

DIGITAL COMPETENCES AND ACADEMIC PERFORMANCE IN UNIVERSITY STUDENTS: NON FACE-TO-FACE EDUCATION IN TIMES OF COVID-19 PANDEMIC

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ABSTRACT

The present research aims to determine the relationship existing between digital competencies and academic performance in students of the National Autonomous University of Huanta, Peru, during the non face-to-face education, 2020-2021. The way to teach using the distance education is more important nowadays, when the pandemic situation imposes the need to keep measures like the social distance among the people. We analyzed the variable “digital competence” and its dimensions, “information”, “communication”, “content creation”, and “security and problem solving”, as well as the variable “academic performance”. For this end, we selected a sample of 209 students of the aforementioned university, using the stratified sampling method for three groups of students, namely, Administration of Sustainable Tourism and Hotel Management (ASTHM), Engineering of Agronomic and Forestry Business (EAFB) and Engineering and Environmental Management (EEM). We applied questionnaires and the collected data were processed by the Spearman’s Rho correlation coefficient. The result was that there is a significant relationship between digital competencies and academic performance, with a significance level of 0.01 (bilateral), likewise the value obtained through Spearman’s Rho coefficient is 0.416, indicating that there is a moderate positive relationship, equivalent to 41% average; concluding that university students need to improve their digital competencies to obtain a higher academic performance as far as the non in-person education is concerned.

KEYWORDS: Digital competencies, academic performance, college student, non in-person education, Spearman’s Rho coefficient, Cronbach’s Alpha.

MSC: 62P25.

RESUMEN

La presente investigación tiene como objetivo determinar la relación que existe entre las competencias digitales y el desempeño académico de los estudiantes de la Universidad Autónoma de Huanta, Perú, durante la educación no presencial en 2020-2021. La manera de enseñar mediante la educación a distancia es más importante hoy día, cuando la situación pandémica impone la necesidad de mantener medidas como el distanciamiento social entre las personas. Se analizaron la variable “competencia digital” y sus dimensiones “información”, “comunicación”, “creación de contenido” y “seguridad y solución de problemas”, así como la variable “desempeño académico”. Con este fin, se seleccionaron 209 estudiantes de la mencionada universidad, usando un método de muestreo estratificado de tres grupos, los correspondientes a: Administración de Turismo Sustentable y Gestión Hotelera (ATSGH), Ingeniería Agronómica y Negocio Forestal (IANF) e Ingeniería y Gestión Ambiental (IGA). Se aplicaron cuestionarios y los datos recolectados se procesaron con el coeficiente de correlación Rho de Spearman. El resultado fue que existe una relación significativa entre las competencias digitales y el desempeño académico, con un nivel de significación de 0,01 (bilateral), igualmente el valor obtenido con ayuda del coeficiente Rho de Spearman es de 0,406, lo que indica que existe una relación positiva moderada, equivalente a un promedio del 41%; se concluye que los estudiantes universitarios necesitan mejorar sus competencias digitales para obtener un desempeño académico superior hasta lo que ahora concierne a la educación no presencial.

PALABRAS CLAVES: Competencias digitales, desempeño académico, estudiante universitario, educación no presencial, coeficiente Rho de Spearman, Alfa de Cronbach.

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1. INTRODUCTION

The global pandemic of COVID-19 has led to the suspension of the teaching activities in many countries. At the university level, the urgent transformation of in-person classes into an online format has moved in a way that can be described as acceptable in general terms, although the taken measures have been adjusted to the urgency and not to an a priori planning, teaching a subject with a completely online methodology has become feasible. Peru, not oblivious to this reality, adopted immediate decisions of restriction by converting in-person classes into non face-to-face classes. In this case, the National Autonomous University of Huanta, hereinafter UNAH, in the framework of the regulations that every university with institutional license granted by the National Superintendence of Higher University Education (SUNEDU) must comply with fulfilling the established and enabled technological conditions for the teaching of classes through tools such as Meet, Zoom and Classroom. This challenge assumed by teachers and students has meant a radical change which seeks to reduce gaps in digital knowledge and preserve or improve the academic performance of their students. Considering that on the panorama of digital competencies in adults it is known that almost a quarter of the population (24.3%) are completely unaware of how to work with a computer due to various factors ranging from the absence of a computer at home, to its operation, or they find it extremely complex. Out of this alarming figure it was found that within the remaining group (75%), only 5% of them had certain skills to properly use the computer, as well as knowledge in computer science, within this concern our research problem is born ([2]).

