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Does educators' digital competence improve entrepreneurial students' learning outcomes?

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Abstract

Transforming higher education due to digitalization is a critical challenge to ensure adequate capabilities for a more entrepreneurial economy. Studies about digital competence in higher education focus primarily on students' digital competence. There are few studies regarding educators' digital capabilities and students' learning outcomes. Following the economics of education theories and evidence-based education, this novel research is presented. The study aims to identify how educators' digital competence impacts education results, measured by students' learning perception and academic performance. Hypotheses are formulated to find evidence of the return on investment in education relevant to educational policies and higher education management. The goal was to find a model to understand how a specific relevant element of the teaching intervention i.e. the digital capabilities of the educators are reflected in students' learning outcomes. To that end, this study used a validated tool for digital education assessment (DigCompEdu) to collect data through an online self-administered questionnaire. Correlations and partial least squares structural equation modeling (PLS-SEM) method were used for the analysis. Higher education is essential for the economy and human capital development; therefore, understanding the relevant factors for teaching efficiency is pertinent. Findings show some relationship between professional commitment, digital teaching skills, and student perception of learning. Nevertheless, the analysis does not find a significant link between educators' digital competence and academic achievement. It is acknowledged that measurements in education are difficult due to the complexity and multidimensionality of this human process. The study's contribution is due to its novelty in studying a research gap in digital teaching skills and student outcomes. As a preliminary work, it intends to guide future explorations on education-based learning in universities to identify critical elements of students' achievements that can guide policymakers and university managers.

Keywords Higher education · Evidence-based education · Digital competence · Academic achievement · Human capital

Extended author information available on the last page of the article

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Introduction

The relevance of contributing to a more digitalized society is a primary goal of most governments and part of the political agenda of the EU (European Commission, 2014). In order to ensure our social welfare state and tackle the challenges posed by the post-pandemic society and the current climate and economic crises, it is essential to embrace digital citizenship. Education plays a crucial role in achieving this goal, as emphasized by international institutions such as the OECD (OECD, 2018). Since the last century, the economics of education has focused on the role of education as an instrument to build a more progressive and dynamic society resulting in wealth and economic development (Becker, 1994). This paper discusses an empirical result of educational intervention following the economics of education research.

Digital transformation of education has been an increasing studied research topic, especially after the Covid crisis (De Obesso et al., 2023). Efforts to conceptualize and organize all the knowledge around the different issues regarding online education have emerged (Greenhow et al., 2022). The challenges of integrating advances in artificial intelligence (AI) are currently under debate by various institutions. For example, the European Union highlighted digital teaching competence as one of the most significant issues in integrating emerging technologies into the educational landscape in their latest report *Technology in Education: emerging trends and policy implications* (Tuomi et al., 2023). The integrative inclusion of technology in education creates uncertainty because of the ambiguity and complexity of the teaching profession (Falloon, 2020). Recognizing the changes worldwide and the universities' role in developing a more digitalized society is essential to face the challenge (Krishnamurthy, 2020). It also reinforces the university's main mission as a bridge for students' employability and future society development (Van Der Velden & Allen, 2007). In today's knowledge economy and job market, there is an increasing demand for skills, abilities, and competencies that can effectively deal with the risk of automation (Holford, 2019; Sorgner, 2017). Digital competence is considered as one of the most important skills for individuals to access lifelong learning opportunities and entrepreneurial spirit (Morselli, 2019). At the same time, digital competence is also a key factor in the digital transformation of enterprises, where the digital competencies of employees play a significant role (Kafel et al., 2021). However, some authors claim that graduates do not have the profile that companies need (Alam et al., 2020) partly due to progressively unstoppable digital labor market needs (Bejaković & Mrnjavac, 2020) to ensure economic development and prosperity (Aparicio et al., 2016).

On the other hand, based on the constructivist theory of education, we consider learning a social activity in which people actively create their own understanding of reality influenced by their experiences, values, language, and education (Berger & Luckmann, 1991). This is the origin of the educational approach that focuses the student on the center of the educational process, named student-centered learning (O'Neill & McMahon, 2005). Based on these foundational thoughts and linked to the

search for a standardized model of education that allows measurement elements of the educational system for comparison and benchmarking, the competence-based system was embraced by the European Union at the beginning of the century to strengthen employment, economic reform, and social cohesion as part of a knowledge-based economy (European Council, 2000).

