Digital Competence of Higher Education Students as a Predictor of Academic Success

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Abstract
The purpose of the present study is to analyze the digital competence of Higher Education students, as a function of their academic performance (have either repeated or a not previously), as well as to predict its significant predictors. For this, an ex-post factor and a sample of 17301 students from Chile (Latin America) were utilized. A questionnaire composed of a total of 30 items, classified into five endogenous and exogenous dimensions through a causal model, adapted from the works of Gutiérrez-Castillo (2013), Gutiérrez-Castillo & Cabero (2016) and Gutiérrez-Castillo et al. (2017), was administered via online to the students. The results showed statistically significant differences in digital competence, as a function of repeating an academic year or not, with better scores for the latter. Also, factors such as the number of digital resources utilized for the teaching-learning process, the previous preparation for managing their studies, as well as the level of education of the parents, mainly the father, significantly had an influence on both types of students. This study highlights the importance of the development of an adequate digital competence which has an influence on the learning of the students and their posterior class promotion.

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1 Introduction

It is well known that in recent decades, Information and Communication Technologies (ICT), in this digital world, have revolutionized all sectors of society, from the way we communicate and work to the educational field. In short, has become a vitally important component in the workforce, recreationally, and in schools (Goriss-Hunter et al., 2022). ICT can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum (UNESCO, 2021).

The digital competence of teachers and students is not a new subject, and has been addressed from different conceptual frameworks, such as the DigComEdu model (Cabero-Almenara & Palacios-Rodríguez, 2020; Ghomi, & Redecker, 2019), the PEAT (Pedagogical, ethical, attitudinal and technical) dimensions developed by DICTE (2019), TPACK (Technological Pedagogical Content Knowledge) (Miguel-Revilla et al., 2020). These competencies have been measured with self-perception instruments, such as those designed by the following authors, self-perception instruments created by the authors themselves (Gutiérrez-Castillo et al., 2017; Cabero-Almenara, et al., 2020; Guillen-Gamez et al., 2021), or others of a similar nature such as those developed by Cerdá et al., (2022). Likewise, this construct has been analyzed from the predictors that affect its acquisition, such as differences as a function of gender (Basantes-Andrade et al., 2020), the student's age (Lucas et al., 2021), differences between teachers and students (Guillén-Gámez & Mayorga-Fernández, 2020), its relationship with social class (Cabero-Almenara & Ruiz-Palmero, 2018) or the area where the education center is located (Lebedeva, 2021). Not many studies have sought to associate it with the student's repetition of academic years; that is, with the possible relationship that could be established between a high level of digital competence of the student and academic success.

The student's need to master digital competences has been perceived as being more necessary in the current state of pandemic (COVID-19) we are experiencing (Christopoulos & Sprangers, 2021) in which a high degree of mastery has been required to advance in education (Chang & Aytenew, 2021), and to be able to function in virtual learning environments (Learning Management Systems, LMS), to which the education process greatly shifted during this period (Sumardi et al., 2021). Assuming an online modality where the use of the ICT is constant implies that students dedicate more of their time for studying, for independently searching for additional information, for sharing, for collaborating, and ultimately, for taking on the reins of their own learning (Ariebowo, 2021), obtaining a better academic performance as compared to students who are enrolled in in-person modalities, in which a continuous contact with technology does not exist (Soffer & Nachmias, 2018).

In light of this new educational panorama, the importance of this study is in the focus which it analyzes: how the level of digital competence of students can help improve their teaching–learning process, and consequently, their academic performance. However, in the acquisition and development of students on their digital training, various predictors can also affect which are necessary to analyze in order to take into account all the variables that may influence. In addition, it would be interesting to see how the influence of some predictors on others (co-variables) influence this level of competence. In this order of thoughts, we ask ourselves:

1. What is level of digital competence of Higher Education students according to their academic year repetition rate?

2. What are the predictors that significantly affect the level of digital competence of students, depending on whether or not they have repeated an academic year?

3. How does the relationship of co-predictors (one predictor over another) influence the level of digital competence of students?

2 Theoretical Framework and Related Studies

2.1 Digital Competence of Students

A clear and unique definition of the term digital competence does not exit (Park et al., 2020), as its terminology is affected and continuously developed by technological changes (Tømte, 2013). Although there is no such consensus, such development is necessary to transform information into knowledge and to work as part of a society with a digital environment (Marimon-Martí et al., 2022). This fact has been clearly reflected in the situation produced by the COVID-19, where both teachers and students have evidenced the lack of digital competence, which has had repercussions in the creation of situations of academic failure and learning difficulties (Navarro-Espinosa et al., 2021; Scully et al., 2021).

In recent times there have been numerous studies on digital competence in university education in times of COVID-19. Studies such as García-Prieto et al. (2022), have shown that during this pandemic, university students have developed their level of digital competence, as have the teaching staff (Myyry et al., 2022). Recent studies such as those by Reisoğlu & Çebi (2020) summarizes some of the skills a good teacher must possess to achieve a quality education process with the students: training for technological literacy, communication and collaboration, safety, and the resolution of problems. In this context, Bernate et al. (2020) indicated that students had good levels of creativity and digital innovation for the creation and development of new projects. However, the students showed basic skills for searching, organizing, evaluating, and processing information, results similar to those from Fleaca & Stanciu (2019).