In order to analyze the achievement of digital competencies, the students were consulted; they had the opportunity to be trained quickly, before the implementation of this teaching mode; without previous evaluation, they started their academic work on August 3, 2020, after long studies regarding connectivity and technological capacity. The UNAH, applied strategies such as the distribution of chips for free, to avoid some degree of absenteeism during the teaching-learning activity 2020-2021.

The literature suggests that academic performance is multifactorial in nature ([7]). This means that multiple factors are involved in the academic performance of students, from variables that have to do with personal determinants to others associated with social aspects. For the analysis of academic performance, the grades obtained were reviewed, thus checking if there is any degree of relationship with the digital competencies variable.

The contribution of this research is supporting the solution of the problem of digital competencies, which currently have been incorporated in the competence of 28 regular elementary school students named: "Performance in virtual environments generated by ICT", which consists of the student interpreting, modifying and optimizing virtual environments during the development of learning activities and in social practices ([12]). This involves the articulation of the processes of search, selection and evaluation of information; modification and creation of digital materials, communication and participation in virtual communities, as well as their adaptation according to their needs and interests in a systematic way. UNAH's teachers developed training in didactics associated with digital competencies, which was not observed in the students, showing evident difficulty on their part with respect to digital competencies, affecting their academic performance. Different authors emphasize that one of the fundamental challenges in the field of education is to measure and diagnose the digital competence of students, therefore, the use of ICT tools in teaching and learning models improves the perception of the students' own digital competence, also their motivation and, consequently, their learning is enhanced, reflected in their academic performance. In universities under their autonomy there is no regulation, neither the courses nor the hours that university students should take to achieve these digital competences. As part of this research we determined that digital competence influences academic performance, creating importance to the strengthening of implementing it in a transversal way throughout their academic training. The general objective of this research is to determine the relationship between digital competencies and the academic performance of UNAH's students during non in-person education in times of COVID-19 pandemic, 2020-2021, with respect to the dimensions of information, communication, content creation, security and problem solving.

Some authors have investigated on this subject in different countries like Finland and China, where digital competences in education have been studied ([10][17]). In Myyry et al. Teacher's digital competence is studied whereas in Wang et al. they studied how digital competence preserves University students' psychological well-being, in both cases during the pandemic period. The conclusions are varied and a door is opened to develop this subject.

Briefly, this paper is a statistical study of the relationship between digital skills and academic performance in three groups of students of three professions of the National Autonomous University of Huanta, Peru. We

applied questionnaires to these students and the collected results were processed using the Spearman's Rho coefficient ([1][8]). This non-parametric method was used in the absence of normality of the data. Spearman's rho coefficient is utilized to measure the correlation between two random continuous variables. The reliability of the questionnaires was validated by means of the Cronbach's alpha coefficient ([5][6]).

The paper is divided in the following sections; section 2 contains the main concepts and theoretical details applied in the study, like the Cronbach's alpha coefficient and the Spearman's Rho coefficient. Section 3 is dedicated to show the results of the calculus. Section 4 finishes the paper with the conclusions.

2. MATERIALS AND METHODS

The research methodology to be used should allow us describing the variable "Digital Competences" in a context of UNAH, which is an entity where primary information was collected to systematize and statistically process the relationship that exists with "Academic Performance".

The present study developed in the population of UNAH's students, distributed in three professional schools: Administration of Sustainable Tourism and Hotel Management (ASTHM), Engineering of Agronomic and Forestry Business (EAFB), and Engineering and Environmental Management (EEM), from the II to VI Academic Cycle, which is a total of 457 students. Proportional stratified sampling was considered, a systematic procedure where each stratum is represented in the sample in proportion to its frequency in the total population. The sample size was of 209 students, distributed in 72 ASTHM, 69 EAFB, 68 EEM. We differentiated the sample by schools because every one of them has its proper characteristics, so we also needed the representativeness of every one of them; see that they have approximately the same sample size. On the other hand the simple random sampling method was applied in every stratum.