Due to these paradigm shifts, higher education in Europe has faced many changes in recent years compelled by digitalization, standardization and measurement systems, and new methodological approaches focused on skills (Del Pozo Andrés, 2009; Marcelo & Yot-Domínguez, 2019), creating a standard system of skills and competencies as measurable outcomes for higher education. The new educational model emphasizes the value of active and practical learning, going beyond traditional knowledge to develop the skills and capabilities that are in high demand in the job market. Students play a vital role in the learning-teaching process. Entrepreneurship and learnability are gaining importance in curricula, and they are supported and guided by expert professors in their respective areas of expertise who also have the need to adapt to the changing educational environment (Chalmers, 2012).

In the literature studying the efficacy of education, the impact of different elements is scrutinized to understand what influences student competence acquisition. In the competence learning approach, academic achievement is a key outcome to consider (Arens & Morin, 2016). The difficulty of measuring intervention and educational outcomes is a constant in the specialized literature, as is the need to measure it in order to be able to implement appropriate strategies or correct those that are not successful. The trend of measuring educational outcomes based on evidence leads us to consider education as an intervention that obtains results (Biesta, 2009; Gorard, 2020; Hattie, 2012; Swinson, 2012). These can be grades, drop-out rates, number of graduates, employment rates, number of companies created, etc.

Educators' digital competence (EDC) has been addressed as a primary teaching skill to foster a well-prepared future generation (Cabero-Almenara et al., 2022). Some previous authors' studies have revolved around how EDC has evolved since the pandemic (Núñez-Canal et al., 2022; Pérez-Rivero et al., 2022). Following this research line, now it is presented an empirical study about the relationship of this crucial faculty skill, with the academic students' achievement as a measurable outcome of the educational process.

The study aims to define how educators' digital competence impacts students' academic results, understanding that academic performance is an antecedent of students' future work and is related to the return on investment in their education (Hanushek & Woessmann, 2008). To determine the impact of an educator's digital competence on a student's academic performance, we have carried out an empirical study using quantitative methodology and developed an econometric model based on theories of economics of education and recent research on digital competence. The model measures the effect on two output concepts: first, the student's perception of learning, and second, the grades obtained by the student. We have analyzed a sample of 243 students using correlations and the PLS-SEM methodology with some specific results explaining the relationships.

Therefore, the work is structured as follows: first, a literature review is conducted to set the research question and the hypotheses; second, research methods based on

structure models is explained, as well as the phases for data collection and data treatment; third, the findings are described, followed by the discussion with the limitations of the study; finally, conclusions and implications of the research are exposed, jointly with future research lines.

Literature review

Changes in recent years leading to the so-called fourth industrial revolution (Schwab, 2016) have boosted digital literacy as a means and an end for students' learning. Technology, heightened by the 2020 health crisis, revolutionized the educational system (Bond et al., 2021). In addition, thanks to the adaptative capacity of institutions and their teaching staff, the hybrid training modality appeared (Benitez-Amado, 2020). Hybrid learning emerged without prior planning (Bozkurt & Sharma, 2020) as a logical evolution and opportunity for post-pandemic circumstances of mixing asynchronous and synchronous learning (Marinoni et al., 2020). The hybrid model meant an excellent investment for universities in hardware technology, software, platforms, etc., and the digital transformation of structures, faculty, and staff (Krishnamurthy, 2020). In this new reality, enhancing digital academic skills has become a priority resulting in faculty training in online teaching, learning management system, hybrid classes, assessment systems, content generation, feedback, etc. (De Obesso & Nuñez-Canal, 2021). Furthermore, universities are integrating technologies beyond online learning as a primary element in all teaching-learning processes (Al-Samarraie et al., 2018). The appearance of AI generative models has advanced this evolution by integrating new apps as ChatGPT that can replace the way students work, the learning process and, especially, how they have been assessed to date (Tuomi et al., 2023). All this has led to a real revolution that has given great importance to the digital competences of educators (Bonfield et al., 2020). Therefore, digital competence in higher education has recently become of great interest to researchers (Núñez-Canal et al., 2022), and more works have been published (Zhao et al., 2021).

Moreover, digital university transformation has impacted the traditional role of educators. Other research has linked educators' digital competences to a better learning experience for students (Fuentes et al., 2019) and as a relevant aspect of higher education (Liesa-Orús et al., 2020). The increase in digitization leads attention to be focused on course design and types of student–teacher-content interactions (Bernard et al., 2009).

Educators' digital competences have guided different studies, such as TPACK model (Mishra & Koehler, 2006), which details three elements teachers can activate: discipline, pedagogy, and technology. Other European Commission studies are based on Ferrari's digital competence model DIGCOM (Ferrari et al., 2014). From this perspective, digital competence embraces five elements: information, communication, content creation, security and problem-solving. Cabero-Almenara (2006) favors the instrumental use of ICT, semiotic mastery, curriculum design, learning experience, students' cognitive development, resource creation, assessment

methods, digital critical thinking, institutional context, open-mindedness, and attitude, conducting research, and communication mastery.

