20 % express their use to enter social networks (Table 6).

Regarding the most widely used technological tools, a significant number of the sample reported that they frequently use YouTube with 41.25 % and search engines such as Google with 31.25 % (Table 7).

Table 7

Technological tools used

| Technological tools used | Frequency | Percentage |
|---|---|---|
| YouTube | 33 | 41.25 |
| Search engines (GOOGLE) | 25 | 31.25 |
| Blogs | 0 | 0 |
| Zoom | 13 | 16.25 |
| Hangouts Meet | 0 | 0 |
| WhatsApp | 9 | 11.25 |
| Others | 0 | 0 |
| Total | 80 | 100 |

Source: Analysis obtained through descriptive statistics.

Regarding the frequency of use of the technological tools that the participants reported using, it was found that 66.2 % reported using them every day and a lower percentage, although significant 22.5 % expressed using them between 2 and 3 days per week (Table 8).

Table 8

Frequency of use of technological tools

| Frequency use | Frequency | Percentage |
|---|---|---|
| Everyday | 53 | 66.25 |
| Between 4 and 5 days a week | 9 | 11.25 |
| 2 - 3 days a week | 18 | 22.5 |
| Once a week | 0 | 0 |
| Total | 80 | 100.00 |

Source: Analysis obtained through descriptive statistics.

Another aspect evaluated is related to the perception that the participants have about the use of technological tools to support mathematical learning, to which 36.2 % reported using technological tools to support their learning processes in the area of mathematics, although another important percentage expressed doing it a few times, a question that shows heterogeneity between its use in the generic group of investigated students (Table 10).

Regarding the use of technological tools by students, they stated that they use them between 1 and 2 hours with 30 %, and between 3 and 4 hours a day in 28.75 %, and another group of participants who expressed use them more than 5 hours a day with 21.25 % (Table 9).

Table 9

Hours of use of technological tools

| Hours of use of technological tools | Frequency | Percentage |
|---|---|---|
| More than 5 hours a day | 17 | 21.25 |
| Between 3 and 4 hours a day | 23 | 28.75 |
| Between 1 and 2 hours | 24 | 30 |
| Less than 1 hour | 16 | 20 |
| Total | 80 | 100 |

Source: Analysis obtained through descriptive statistics.

Table 10

Use of technological tools to support the learning of mathematics

| Use of technological tools to support the learning of mathematics | Frequency | Percentage |
|---|---|---|
| Yes, many times | 29 | 36.25 |
| Yes, frequently | 19 | 23.75 |
| Yes, rarely | 27 | 33.75 |
| Never | 5 | 6.25 |
| Total | 80 | 100.00 |

Source: Analysis obtained through descriptive statistics.

Regarding the assessment that the participants made on educational technologies as a help and support in mathematical learning, most of them were rated above seven, showing the value they give to these tools as a support for their learning processes (Table 11).

Table 11

Assessment of educational technology and mathematical learning

| **Assessment of educational technologies as aid and support in mathematical learning** | **Frequency** | **Percentage** |
|---|---|---|
| 1 | 0 | 0.00 |
| 2 | 0 | 0.00 |
| 3 | 0 | 0.00 |
| 4 | 0 | 0.00 |
| 5 | 1 | 1.25 |
| 6 | 0 | 0.00 |
| 7 | 8 | 10.00 |
| 8 | 20 | 25.00 |
| 9 | 16 | 20.00 |
| 10 | 35 | 43.75 |
| Total | 80 | 100.00 |

Source: Analysis obtained through descriptive statistics.

During the current school year, the scores obtained by the participants in the area of mathematics were taken before the mandatory period of confinement that demanded of the schools the compulsory closure of their academic activities in their face-to-face version. When analyzing the academic performance of the students, it is identified that the majority obtained low and basic scores (Table 12).

Table 12

Academic performance in the area of mathematics before confinement

| **Performance Academic** | **Frequency** | **Percentage** |
|---|---|---|
| 0-30 Very low | 0 | 0 |
| 30-64 Low | 34 | 42.5 |
| 65-79 Basic | 37 | 46.25 |
| 80-90 High | 7 | 8.75 |
| 91- 100 Superior | 2 | 2.5 |
| Total | 80 | 100.00 |

Source: Analysis obtained through descriptive statistics.

During the compulsory confinement and social distancing measures taken by the national government, the institutions resumed school activities in a distance, remote and virtual mode, substantially modifying school dynamics as they had been experienced by all educational actors. The scores indicate a substantial change in academic performance since most of them went up to a basic level and a higher percentage of students were found who scored higher than the data collected before the confinement period (Table 13).

Table 13

During confinement

| Academic Performance | Frequency | Percentage |
|---|---|---|
| 0-30 Very Low | 0 | 0 |
| 30-64 Low | 12 | 15.0 |
| 65-79 Basic | 50 | 62.5 |
| 80-90 High | 14 | 17.5 |
| 91- 100 Superior | 4 | 5.0 |
| Total | 80 | 100.0 |

Source: Analysis obtained through descriptive statistics

The analysis of descriptive statistics on academic performance in the area of mathematics shows a significant increase in the mean of the scores obtained by the participants before and during confinement (Table 14).

Table 14

The difference in means of academic performance before and during confinement

| | N | Mean | Standard Deviation | Mean Standard Error |
|---|---|---|---|---|
| Before confinement | 80 | 64.08 | 13 263 | 1 483 |
| During confinement | 80 | 71.33 | 10 494 | 1 173 |

Source: Analysis obtained from the Student t test.