Spearman's Rho coefficient is used to process the collected data obtained from the questionnaires, it is calculated with Equation 1 ([16]):

$$\rho = 1 - \frac{6 \sum_{i=1}^N D_i^2}{N(N^2-1)} \quad (1)$$

Where D_i is the difference between the ranks of X and Y calculated for all ~~every one~~ of the elements of the sample. N is the total number of pairs.

Spearman's Rho coefficient is here used because the collected data are not normal as we pointed above. $-1 \leq \rho \leq 1$, such that ρ near to 0 means independence between the two variables, whereas ρ near to -1, 1 means dependence between the variables. The sign indicates direct dependence where $\rho > 0$ and inverse dependence where $\rho < 0$.

In psychometrics, Cronbach's Alpha is a coefficient used to measure the reliability of a measurement scale. In the field of psychology, education and social research, reliability is a psychometric property that refers to the absence of measurement errors, or what is the same, the degree of consistency and stability of the scores obtained throughout successive measurement processes with the same instrument.

A researcher tries to measure a non-directly observable quality (e.g., intelligence) in a population of subjects. For this end, he (she) measures m observable variables (for example, m responses to a questionnaire or a set of m logical problems) of each of the subjects. The variables are assumed to be related to the unobservable magnitude of interest. In particular, the m variables should perform stable and consistent measurements, with a high level of correlation between them. In this research we designed a questionnaire consisting in many items; therefore an acceptable value of this coefficient guarantees the questionnaire is reliable. Also, we have to assess a complex quality in students like "Digital Competences" and "Academic Performance", and the way to obtain the wanted results is to measure other measurable aspects, like those appearing in the questionnaire.

Cronbach's alpha makes it possible to quantify the level of reliability of a measurement scale for the unobservable magnitude constructed from the m observed variables ([5][6][13]). Cronbach's Alpha can be calculated from the variances with the following formula:

$$\alpha = \left[\frac{m}{m-1} \right] \left[1 - \frac{\sum_{i=1}^m S_i^2}{S_t^2} \right] \quad (2)$$

Where:

- S_i^2 is the variance of the ith item,
- S_t^2 is the variance of all the observed values,
- m is the number of questions or items.

Based on the correlation among items, the Standard Cronbach's Alpha is defined as follows:

$$\alpha_{stand} = \frac{mp}{1+p(m-1)} \quad (3)$$

Where:

- m is the number of questions or items.
- p is the mean of the linear correlations among the items.

Alphas bigger than 0.7 or 0.8 are enough to consider there is reliability of the scale.

3. RESULTS

We used the stratified sampling method for three groups of students. The three strata are the schools, Administration of Sustainable Tourism and Hotel Management (ASTHM), Engineering of Agronomic and Forestry Business (EAFB), and Engineering and Environmental Management (EEM), from the II to VI Academic Cycle. The elements of each group were selected utilizing simple random sampling method for choosing independently samples from the strata. The Equation for determining the sample size is the following ([4][14][18]):

$$n = \frac{k^2 N p q}{e^2(N-1) + k^2 p q} \quad (4)$$

Where:

n is the sample size,

N is the population size,

k is a constant depending of the level of confidence,

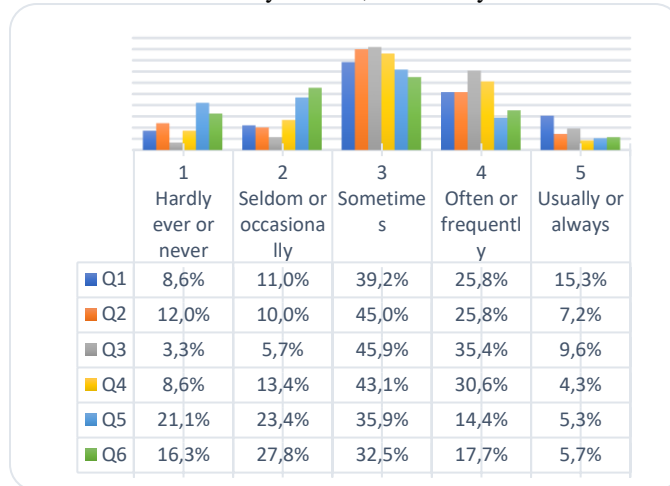
e is the sampling error,

p: is the proportion of elements of the population satisfying the characteristic measured,

q: is 1-p.