To enhance and measure the digital competence of educators in developing digital literacy, the UE has developed a framework known as DigCompEdu.[1] This approach is based on the work of Redecker and Punie (2017) which has been validated for several studies at different levels of education (Antonio-Manuel Rodríguez-García et al., 2019).

Nevertheless, the relationship between educators' intervention, the role of their digital skills and the educational outcomes is still unexplored. Some articles are based on teaching efficacy investigations based on self-perceptions (Chang et al., 2011) or how some aspects of professional teaching competences impact instruction (Kunter et al., 2013). Moreover, at the school level, some research seeks a link between training and the productivity of teachers in promoting student achievement (Harris & Sass, 2011). Therefore, this study aims to be a pioneer preliminary work in researching the relationship between digital competence and learning outcome.

This work is focused on the challenging task of measuring educational outcomes, which is studied by the economy of education scholarly tradition. This field explains the crucial role of education investment in the economic prosperity of individuals and society, also known as human capital (Becker, 1994; Lassibille & Navarro Gómez, 2012). After measuring formal education, experience, and on-the-job training, human capital studies were complemented with research on the relevance of non-cognitive skills (Hanushek, 2013). Based on those theories, the OECD has been measuring educational outcomes with PISA reports giving an international framework for benchmarking, developing and improvements of educational policy systems.

The basic concept of these theoretical foundations is that education can be measured in different ways: student academic achievement is one of them, jointly with several intangible elements challenging to assess. After the famous Coleman report (Downey & Condron, 2016), which determined that schools did not offer a significant difference in learning outcomes but were responsible for perpetuating differences in socioeconomic inequalities between students, the most studied variable in the literature on education outcomes is the socioeconomic dimension of students due to its importance in academic achievement (Sirin, 2005). This variable is also confirmed at a higher educational level (Abu Saa et al., 2019). Nevertheless, academic success is considered a complex process involving institutional factors, such as support programs, and student characteristics, such as demographic factors (Mills et al., 2009).

Moreover, the economics of education philosophy is also little developed for higher education. The transition from the university environment to the labor market also gives rise to much theoretical and practical work on human capital (Allen & van der Velden, 2007). For example, the European Union education regulations' primary objective is to foster skills and competences for lifelong learning (European

[1] Access to the European Framework for the Digital Competence of Educators (DigCompEdu) https://joint-research-centre.ec.europa.eu/digcompedu_en

Council, 2018) in the context of future job decline in favor of automatization (Frey & Osborne, 2017).

The search for reliable educational outputs at the university level has led to the definition of constructs as intended learning outcomes – used more in the Anglo-Saxon context (Biggs, 2003) – and to the competence notion used in continental Europe. However, the origin of the construct competence as a desirable outcome of educational systems has to be founded in the OECD framework of the DeSeCo Project (Rychen & Salganik, 2003). Competence is an intricate reality that is more than knowledge and skills. "It involves the ability to cope with complex demands, relying on knowledge and mobilizing psychosocial resources (including skills, capacities and attitudes) in a particular context" (OECD, 2005).

A wide variety of studies tries to explain academic performance. Using data mining, several systematic reviews (Abu Saa et al., 2019) identify three groups of elements predicting academic performance: previous grades and class performance, students' e-Learning activity, and students' socio-demographic environments. It is important to highlight other relevant studies that link academic outcomes with student socioeconomic status as an antecedent of university success (Sirin, 2005).

Some recent research finds a relationship between reading competence according to the cognitive tradition (González-Betancor et al., 2022), while others search for a link between online students' activities and academic performance (Dima et al., 2022). In this sense, correlations of behavioral patterns with students' success have increased in recent literature. Furthermore, empirical analysis demonstrates that some behavioral factors strongly correlate with academic performance (Yao et al., 2019). More recently, after the COVID-19 pandemic, Dima et al. (2022) refer to the relationship of the ability to engage with online activities and with the learners' performance.

Education is influenced by a variety of factors, including the number of students, the socio-economic background of peers, the quality of previous education, and the educational system. However, our focus is primarily on the capacity of educators in higher education. The shift towards a new educational paradigm has led to changes in teaching practices by faculty. The student-centered learning approach shifts the professor's role as a facilitator of knowledge rather than an agent to convey concepts and theories (McCabe & O'Connor, 2014).