On their part, Belmonte et al. (2019) provided evidence that students did not possess enough technological literacy skills to teach the next generation of digital natives, or trust in themselves to show and resolve problems through technological resources, although these results were contrary to those from Bernate et al. (2020). The critical results from Belmonte et al. (2019) were similar to those from van Deursen & Van Diepen (2013), as the students in their study had serious difficulties in defining problems of information.

2.2 The Use of Digital Resources on the Learning of the Student

Some studies have provided evidence on the positive relationship between the intensity and use of the ICT and Internet on the learning of students, with respect to their digital skills (Martinez-Lopez et al., 2020). For example, Mayor et al. (2019) found that the use of social networks was a moderate intensity predictor of the digital competence of 300 students in the Education university degree at the University of Seville (Spain). Ghomi and Redecker (2019) analyzed the relationship between the number of digital resources utilized by educators in the education process, and their level of digital competence. With a sample of 335 German teachers, who worked in different education stages, the results determined that those who utilized between 5 and 9 digital tools in the classroom, obtained higher levels of digital competence, as compared to those who utilized 0 to 4 resources. Similar results

were found by Lucas et al. (2021), where the number of digital tools utilized for teaching and learning was the strongest predictor of the digital competence of the teachers.

With less frequency, we also find the link between the parent's use of the ICT and the learning of the children. For example, Hammer et al. (2021) used a sample of 1206 Secondary Education students along with their respective parents. The results showed that the parent's beliefs and uses of digital media, more specifically smartphones, were closely related with self-efficacy and skills possessed by the children on the use of these digital resources.

In parallel, other studies have analyzed how a greater use of digital resources increases the acquisition of new skills (Csordás, 2020), with a direct effect in academic performance (Alderete & Formichella, 2016; Cox & Marshall, 2007; Mehrvarz et al., 2021). More specifically, Maria and Awan (2019) analyzed the impact of digital media on the learning of 400 students from 16 universities in Multan (Pakistan). The results indicated that students who utilized social networks to obtain scientific knowledge obtained good grades, as compared to those who only used them for fun or entertainment. Similar results were found by Hernández-Martín et al. (2021), who stated that significant differences in digital competence were found between the students who utilized social networks more than 3 or 4 times per week, and those who used them every day.

In general, we can confirm that the use of digital resources in the student's teaching and learning process can affect their academic performance, and also, the low academic performance of an individual is the most distinctive characteristic of repeating a year during the educational period (García & Jiménez, 2019).

2.3 Other Factors That Have an Influence on the Digital Competence of Students

Education researchers have long been interested in the positive effect of the level of education of the parents on the academic education of their children. Idris et al. (2020) explored the relationship between the education of the parents, and the academic performance of children, through the level of education of the father and the mother. With a sample of 510 Secondary Education students from 34 public schools in the district of Mardan (Pakistan), the findings revealed that the higher education of the father and mother positively contributed to the academic performance of the children. In a similar context, Odoh et al. (2017) examined the influence of the level of education of the parents, and the academic performance of the children (n=150), who were enrolled in the last year of accounting at the University of Nigeria. The results obtained indicated that the level of education of the parents had a significant influence on the academic performance of the children, thus recommending, among others, that the government must improve the literacy of the parents with a low level of education.

Similar results were found by Li and Qiu (2018), Wijaya et al. (2020). With confounding results, through a longitudinal design with a control group (n=90), and an experimental group (n=84), the authors showed that the children who had fathers with a low level of education obtained a very good academic performance, although it was lower that children who had mothers with a low level of education.

Other influences on the student's digital competence may be gender and age, which have been considered factors associated to the competence of students, as shown by the large amount of literature on these subjects in the last few years. With respect to gender, numerous studies have found that men tend to be more competent (Gnambs, 2021; Lucas et al., 2021; Çebi & Reisoğlu, 2020; Wild & Heuling, 2020). Other studies have found

the opposite, although in a smaller number of studies (Krumsvik et al., 2016; Siddiq & Scherer, 2019), and some other studies point to the lack of differences (Guillén-Gámez & Peña, 2020; Usart et al., 2021).

In terms of age, a few previous studies have concluded that older teachers or future teachers have more advanced competences (Wild & Heuling, 2020). However, contradictory results have also been found by other authors, who attest that older students self-evaluate with less competences than the younger students (Usart et al., 2021), although some of them recognized the need for professional development on the use of digital technologies (Hämäläinen et al., 2021). Other studies have not found age to be a significant factor for digital competence (Napal et al., 2018; Vega-Gea et al., 2021).

Considering the different but related studies, as of today, there is a lack of studies on: (1) how the level of digital competence could have an effect on the academic performance of the students, and the consequences of repeating a year (García-Prieto, 2022); (2) how the level of education of the parents could have an influence on the level of digital competence of the children; and (3) how the time that passes between the last period of formal studies and the present one could have an influence on the competences of the students, more specifically in digital competences. From all these shortcomings, our contribution arises with this study, with the purpose of taking a step further in this type of study. Therefore, all of these are encompassed in the objectives of the study, which were described below:

1. To discover the level of digital competence of Higher Education students in relation to whether or not they had repeated a course or not.
2. To identify predictors that affect the acquisition of digital competence, for both students who have repeated a course at some point, as well students who have never repeated.
3. To predict the level of digital competence, depending on the relationship of different co-variables (gender, age, number of digital resources, level of education of the father and mother, level of preparation to face educational changes, and time between one study and another).