Here N = 457, k = 1.96 (corresponding to 95% of confidence), p = q = 0.5, and e = 0.05 (5%), thus n = 208.96 ≈ 209. See that we used p = 0.5 because this is the value usually selected when this datum is unknown.

The proportional stratified sample is equivalent to 209 students, from which 53% are female and 47% are male; 53% are between 16 and under 21 years old, 22% are between 21 and under 26 years old, 23% are between 26 and under 31 years old, and finally 1% are between 31 and 36 years old; 34% belong to the



professional career of Administration of Sustainable Tourism and Hotel Management (ASTHM), 33% to Agronomy and Forestry Business Engineering (EAFB) and 33% to Environmental Engineering and Management (EEM). 25% belong to the II academic cycle, 23% belong to the III academic cycle, 22% belong to the VI academic cycle, 17% belong to the V academic cycle, and 12% belong to the VI academic cycle.

The pre-investigation hypothesis test was performed through expert validation and Cronbach's Alpha, the result of which was 0.6842 with a moderate positive validation

Figure 1. Answers to the Dimension "Information". Source: Authors.

that is equivalent to 68% average. This value is interpreted that in general we expect that students have digital skills slightly over the mean.

The data collection techniques were developed by means of surveys, documentary analysis, file recording, with an instrument based on evaluation records and a questionnaire. The information was processed using the SPSS software package ([3]). SPSS is a statistical computer program widely used in social sciences and market research companies. It is a program that allows working with large databases and a simple interface, which has numerous statistical methods implemented.

In this dimension we have the following questions and responses to the questionnaire:

(Q1) Do you use different browsers on the Internet according to the type of search?

- The biggest majority 39.2% answered "sometimes".

(Q2) Do you use keywords in the text fields of the search engines?

➤ 45% of students answered “sometimes”.

(Q3) Do you recognize common words when surfing Internet?

➤ 45.9% and 35.4% answered “sometimes” and “often or frequently”, respectively.

(Q4) Do you recognize educational portals and contents on Internet, as well as information banks?

➤ 43.1% answered “sometimes” and 30.6% “often or frequently”; valuing that students recognize educational contents and therefore know how to differentiate them.

(Q5) Do you recognize fake information on the web?

➤ 35.9% answered “sometimes” and 23.4% “seldom or occasionally”.

(Q6) Do you recognize hosting and file recovery services in the cloud?

➤ 32.5% answered “sometimes” and 27.8% “seldom or occasionally”.

Regarding Dimension 1 of Information there is an average knowledge on student, having to emphasize and strengthen their abilities in the recognition of false information, as well as the application of techniques and methods of file hosting and recovery.