The relationship between the quality of education received and the qualifications and preparation of educators is beyond doubt (Tschannen-Moran & Hoy, 2001). As agents of all educational intervention elements, educators are considered the most important (Reyero, 2014; Rivkin et al., 2005). Teacher efficacy has proved to be powerfully related to many meaningful educational outcomes, such as teachers' persistence, enthusiasm, commitment and instructional behavior, and student outcomes, such as achievement, motivation, and self-efficacy beliefs (Tschannen-Moran & Hoy, 2001). The relationship between professional teachers' competence, pedagogy, and knowledge of their content area, as well as their intrinsic motivation, explains the impact on the students' results (Kunter et al., 2013). As Chang et al. (2011) have pointed out, teaching efficacy is a construct well-used in primary and secondary education research but almost non-existent at the university level. In this sense, teaching efficacy has been generally measured through faculty self-perception – based on Bandura's theories (Bandura, 1997) – of learning achievements. Other

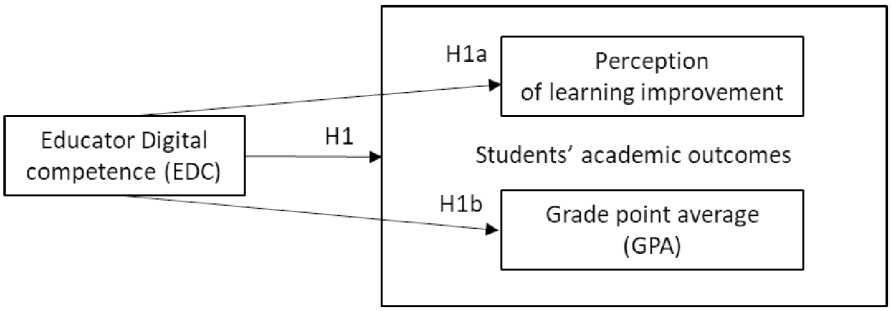

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Fig. 1 Hypotheses

ways of measuring are very limited in the literature and mostly based on student satisfaction questionnaires which have been criticized as considering students more as clients losing their educational purpose (Mark, 2013).

We aim to measure the digital capacity of faculty teachers and its impact on students' academic results. Furthermore, given the relevant role of technology, especially after the experience of the pandemic, where all teachers had to adapt to the digital context (Hervás-Gómez et al., 2021), Educator Digital Competence (EDC) has resulted in essential skills for university professors (Nascimbeni et al., 2019). However, the relationship of digital teaching skills has not yet been studied. This research gap leads to our main research question: To what extent is there a relationship between Digital Educator competence and students' academic outcomes?

Research methods and data collection

After conducting a thorough literature review on the primary theories of the economics of education and previous research on the educators' digital competences, and trying to answer the research question, we have developed a general hypothesis with two sub-hypotheses to be tested in our upcoming empirical study (see Fig. 1).

Hip 1: Educator Digital Competence impacts students' academic outcomes respectively:
Hip 1a: Measuring the student academic outcomes as learning self-perception
Hip 1b: Measuring the student academic outcomes as average grades

Our research methodology involves conducting an empirical study through an online survey, using tested instruments to gather data for analysis and evaluation in order to validate our hypotheses. The DigCompEdu[2] model has traditionally been

[2] Access to the European Framework for Digital Competence for Educator "DigComEdu" https://joint-research-centre.ec.europa.eu/digcompedu_en

used for educators' self-assessment to evaluate the level of performance for each of the 22 competences divided in six areas: A.1.professional engagement; A.2. use of digital resources; A.3. digital teaching and learning; A.4. digital assessment methods; A.5 empowering learners in the use of IT; A.6. facilitating learners' digital competence. This establishes, on a Likert scale, the following levels of performance: A1 Beginner; A2 Explorer; B1 Integrator; B2 Expert; C1 Leader; and C2 Pioneer (Redecker, 2020). In this research, the tool was used to assess 22 digital competences from the learners' perspective, evaluating how they perceive their teachers' performance on each competence. In addition, the effectiveness of teaching in learning outcomes has been measured traditionally by student satisfaction questionnaires (Shevlin et al., 2000). In this sense, each question has been readapted from a self-assessment wording to ask students how they perceive their teachers' performance of these competences. We add a possible answer to complete the adaptation, such as "I cannot answer".