3 Method

3.1 Design and Participants

To achieve the objectives set, a non-experimental, ex post facto design was utilized. The collection of data was conducted through a non-probabilistic, convenience sampling method (Emerson, 2015), during the 2020/2021 academic year, which was conducted online since the start of the pandemic. Our sample was composed by more than 20,000 students from the AIEP Andres Bello University in Chile. Once the database was screened with respect to lost or atypical values, the sample was composed by a total of 17,301 students. As for the sociodemographic characteristics, 68.70% were female (n = 11.887), with an average age of 26.62 years old, who used between 2 and 3 technological devices to study during their first year of their degree; while 31.30% were men (n = 5.414), with an average age of 28.20 years old, and with a mean use of 3–4 technological devices to study. With respect to repeating a year, 22.90% of the female students had repeated, while for the men, 28.40% had done so (n = 1538).
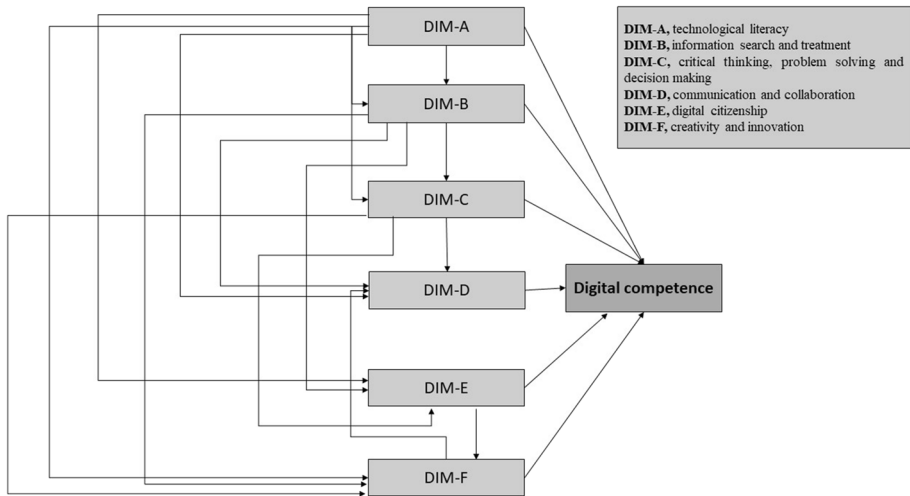
Fig. 1 Causal model of the instrument

Table 1 Reliability of the instrument

	D1	D2	D3	D4	D5	D6
Cronbach's alpha	0.88	0.91	0.88	0.90	0.94	0.95
CR	0.91	0.93	0.93	0.92	0.95	0.96
AVE	0.62	0.74	0.81	0.70	0.80	0.80

3.2 Instrument

The questionnaire was composed by a total of 30 items, classified into five endogenous and exogenous dimensions through a causal model, adapted from the works of Gutiérrez-Castillo (2013), Gutiérrez-Castillo & Cabero (2016) and Gutiérrez-Castillo et al. (2017). (The model was the following: DIM-A technological literacy (13 items), DIM-B, search and treatment of information (6 items); DIM-C, critical thinking, problem solving, and decision making (4 items), DIM-D, communication and collaboration (9 items), DIM-E, digital citizenship (6 items), DIM-F, creativity and innovation (6 items). The different dimensions of the model were justified starting from the works by Rush & Renguette (2017) (DIM-A); van Laar et al. (2019) (DIM-B); Pötzsch (2019) (DIM-C); Midtlund et al. (2021) (DIM-D); Mattson (2017) (CIM-E); and Genlott et al. (2019) (DIM-F). The causal model is shown in Fig. 1.

The reliability criteria were satisfactory (Table 1): this was measured with Cronbach's alpha and composite reliability (CR), with adequate levels found for each dimension. With respect to validity, the instrument possessed convergent validity and discriminant validity, and was evaluated with a structural model. The convergent validity was measured for each dimension through the average variance extracted (AVE), with a good fit of the model found, as shown by values higher than 0.50, as observed in Table 1, and as recommended by the scientific literature (Bagozzi & Yi, 1988). The evaluation of the structural model was conducted with the R^2 coefficient of determination, and the coefficients path and the

bootstrapping technique starting with a value obtained with Student's t test. These statistical tests showed a good fit of the instrument. Also, the SRMR (standardized root mean residual) provided a coefficient of 0.049, with a value lower than 0.08 recommended by Hu & Bentler (1999), as well as the NFI (Normed Fit Index) criteria, which should be greater or equal to 0.90 (Lohmöller, 1989), with a value of 0.903 provided. Therefore, the model was satisfactory.