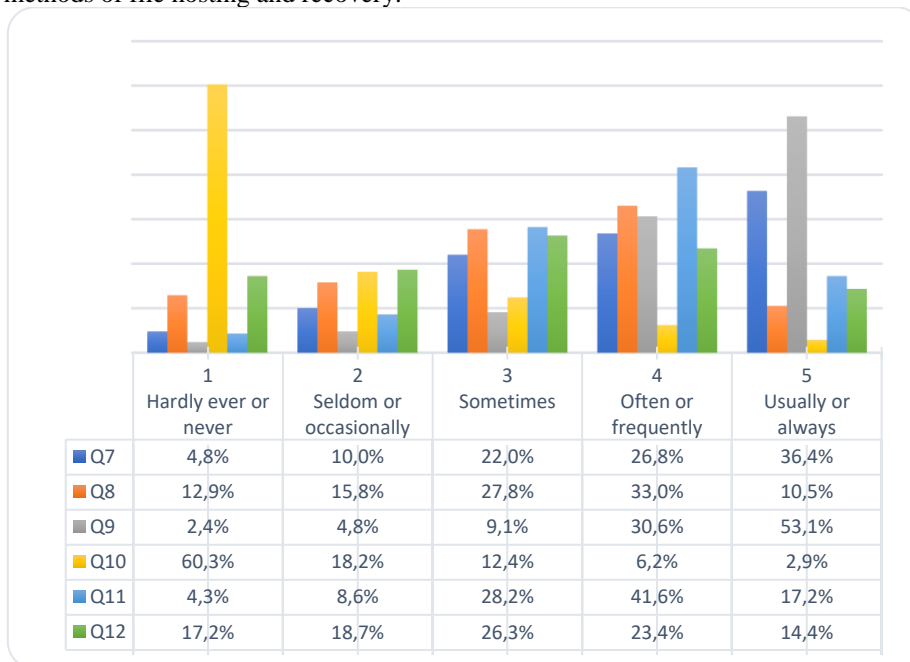


Figure 2. Answers to Dimension “Communication”. Source: Authors.

Regarding Communication we have the following questions and responses:

(Q7) Do you use e-mail (Gmail, Yahoo, Hotmail, etc.) as a means of communication?

➤ 36.4% of the students answered “usually” or “always”.

(Q8) Do you share information using your link and/or URL address?

➤ 33% of the students answered “often” or “frequently”.

(Q9) Do you use social networks (Facebook, WhatsApp, etc.) to interact and/or share information?

➤ UNAH’s students use “usually” or “always” social networks (53.1%), frequently for communicating among them.

(Q10) Do you have YouTube channel, where you share concerns and experiences?

➤ 60.3% of the students answered “hardly ever” or “never”.

(Q11) Do you use appropriate language when video chatting, chatting and sending messages?

➤ 41.6% answered “often” or “frequently”, thus the students mostly try to communicate through appropriate language.

(Q12) Do you have more than one e-mail account?

➤ 26.3% answered “sometimes”.

So, the results about the Communication is that students have access to a variety of technological tools to strengthen their communication, highlighting that most of them keep a high level of language typical of a university student.

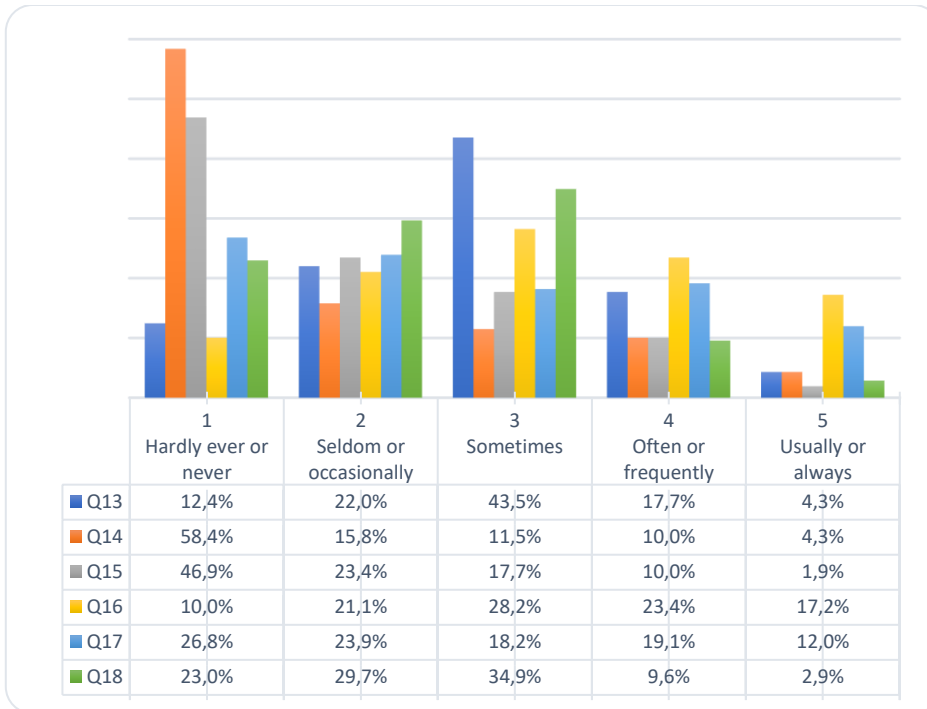


Figure 3. Answers to Dimension “Content creation”.

In the dimension “Content creation” the answers and results were the following:

(Q13) Do you make comments in forums of common interest?

- 43.5% mentioned “sometimes”.