The contribution of this article is to look at the relationship between how students rate faculties' digital level of performance with their perception of learning (DeShields et al., 2005). In this sense, we introduce a dependent self-perceived learning question: *To what extent do you think that educators' digital competences have improved your students' learning (where 1: Very little and 6: Very much)?*

However, we have also tried to further relate this assessment of teachers' digital capacity with student learning outcomes through the grade point average (GPA) achieved up to the moment of applying the survey. The marking scale at universities in Spain is usually over a 10-point rating. To retrieve that information, the following question was included: *Could you tell your average mark known at this moment*? Students could answer only one of the following options: 1. More than 9 average points; 2. Between 8 and 8.9 average points; 3. Between 7 and 7.9 average points; 4. Between 6 and 6.9 average points; 5. Between 5 and 5.9 average points. By introducing not only students' perceptions as input, but also their academic results score to evaluate the quality of teaching, we can continue to propose improvements in educators' skills and methodologies.

This paper analyzes the results of the responses of 268 students from different universities and colleges in Spain in business administration and management studies gathered between November 2021 and January 2022 (see Table 1). The data were collected through an online survey distributed in several cities in Spain among undergraduate students from different academic years. In addition, we have conducted a non-probabilistic study of the data collected from the students, for which we have used the snowball sampling methodology.

Table 2 shows the main data of the survey conducted. Regarding gender, 54.1% of the respondents are male, 45.9% are female and about 90% are aged between 17 and 22. Half of the students are enrolled in marketing degrees followed by students studying business administration or digital business. The students interviewed are concentrated in the first three years, half of them in the first academic year.

Table 1 Data of Sampling of Digital Educators' Competence Study

Scope	National (Madrid, Valencia, Barcelona, Zaragoza, Sevilla and Málaga)
Universe	University population of both sexes aged 18 and over in Spanish universities
Sample size	Pilot test (design phase): 050 observations Made: 243 observations
Sampling procedure	Simple random sample, non-probabilistic by snowball methodology Data collection through sending the questionnaire to email accounts of the database of students of the universities
Compliance	The survey has the approval of the Research Ethics Committee of the University of origin of the students, with acceptance of the use of data for research purposes.
Sampling error	For a confidence level of 95%, the error is ± 2%.
Date	From 1 November 2021 to 22 December 2021

Source: Prepared by the author

Results

In this scholarly exploration, we collected and analyzed data to understand the significant relationship in the education process focusing on educators' skills and learning outcomes. The discussion of the results could provide insight into the efficiency of education interventions and the relevance of digital educators' skills in the learning process.

Regarding the assessment of Educators' Digital Competence, students consider the level of their professors' digital skills to be medium–high. However, more than 88% of students rate the digital skills of their teachers as medium, i.e. inclusive, or higher. This is surprising, as digital learners give this rating over faculty teachers; the researchers expected lower values (see Fig. 2).

The second finding is based on the assessment of students about the relevance of EDC in the improvement of their learning. It has been found that educators' digital competencies have had a positive impact on their learning. Approximately 89% of students reported a medium level or higher improvement in their learning. Moreover, 70% of students rated the impact at level 4 (quite a lot), with the highest rating being level 6 (a lot). Finally, only 11% consider that the impact *has been little or minimal* (see Fig. 3).

Students were asked about their GPA to investigate variable relationships. From the 268 surveys received, 49 data were lost because 40 did not know the average mark and the remaining nine preferred not to answer. The result of the 219 valid responses, was that around 65% had obtained a GPA (from 0–10) of 7 points or higher. Only four students reported an average mark of fewer than 5 points, equivalent to 1.8% of the total number of valid answers (see Fig. 4).

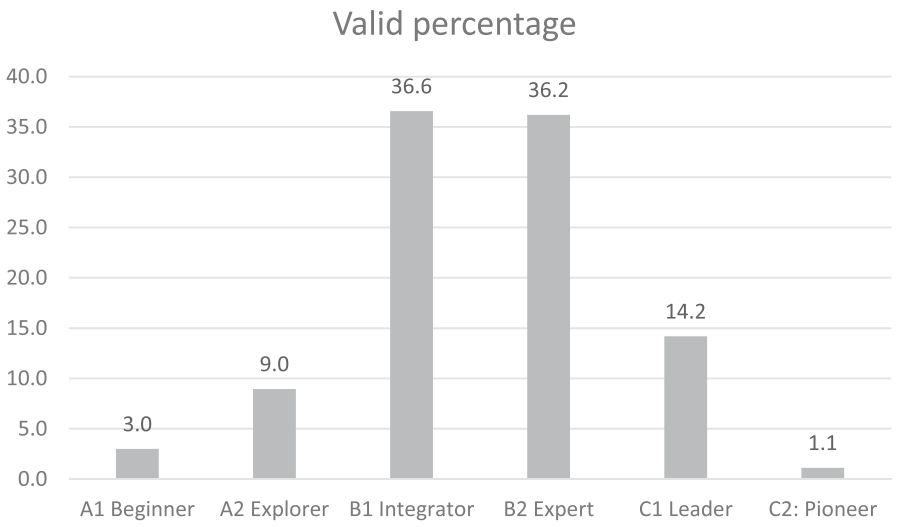
Once the variables under study were identified, we conducted a search to find a relevant relationship among the data collected and the variables to complete the study. The Pearson correlation analysis shows that one of the test relationships is