4 Results

The results are divided into the following sections: the first analyses and compares the means of the student's digital competence as a function of having repeated or not; the second section analyzes the significant predictors of the student's digital competence through the use of multiple linear regressions; and lastly, the co-variables that are predictors of a high digital competence are identified.

4.1 Descriptive Results for the Students who are Repeaters and those who are not

To answer the question number 1, the Fig. 2 shows the level of digital competence of the students for each dimension of the instrument, depending on having repeated an academic year. It is observed that the level of digital competence is greater in dimension A (technological literacy), for both types of students, with it being higher for the non-repeaters. On the contrary, it is observed that the students possess an inferior competence in dimension C (critical thinking, problem solution, and decision making), and dimension F (creativity and innovation), for both types of students, although it was lower for the repeaters. If we set the criteria that students had to have a medium–high (7.5/10) digital competence, it was observed that only dimensions A and B obtained scores higher than 7.50. In general, it was
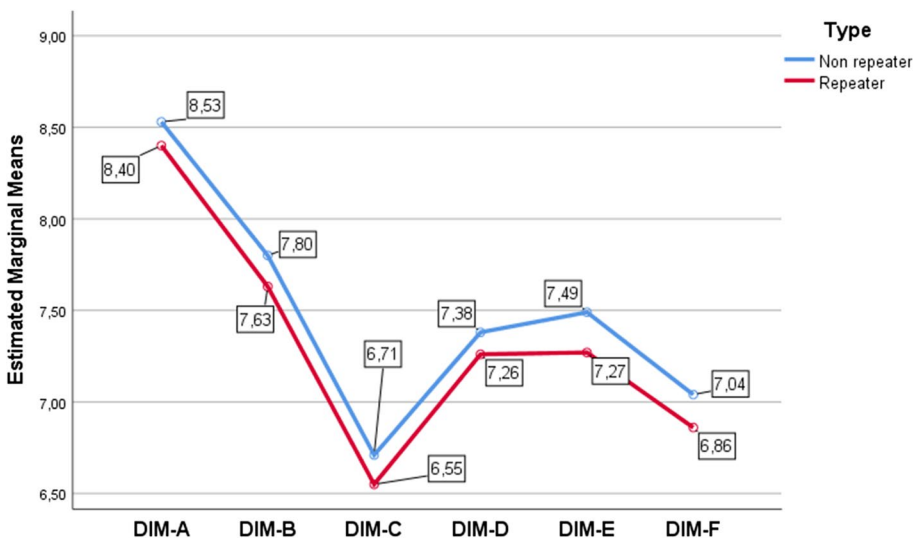

Fig. 2 Digital competence of the students as a function of repeating or not an academic year at some point

observed that the non-repeating students obtained higher scores than the repeaters in all the dimensions of the instrument.

To verify if the differences found in the scores shown in Fig. 2 were significant, statistical and comparative tests were performed with these scores. The Kolmogorov–Smirnov test indicated the non-normality of the data in all the dimensions of the study and the overall score ($p < 0.05$). However, Srivastava (1959) affirmed that non-normality would not have a serious effect on the distribution of data from large samples (in our case, n = 17,301). Therefore, parametric (Student's t test), as well as non-parametric (Mann–Whitney test) statistics were utilized to compare the distributions as a function of the students repeating or not, to compare if similar values were obtained in both types of tests. With respect to the effect size of the cases in which significant differences were found, Hattie (1992) interpreted the magnitude of the effect size for education contexts according to the formula by Cohen: values lower than 0.1 with "developmental effects", between 0.2 and 0.3 with "teacher effects", and values greater than 0.4 with "Zone of desired effects".

Table 2 shows the dimensions in which significant differences were found in the scores between both types of students. It was observed that after the application of both statistical tests, the results were similar: statistically significant differences were found in the level of digital competence of the student, as a function of repeating an academic year or not. With respect to the effect sizes, it was observed that all of them were small in all the dimensions (approximately 0.1).

4.2 Identification of Factors that Affect the Level of Competence of the Students

To answer the question number 2, variables were identified which had an influence on the digital competence of students, through two multiple linear regressions (MLR). The first regression focused on the total level of digital competence of the students (sum of all the dimensions) for the students who had never repeated, while the second regression was centered on the students who had repeated at some point. It was estimated with the ordinary least squares method, with the forward method, in which each variable is inserted into a new model if it attains the level of significance established (> 0.05) once the influence from the other variables which have entered the model is eliminated (principle of parsimony). The different variables analyzed are described in Table 3, considering that they were codified into dummy variables.