To establish statistical comparisons to determine the differences found in the scores and means referring to the academic performance of the participants was significant, a student T-test was applied to a sample, which showed that the level of bilateral significance was 0.001 is that is, less than 0.05, so it is assumed that the differences found between the scores obtained by the same group at different times are statistically significant (Table 15).

Table 15

The student t-test for a sample

| | Proof value = 0 | | | | | |
|---|---|---|---|---|---|---|
| | T | Gl | Bilateral sig. | Mean difference | 95 % confidence interval of the difference | |
| | | | | | Lower | Higher |
| Before confinement | 43 209 | 79 | 0.0001 | 64 075 | 61.12 | 67.03 |
| During confinement | 60 793 | 79 | 0.0001 | 71 325 | 68.99 | 73.66 |

Source: Analysis obtained from the T student test.

Finally, a correlation analysis was performed between the use of technologies and the academic performance of the students, which showed a moderate positive significant correlation between the assessment that the participants assigned to the technology and the academic performance during the confinement. On the other hand, moderate and slight negative statistically significant correlations were found between students' academic performance and hours of use, as well as tools for learning mathematics. Given the above, it is worth considering that the greater the number of hours, the lower the scores, which can be analyzed in relation to another of the questions asked in the questionnaire and which showed that a significant percentage dedicated these hours to browsing social networks (Table 16).

Table 16

Correlation between variables

| | | | Hours of use | Mathematical tools assessment | Technology |
|---|---|---|---|---|---|
| Academic performance confinement | before | Pearson Correlation | -0.247* | -0.148 | 0.175 |
| | | Sig. | 0.027 | 0.189 | 0.12 |
| Academic performance confinement | during | Pearson Correlation | **-0.311**** | **-0.430**** | **0.420**** |
| | | Sig. | 0.005 | 0 | 0 |
| | | N | 80 | 80 | 80 |

*P<0.05 level (bilateral); **P<0.01 (bilateral)

Source: Analysis obtained from the Student t-test.

## DISCUSSION

The current challenges to which society is confronted are undeniable, and in the case of study, education. This implies transforming the habitual frameworks of the teaching-learning processes, without disfavoring the proposed objectives, and at the same time favoring the development of academic competencies. The results evidenced in the study warn the following:

First, they point out the potential use of technology-mediated learning, that is, how digital resources facilitate the teaching-learning relationship as alternative means to the usual framework of face-to-face teaching, that is, that in an openly digital generation, Digital resources can enhance student learning and the acquisition of academic knowledge and skills. This, taking into account the achievements obtained in academic performance, which went from 64.08 % (pretest) to 71.33 % (posttest) in the general study population. This change is also evident in the quality of the performance, since, in the pretest, 42.5 % were in low performance, and in the posttest, the low performance obtained only 15 %. In other words, 27.5 % of the students with low performance increased their performance, with respect to their performance, and the use of digital technologies and resources.

Likewise, the basic performance, during the pretest had 46.25 %, while in the posttest it was found 62.5 %, that is, an increase of 16.25 % in the quality of the general performance thanks to the use of digital technologies and resources. Similarly, high performance during the pretest obtained 8.75 %, while 17.5 % was found in the post-test evaluation, that is, an increase of

100 % in this category, thanks to the use of digital technologies and resources.

This suggests that the frequent use of digital technologies and resources favors teaching-learning and enhances academic performance. This is noted, thanks to the fact that the quality of performance, in general, went from being low-basic 88.75 % in the pre-test, to being high-80 % in the posttest. Thus, the low performance was the one that decreased the most, while high performance was the most evident, with an increase of 100 % compared to the pretest. In this sense, the conclusions of (1-3,34,35) are confirmed.

Secondly, it stands out, the student's willingness to learn through technological resources, that is, because 88.75 % of the participants consider the importance of educational technologies as aid and support in learning, rating their value among 8 and 10. Likewise, 88.75 % report the use of technology for academic processes such as academic searches (31.25 %), academic videos / YouTube (41.25 %), or zoom (16.25 %). Thus, 60 % of the participants report they used technological tools to support learning. In other words, the teaching-learning relationship is enhanced when learning is mediated through digital resources, while it can be inferred that student participation in their learning process since it self-manages their digital resources.

Thirdly, the time and quality of the use of digital media suggest that the potential of the digital resource lies in its usefulness, not in its quantity, although 66.2 % stated that they use digital media every day, their daily use. It ranges from 1 to 4 hours 58.75 %. That is, "daily" is not synonymous with "all day", but its use is related to the quality of the search and the effectiveness of the use, that is, to the specific search in relation to academic processes as suggested in 88.75 % about its use, indicated above. Furthermore, since internet access, according to the participants, is 50 % a few times, and 22.5 % frequently, it is valid to argue that such condition is related to the quality of the use of technologies, that is, how much the more limited the access, the more specific is the academic search.

The above, then, confirms the findings of (4-7,13-14,20), about the means, resources, motivation, and academic performance from the use of technologies, in short, it is established that the technological means in middle education can enhance academic performance based on student participation, search quality, and time spent on resources.

## Author contributions

**MC-M.** Carried out the theoretical framework, the methodology; **LC-T** performed the statistical analysis and presented the results; **GO-L** and **PM-P** did the data collection; **VB-A** wrote the discussion.

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## Conflict of interest

The authors declare that they have no conflict of interest within the manuscript.

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