Table 2 Profile of respondents

Variable	Values	Frequency	Percentage
Gender	Male	145	54.1%
	Female	123	45.9%
Age	From 17 to 19	119	44.4%
	From 20 to 22	119	44.4%
	From 23 to 25	22	8.2%
	From 26 to 31	4	1.5%
	From 32 to 34	1	0.4%
	From 35 to 40	1	0.4%
	More than 50 years	2	0.7%
Studies in progress	Business administration	52	19.4%
	Marketing	141	52.6%
	Communication	15	5.6%
	Digital business	44	16.4%
	Human resources	1	0.4%
	Others	15	5.6%
Current academic year	1º	133	49.6%
	2º	43	16.0%
	3º	85	31.7%
	4º	3	1.1%
	Postgraduate	4	1.4%
Universities	Public university	13	4.9%
	Private university	209	78.0%
	Centre attached to a public university	31	11.6%
	Centre attached to a private university	15	5.6%
Total		268	100.0%

Source: Prepared by the authors

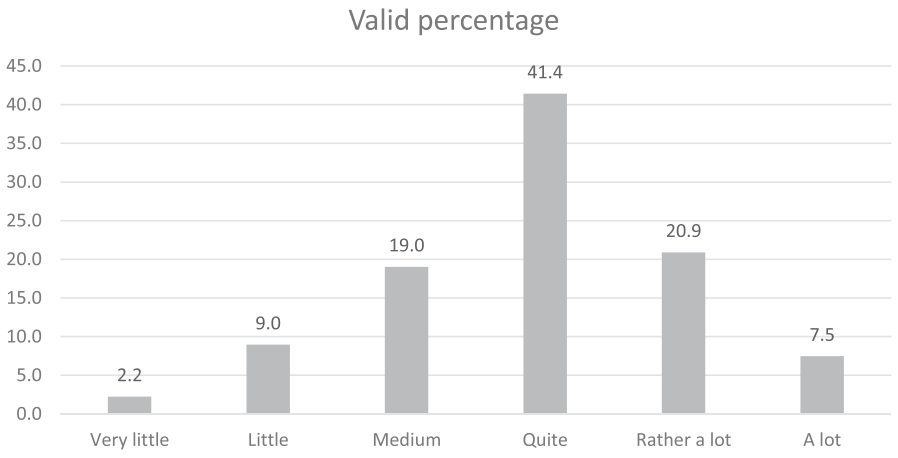
significant at the 0.01 bilateral level. The results, as presented in Table 3, are positive (sig = 0.000) when we relate the variable that assesses the students' perceived EDC level with their learning outcomes measured by their perception of learning. However, the same test concludes that there is almost no correlation between the EDC level variable and the students' academic performance measured by their GDP. In the latter case, the results are not bilaterally significant (sig = 0.491), which is well above the 0.05 level required for the correlation to be significant. When we looked for the correlation between the variable that assesses the EDC level globally in the current academic year and the variable that measures students' outcomes, we found that the correlation between them is almost zero. Therefore, this analysis concludes that the students' GPA is not correlated with the level of performance of the faculty teachers as assessed through their digital competences, nor with the students' perception of their own learning.



Source: Prepared by the authors

Fig. 2 How do you evaluate the digital competences of your educators globally in the current academic year? Assign a proficiency level of A1 to C2, where 1.A1 is the lowest and 6.C2 the highest

Therefore, the results of the analysis show a relationship between the EDC and perception of learning and do not show a relationship between the EDC and GPA of the student. According to that result, *H1* is only partially confirmed as only *H1a* has a positive relationship and *H1b* has not been confirmed. Results are reflected in Fig. 5.