Table 2 Statistical comparison for each dimension of the instrument between the repeating and non-repeating students

Dimensions	Mann–Whitney				Student's t test		
	U	Z	p	(d)	t	p	(d)
DIM−A	26,576,465.500	−4.239	.001	.064	4.974	.001	0.088
DIM−B	26,406,632.000	−4.833	.001	.073	5.313	.001	0.094
DIM−C	26,732,565.500	−3.681	.001	.056	3.789	.001	0.067
DIM−D	26,893,581.000	−3.110	.001	.047	3.417	.001	0.060
DIM−E	26,288,476.000	−5.253	.001	.08	5.536	.001	0.098
DIM−F	26,570,239.000	−4.252	.001	.065	4.596	.001	0.081
Total CD	26,424,843.000	−4.764	.001	.072	5.298	.001	0.094

Table 3 Description of the study variables

ID	Variable	Categories and values
	Digital Competence	Max. 10 points
IV 1	Gender	Female (0); Male (1)
IV 2	Age	Scala
IV 3	How much time has passed since your last period of formal education?	Less than a year (0); between 1 and 2 years (1); between 3 and 5 years (2); between 5 and 10 years (3); more than 10 years (4)
IV 4	How prepared are you to face the challenge of studying your degree?	7-point Likert scale
IV 5	Number of digital resources used throughout the year to study	Scale
IV 6	Level of education of the Father	None (0); Early Childhood Educa-
IV 7	Level of education of the Mother	tion (1); Primary Education (2); Secondary Education (3), Bac-calaureate (4); University Degree (5); Doctorate (6)

Table 4 shows that for students who had repeated at some point, it is in the fifth step in which a greater percentage of the explained variance is obtained (14.20%). The regression model was statistically significant, $F(4, 4253) = 141.978$, $p < 0.01$. For the students who had repeated a year previously, it was observed the greatest percentage of variance explained was achieved on the sixth step (14.60). Also, the model was also significant, $F(6, 13,035) = 372,080$, $p < 0.01$. These data show that the percentage of total variance explained in the digital competence of the students, through sociodemographic and academic variables, is moderately good and homogenous in both groups.

Table 5 shows the factorial loads standardized for each type of student, along with its level of significance. For the students who had repeated at some point, it was observed that the variable with the strongest influence at the level of digital competence was the number of digital resources used to study ($\beta = 0.218$; $t = 15.090$; $p. < 0.05$), with values that were very similar to the variable "previous preparation for studying the degree" ($\beta = 0.214$; $t = 14.723$; $p. < 0.05$). These coefficients are also similar for the students who had never repeated, for the number of digital resources ($\beta = 0.199$; $t = 23.913$; $p. < 0.05$), as well as the previous preparation for studying the degree ($\beta = 0.228$; $t = 27.305$; $p. < 0.05$). As for the significant variables with a weaker influence, it was observed that for the repeaters, it was the predictor age, with a negative load ($\beta = -0.093$; $t = -4.910$; $p. < 0.05$); while for the non-repeaters, it was gender ($\beta = -0.026$; $t = -3.242$; $p. < 0.05$). Lastly, the assumption of multicollinearity was verified through the tolerance values (Tol) and the variance inflation factor (VIF). As observed, the tolerance values were greater than 0.6, and the VIF values were lower than 10, which indicates non-collinearity (Chan, 2004).

Considering the coefficients standardized for each type of student, the rate of success on the digital competence of the student will be calculated through its corresponding slope of a line for each type of student.

$Y_{repeater} = 5.067 - 0.093*VI\ 2 + 0.050*\ VI\ 3 + 0.214*VI\ 4 + 0.218*VI\ 5 + 0.147*VI\ 6$.

$Y_{non-repeater} = 5.303 - 0.026*VI\ 1 - 0.099*VI\ 2 + 0.044*VI\ 3 +, \ 0.228*VI\ 4 + 0.199*VI\ 5 + 0.143*VI\ 6$.

Table 4 RLM predictive model

Type	N = 17.301 Models	R² repeater = 14.20%			R² non-repeater = 14.60%	
		R	R²	R² corrected	Standard error	Change in R²
Repeated at some point	1: IV5 + IV4	.247	.061	.061	1.749	.061
	2: IV5 + IV4	.338	.114	.113	1.699	.053
	3: IV5 + IV4 + IV6	.371	.138	.137	1.676	.024
	4: IV5 + IV4 + IV6 + IV2	.376	.142	.141	1.673	.004
	5: IV5 + IV4 + IV6 + IV3	.378	.143	.142	1.672	.001
Never repeated	1: IV4 + IV5	.270	.073	.073	1.661	.073
	2: IV4 + IV5	.344	.118	.118	1.620	.045
	3: IV4 + IV5 + IV6	.374	.140	.140	1.600	.022
	4: IV4 + IV5 + IV6 + IV2	.380	.145	.144	1.596	.005
	5: IV4 + IV5 + IV6 + IV2 + IV3	.381	.146	.145	1.595	.001
	6: IV4 + IV5 + IV6 + IV2 + IV3 + IV1	.382	.146	.146	1.595	.001

Table 5 Factorial loads for each model and their independent variables

	Has repeated at some point					Has never repeated				
	β	t	p	Tol	VIF	β	t	p	Tol	VIF
Constant	5.067	31.874	.001*			5.303	62.199	0001		
VI 1	0.012	0.810	.418	.963	1.039	−0.026	−3.242	.001*	.981	1.019
VI 2	−0.093	−4.910	.001*	.661	1.781	−0.099	−8.582	.001*	.693	2.028
VI 3	0.050	2.644	.008*	.656	1.798	0.044	3.761	.001*	.684	2.067
VI 4	0.214	14.723	.001*	.953	1.049	0.228	27.305	.001*	.938	1.066
VI 5	0.218	15.090	.001*	.963	1.038	0.199	23.913	.001*	.950	1.052
VI 6	0.147	9.320	.001*	.809	1.236	0.143	15.831	.001*	.801	1.248
VI 7	0.010	0.659	.510	.794	1.259	0.005	0.588	.557	.779	1.284