(Q14) Do you elaborate entertaining audiovisual material (TikTok, memes, etc)?

- 58.4% of the students answered that they “hardly ever” or “never” elaborate TikTok or memes.

(Q15) Do you open or create discussion forums in social networks?

- 46.9% of the UNAH’s students answered “hardly ever” or “never”.

(Q16) Do you subscribe to free websites?

- 28.2% of the students answered “sometimes”. Under these pandemic circumstances, information technologies have generated opportunities for global openness, generating an alternative to the creation of free websites in various educational entities, which facilitate the development of the virtual learning teaching process, which is where the importance of their subscription is born.

(Q17) Do you publish or share documents, photos and others of your authorship on the web?

- 26.8% answered “hardly ever” or “never”, followed by 23.9% who answered “seldom” or “occasionally”.

(Q18) Do you develop programs to solve problems posed in class?

- 34.9% answered sometimes.

Thus, concerning the dimension Creation of contents the students show weakness in the creation of contents despite constantly using social networks; these have not yet been an efficient and effective means for the creation of original contents.

In terms of security we designed the following questionnaire:

(Q19) Do you recognize when your device (PC, tablet or smart phone) is infected by a virus?

- 33.5% of the students answered “sometimes”.

(Q20) Do you check that your PC, tablet or smart phone has an updated antivirus?

- 31.6% of students “sometimes” have an updated antivirus.

(Q21) Do you access secure pages to protect your data and personal information?

- 39.7% of UNAH’s students “often” or “frequently” access secure pages.

(Q22) Do you feel tired, a headache and/or tearfulness when you are in front of the computer for a long time?

- 36.4% of the students stated that they “often” or “frequently” feel sick when they spend a lot of time in front of the computer; in view of this phenomenon, which implies a deterioration of health, the university, through the corresponding departments, should strengthen and socialize medical techniques for the health conservation of students.

(Q23) Do you spread and/or share inappropriate material on your social networks?

- 57.9% answered “hardly ever” or “never”.
- (Q24) Do you protect your files to share (do you use passwords)?
- 29.2% answered “sometimes”.

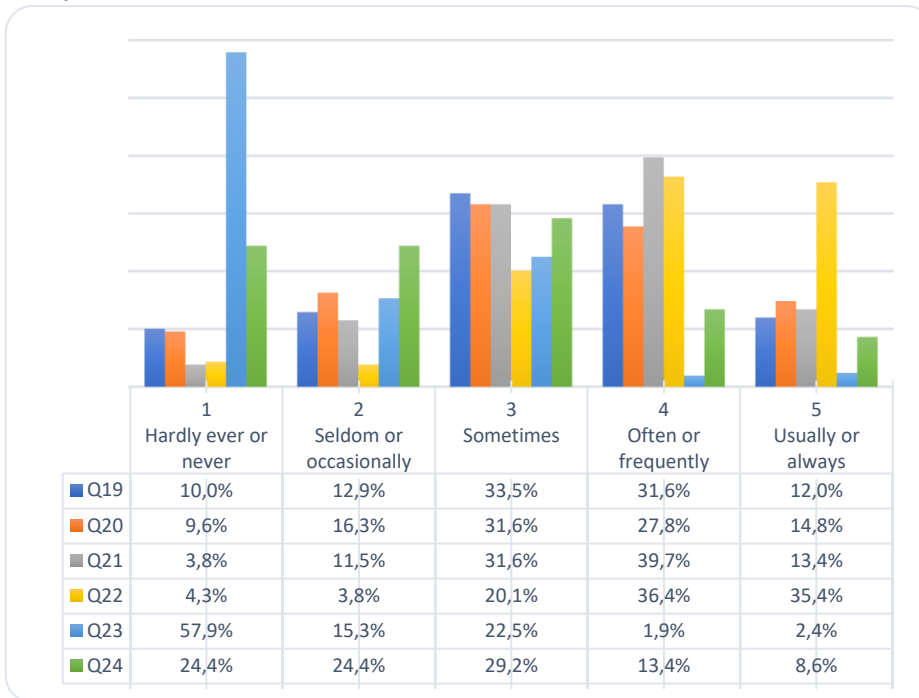


Figure 4. Answers to Dimension Safety. Source: Authors.