Source: Prepared by the authors

Fig. 3 To what extent do you think educators' digital skills have improved students' learning? (being 1: Very little and 6: A lot)

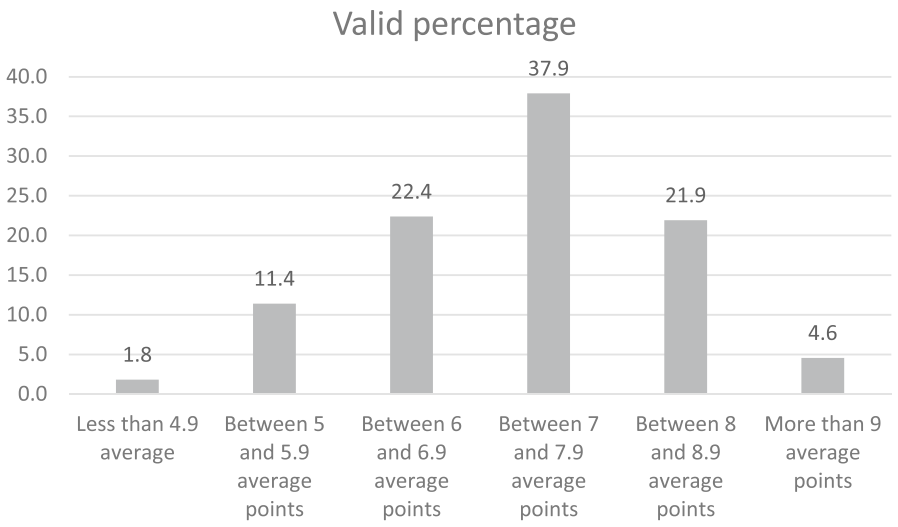


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Fig. 4 Could you give your average mark known at this moment?

According to Nunnally and Bernstein (1994), to ensure the model's reliability, Cronbach's alpha should not be lower than the critical value of 0.7. In this study, a result of 0.928 is assumed (see Table 4), which guarantees a sufficient level of explained variance.

Based on the analysis results, there appears to be a connection between EDC and the perception of learning, but there is no evidence of a relationship between EDC and student GPA. Therefore, to complete the analysis a PLS-SEM (Partial Least Squares Structural Equation Modeling) test is conducted. PLS-SEM is a statistical technique that can be used for a variety of research applications, as well as in the search of digital relationships in education (He et al., 2021). The PLS-SEM method has been used to delve deeper into the possible causal links and to estimate the variables' interrelationships, as shown in Fig. 6.

The literature justifies the use of the PLS-SEM model by a better fit in investigations with small sample sizes or better parameter accuracy for non-normal data (Tenenhaus et al., 2005). Hair et al. (2019) identify that a significant advantage of PLS-SEM is the causal prediction capability, which combines a prediction-oriented approach with factor-based theory confirmation, and is therefore widely used in exploratory research applied to management (Ramli et al., 2019), and as in the present case of assessing the impact of EDC on the learners' outcomes. The results of the correlations after applying the PSL-SEM technique can be observed in Fig. 6, where bold arrows show the significance. A summary that systematizes the findings is available in Table 5 where significance is when the p-value is under 0.05.

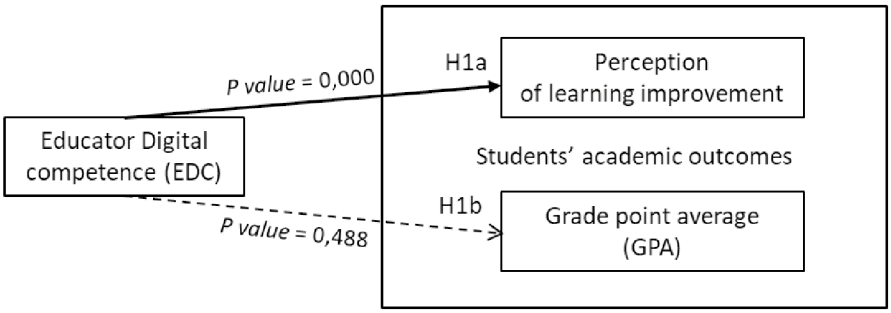
The study found significant positive relationships between *professional engagement* in Area 1 (v = 0.026) and *empowering students* in Area 5 (v = 0.003), with

Table 3 Pearson correlations

		To what extent do you think that educators' digital competences (EDC) have improved their students' learning? (1: Very little and 6: A lot)	How do you evaluate the digital competences of your educators globally in the current academic year? Assign a proficiency level of A1 to C2, where 1.A1 is the lowest and 6.C2 the highest	Do you know what your average mark is so far?
To what extent do you think that teachers' digital competences have improved their students' learning? (1: Very little and 6: A lot)	Pearson correlations	1	.375**	0.047
	Sig. (bilateral)		0.000	0.488
	N	268	268	219
How do you evaluate the digital competences of your educators globally in the current academic year? Assign a proficiency level of A1 to C2, where 1.A1 is the lowest and 6.C2 the highest	Pearson correlations	.375**	1	0.047
	Sig. (bilateral)	0.000		0.491
	N	268	268	219

Source: Prepared by the authors

**The correlation is significant at the 0.01 level (bilateral)



Source: Prepared by the authors

Fig. 5 Results

perception of learning improvements. There is also a value close to significance in *facilitating learners' digital competence* in Area 6 (v = 0.053) with perception of learning, but further studies are needed to clarify if it should be considered a relationship or excluded definitively. In addition, it is important to highlight that no significant relationships were found between the six competences of the EDC model when studied individually with the students' GPA.