*Level of significance at 95%

4.3 Results From the Classification Techniques (trees) for Both Types of Students

With the objectives reached up to now, it was verified that there are significant differences at the total level of digital competence of students, as a function of having repeated or not; as well as the significant predictors that have an effect on their acquisition of digital competence. But, in what order do these significant predictors affect digital competence? Are some predictors associated with others for attaining of a higher success rate (probability) on the level of digital competence? Classification trees analysis is the ideal method for answering these questions, and therefore, the purpose of the study number 3.

Segment trees (Ritschard, 2013), seem to have the best prediction probabilities as compared with other classification techniques, mainly when the data are treated at the categorical level with a small number of categories (Richard et al., 2008). For this, our dependent variable was re-codified into two categories (mean digital competence of the students, with scores lower than 7.5 over 10; and high digital competence, with scores higher than 7.5 over 10). With respect to the independent variables, some of them were re-codified as well: number of digital resources for studying, with two options (at least three resources / more than three resources); previous preparation for studying the degree, with three options (not prepared/moderately/very); length of time between the last period of education and the present one (a year/more than a year), and lastly, the parent's education, with two options (no education/having a university degree). With these values, the classification model was estimated, with the determination of a model which allowed the correct classification with a mean of 61% of the students, among those who possessed an average or high level of digital competence, starting with the separation of the type of student (repeaters or not).

The tree in Fig. 3 focuses on the students who had never repeated an academic year. Node 3 shows the student who is not motivated to face the academic year, where the probability of having a high digital competence is only 35.10%. However, although they are not well motivated, if they use more than three digital resources in their learning process, the probability of obtaining a high competence increases to 44.80% of success. Node 1 classifies those who are not well prepared to face their degree at 73.80%. Also, 45.70% of them have a low competence. However, even though they are not well prepared to obtain the degree, if they use more than three digital resources in their learning process, and also have a father with a university degree, they will have a possibility of obtaining a higher digital
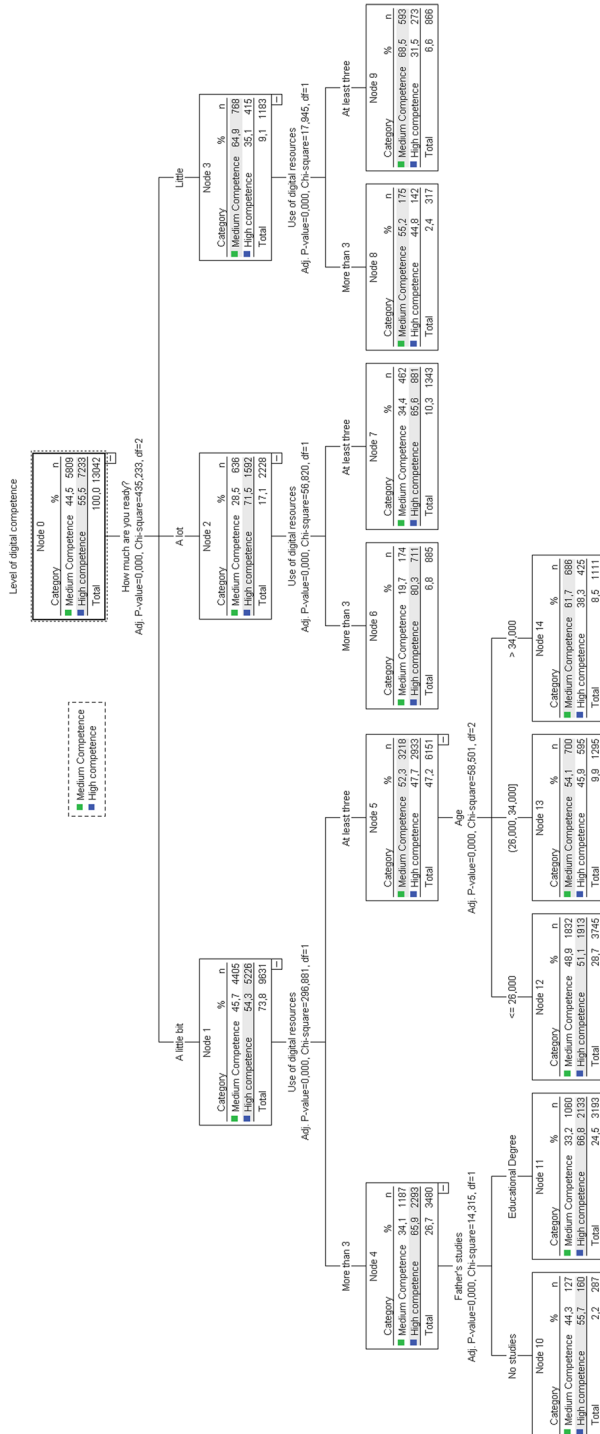
Fig. 3 Classification tree of students who have never repeated

competence, with a probability of 66.80%. On the contrary, if the student is very motivated (node 2), they have a probability of success in having a high digital competence of 71.50%. Even more so, this percentage increases if the students use more than three digital resources to study during their process of learning (80.30% of success).