Regarding Dimension Security the students require training, induction and preparation to access information safely, it is important to emphasize the psycho-pedagogical and health issues, due to the indirect consequences they suffer from the excessive use of computers.

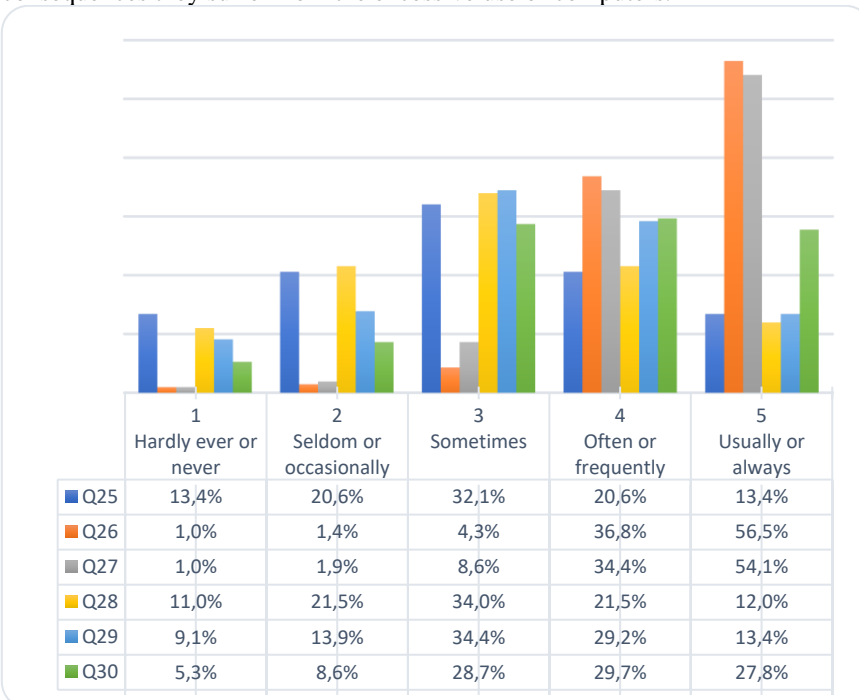


Figure 5. Answers to Dimension Problem solving. Source: Authors.

To measure the ability to solve problems, we have the following questions:

(Q25) Do you use Excel or other programs to solve mathematical operations and/or calculation works?

- 32.1% answered “sometimes”.

(Q26) Do you use Word to do text works?

➤ 56.5% of the students answered “usually” or “always”.

(Q27) Do you use Power Point presentations to present your work in class?

➤ 54.1% of the students answered “usually” or “always”.

(Q28) Do you ask for help from groups, forums, channels, communities, etc. to solve problems and class work?

➤ 34% of the students claimed that “sometimes”, with the understanding that the great majority resort to external advisors to solve problems and class work, and in this line the teaching support should be strengthened, allowing the student to consult directly regarding their doubts.

(Q29) Do you use electronic dictionaries to understand words that you read?

➤ 34.4% answered “sometimes”.

(Q30) Do you use online translators to know their meaning in our language?

➤ 29.7% answered “often” or “frequently”.

Regarding Dimension Problem solving, it can be shown as a result that students require more support in knowledge of Office tools, so the university should adopt efforts to improve this knowledge in students. Cronbach's Alpha was estimated for the total data obtaining 0.902, for each dimension, Information (0.783), Communication (0.630), Content creation (0.721), Security (0.628), Problem solving (0.761), analyzing the results according to the opinion of Ñaupas ([11]), it can be stated that the resulting matrices are acceptable, so the results are validated.