The tree shown in Fig. 4 focuses on students who have repeated at some point. It is observed that students who have repeated some academic year would only have a 52% of successfully having a high level of competency. However, this percentage could increase as a function of the use and relationship of different variables. For example, if the students use more than three digital resources in their learning process, their probability of acquiring a high level of digital competence would increase to 66%. If the student uses less than three digital resources, but is very motivated, the probability of obtaining a high competence would increase to 61.80%. However, if the student is not well motivated, but has a father with university education, the probability of obtaining a high competence could be 46.30%,
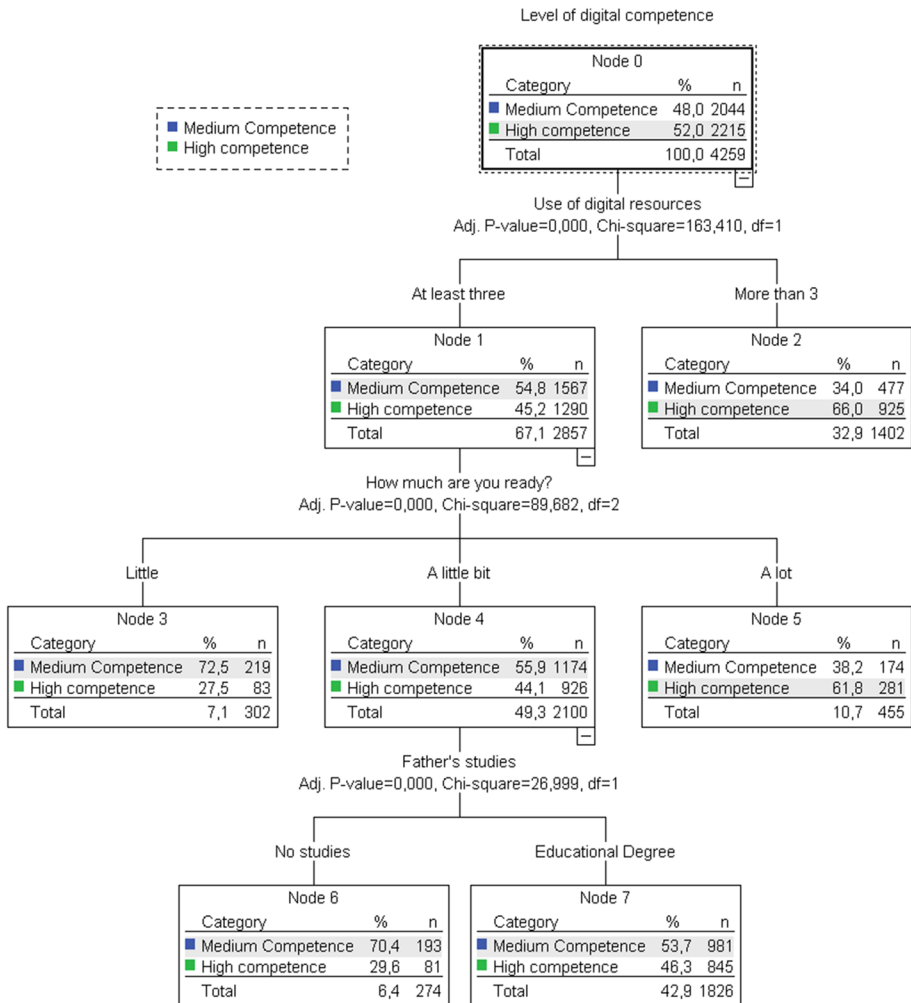

Fig. 4 Classification tree of students who have repeated at some point in time

as compared to those whose parents do not have an education, who will have a 29.60% probability of success.

5 Discussion

In first place, the study revealed that the students had average levels in all the dimensions that composed the digital competence construct (O1), very positively highlighting the dimensions DIM-A (technological literacy), and DIM-B (search and treatment of information), while negatively highlighting the dimension DIM-C (critical thinking, problem resolution and decision making). These results are similar to those found in studies by Bernate et al. (2020) on digital literacy, and van Deursen and van Diepen (2013), on critical thinking and problem resolution, although they were contradictory to the studies by Belmonte et al. (2019), and Fleaca and Stanciu (2019), with respect to the digital literacy of the students. These results bring to light the need to establish training plans, which will ensure that they are more able to function in digital technological scenarios in which they will have to live in a future that is ever closer.

Also, the present study compared the level of digital competence of the students as a function of having previously repeated an academic year. The results indicated a significant difference, with better digital skills observed in those who had not repeated. These findings coincide with the ideas from Garcia & Jimenez (2019), who affirmed that a low academic performance was closely associated with repeating a year, where the use of digital media to obtain scientific knowledge could improve learning (Hernández-Martín et al., 2021; Maria & Awan, 2019), with an existing symbiosis between digital competence and academic performance (Alderete & Formichella, 2016; Mehrvarz et al., 2021). These results point to the need to think about the teachers having a great range of digital resources at the service of pedagogy. Resources that are presently easier to access than in the past, on the one hand, due to the diversity of technologies offered by Web 2.0, and on the other hand, because there is an increasing number of institutional repositories of learning objects that can be utilized by teachers.

In second place, the present study discovered some significant predictors, for both types of students (O2). The first predictor for both types of students was age, with a negative bidirectional correlation. These results coincided with those presented by Usart et al. (2021), who found that the older students self-evaluated themselves as less competent that the younger students, with these ideas contradictory to those from Wild & Heuling (2020). As compared to this panorama, there is a need to continue moving forward on the use of the ICT by the collectives who need them (Hämäläinen et al., 2021).

Another positive and significant factor was the use of ICT resources in the acquisition of this competence, for both types of students (repeaters and non-repeaters). These results coincide with those from Ghomi & Redecker (2019), and Lucas et al. (2021), who found a relationship between the number of digital resources and a good digital literacy, and Mayor et al. (2019), who found a close relationship between the use of social networks and digital competences. Based on these conclusions, it is vital for education centers to provide teachers with adequate technological infrastructures, have digital resources available, in order to interconnect pedagogic methodologies of the educators with the virtual learning environments, which may result in a good digital education (Martinez-Lopez et al., 2020).

As for how the parent's education affects the digital competence of their children, disparate results were found, depending if the student had repeated or not before. For the

students who had never repeated, the levels of education of both mother and father were significant predictors, coinciding with the results from Idris et al. (2020) and Odoh et al. (2017), but contradictory to those from Morabito et al. (2018), who stated that children who had parents who were not well educated obtained a very good academic performance. As for the students who repeated, only the level of education of the father had an influence on the digital skills of the children, similar to the results described by Li and Qiu (2018) and Wijaya et al. (2020), although contradictory once again to Morabito et al. (2018). In light of these discussions, we can attest that the parent's perceptions of technologies have an effect on their use by the students. In this sense, training on digital competences not only of the teachers and students, but also of global citizens, is recommended. Nevertheless, these data must be reflected on, and used with caution, with continued research on this line of work of vital importance.

Lastly, the co-variables that significantly affected the achievement of the student's digital competence were identified, for both repeaters and non-repeaters (O3). Both types of students coincided in that the number of digital resources used in their teaching–learning process, their self-perception of previous preparation for studying their degree, as well as the father's education, were predictors that indirectly and in a correlated manner, affected the success rate in the digital competence of the student.

6 Conclusions and Future Work

The research has allowed us to answer the questions of our study and thus achieve the different objectives proposed in it:

In reference to O1, the study has confirmed that the digital competence of students is different depending on whether or not they have repeated an academic year, with those who have never repeated a course showing better digital skills than those who have. Students who have not repeated any academic year show a higher level of digital competence in all the dimensions analyzed in the questionnaire. Respect O2, we also point out that independently of the students repeating an academic year or not, the mastery in each of the dimensions was similar between the repeaters and the non-repeaters. Higher levels were found in both collectives in the dimensions "technological literacy", and "search and treatment of the information". The dimensions that obtained the lowest scores were "critical thinking" and "creativity and innovation". The study shows that some variables increased the repeaters' level of digital competence, such as the use of more technological resources (O3). This was also found with the students who had not repeated any academic year. Although for this last group, the perception they have on their preparation to obtain their degree was presented as an indicator of an increase in their digital competence.

As for the limitations of the study, it is necessary to reflect on its weaknesses to improve it with future research. Perhaps the main weakness was the type of sampling utilized. For this study, an intentional sampling was used, which means that the sample was not random, and therefore, the results obtained cannot be extrapolated to every degree or faculty, or every area of knowledge. This weakness could be improved in future studies through probabilistic samples from every area of knowledge, or on the contrary, if this is not possible, with intentional sampling that allows collecting the perceptions of students in every area of knowledge (for example, Engineering, Education, or Health sciences, among others), as well as for public and private institutions. In this way, it would not be necessary to increase

the size of the sample, but the results would be more representative and transferable to every type of student.

Another limitation of the study is also related with the type of design utilized. For this study, a non-experimental, ex post facto design was utilized. Perhaps it would be interesting for future studies to utilize pre-experimental designs, in which training classes are implemented, specialized to each dimension of the instrument. If this is not possible, these training modules could be conducted through MOOCs, adapted to every area of knowledge.

Furthermore, it would be truly interesting to know the perceptions of the parents on their digital competences, as it has been demonstrated that although the level of education is closely related with the academic performance of the children, very few studies exist on the relationship of the digital competences between parents and children. Thus, it would be necessary to delve into and unify the entire education community into a same study: students, parents, and teachers. Research from this three-sided perspective could provide an interesting framework of action on training programs, whose implementation would go beyond addressing the technological education deficiencies in a limited manner, but in a specific one for each area of competence.

Data availability All datasets associated with this study are not publicly available as part of measures to ensure the confidentiality of the participants. However, the corresponding author may release may make the data available upon reasonable request.

Declarations

Conflict of interest The data was collected anonymously. Before the students did the questionnaire, the objectives of it were explained, guaranteeing the privacy of the personal data of the students.

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