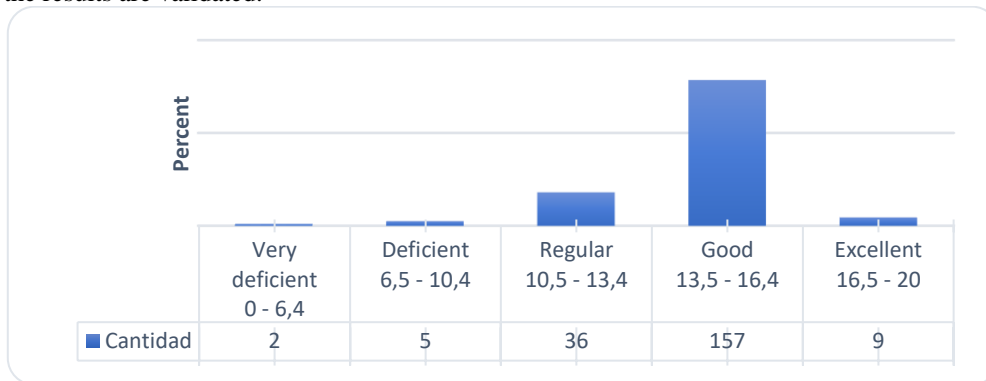


Figure 6. Academic performance of the study sample according to scale. Source: Authors, see [15].

Of the study sample, an exact review of their weighted averages was carried out, resulting in 75% (157) of the students being in the good condition, that is, their average ranges between 13.5 and 16.4; 17% (36) of the students are in a regular condition, that is, from 10.5 to 13.4; 4% (9) of the students are in an excellent condition, that is, their average is between 16.5 and 20, and only 3% (7) of the total sample is in a deficient or very deficient condition, that is, their grade is less than 10.4.

The results of the present research determine a positive average relationship between digital competencies and the academic performance of students that is a moderate positive relationship between digital competencies and academic performance, with a confidence level of 5% and a Spearman's Rho coefficient is 0.416, which is equivalent to a significance of 41.6%. The verification of this hypothesis agrees with Zempoalteca Durán et al. ([19]), where it is stated that the innovative use of ICTs has a favorable effect on students' academic practices.

From the results obtained, we can share the opinion of Mezarina Aguirre et al. [9], where it is considered that the use of ICT, through virtual education, dynamizes digital competences; considering them in the teaching-learning process as a transversal knowledge, more in a non face-to-face education, an educational policy adopted to counteract the high levels of contagion resulting from COVID-19, which has plunged the world into a pandemic situation and even more so in Peru.

The Spearman correlation test with a significance level of 95% ($\alpha = 0.05$) was used to contrast the hypotheses proposed. The results of the correlations show the average ratings of digital competencies and academic performance through its dimensions: information, communication, content creation, security and problem solving.

Regarding the General Hypothesis: There is a direct relationship between digital competencies and the academic performance of UNAH's students during non-classroom education, 2020-2021, see results in Table 1.

			ACADEMIC PERFORMANCE	DIGITAL COMPETENCIES
Spearman's Rho	ACADEMIC PERFORMANCE	Correlation coefficient	1.000	.416**
		Sig. (bilateral)	.	.000
		N	209	209
	DIGITAL COMPETENCIES	Correlation coefficient	.416**	1.000
		Sig. (bilateral)	.000	.
		N	209	209

Table 1. Correlation of variable 1 and variable 2 **. The correlation is significant at the 0.01 level (bilateral).

4. CONCLUSIONS

This study was carried out with 209 students at the National Autonomous University of Huanta, which were randomly selected with a stratified sampling, to measure the relationship between Digital Competencies and Academic Performance. We applied a questionnaire and used the Spearman's Rho coefficient to process the data. The result was that there is a significant relationship between these two variables. The Spearman's Rho coefficient was 0.416, indicating that there is a moderate positive relationship, equivalent to 41% average. Therefore, it is important to improve the digital competencies of the students so that this is reflected in a good academic performance, with a significance level of 0.01 (bilateral). Thus, it is necessary to provide training to students in ICT that allows them to strengthen their digital competencies, in the same way supervise and advise the creation and review of content on the web, allowing them to easily identify false information, avoiding confusion and thus allowing them to develop fluently in virtual environments; adopt educational policies of health care, caused by the physical and emotional wear of synchronous and asynchronous sessions, which at the moment produces situations of fatigue, headache, tearfulness or others. Additionally, teachers should be trained so that they can clear students' doubts, as well as find a methodology of fast and efficient communication, which prevents students from seeking answers in social networks, which in some cases may be wrong.

Despite we cannot generalize these results to the totality of the Peruvian universities because we only analyzed the National Autonomous University of Huanta, according to our knowledge of the higher education in our country; we expect to find similar results for the rest of the universities.

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