Summarizing the results of the second study, we can confirm that the hypothesis has been partially conclusive (see Fig. 4). The general hypothesis H1: Digital Educators' competence impacts students' academic outcomes is moderately fulfilled. Firstly, when this result refers to the first sub-hypothesis 1a: *Measuring the student academic outcomes as learning self-perception,* we can see that from the six clusters where the 22 digital competences of educators are grouped, there are only a clear relationship in two of them: *1 Professional engagement of educators* and *5 Empowering students*. Finally, the other areas of study did not present results for connexions.

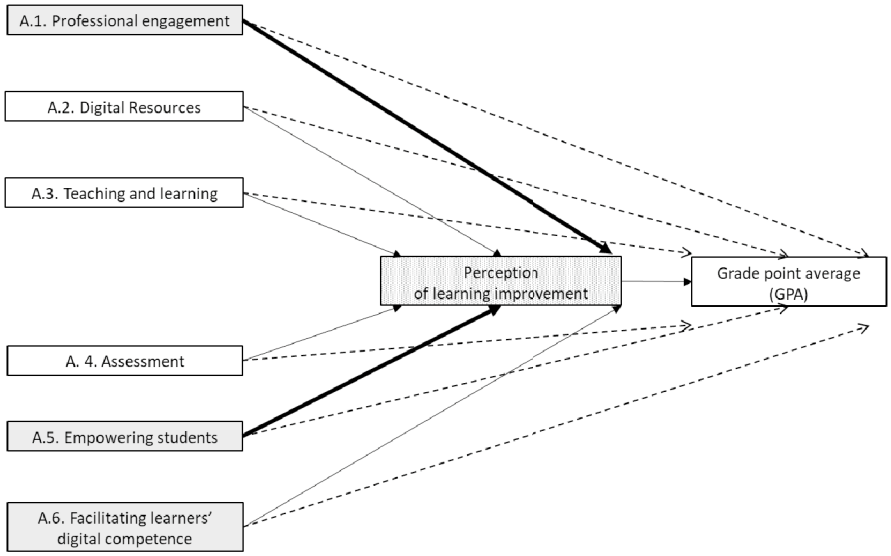
Discussion

The purpose of this paper is to cover a research gap in the literature measuring the possible impact of Educators' Digital Competence in the students' outcomes. The research findings can be contextualized within the discipline of economics of education and evidence-based education. These theories can be extended to tackle the new challenges that educational science is facing, especially in terms of efficiency and digital capabilities of instructors. This application implies a novel use of those theoretical frameworks resulting in some contribution to the economics of education theories.

Table 4 Cronbach's alpha

Reliability statistics	
Cronbach's alpha	No. of elements
.928	24

Source: Prepared by the authors



Source: Prepared by the authors

Fig. 6 Model of partial least squares structural equations (PLS-SEM)

The results show that there are few relationships between the EDC and the outcome variables. Only a few significant results were found when learning was measured by the students' perceptions. However, there is no evidence of any relationship between the level of performance of faculty's digital skills as perceived by students and the academic performance of students, either through the correlations of the variables or their linear relationships.

In addition, other findings of the study indicate that there are only limited connections between the conceptual model used to measure EDC, known as DigCompEdu, and the students' perception of learning. Only two out of the six competencies are relevant: professional engagement of educators and empowering students. The findings also suggest that the model may not be relevant to other competencies related to the pedagogical side, such as content creation, teaching and learning, and assessment.

If we analyze the first positive connection with student learning outcomes, we see that the professional engagement of the faculty is relevant for the learning process more than other educator competence. A possible explanation suggests that the influence of commitment and engagement of professors to teach efficacy depends more on their attitude towards technology and influences students' learning experience the most. This first result is coincident with previous studies where positive attitude of professors adopting technology has an influence on the students' learning perceptions (Liesa-Orús et al., 2020; Torrato et al., 2020). In addition, according to Kunter et al. (2013), the professional competence of the faculty is highly relevant in determining students' outcomes. The study highlights how teachers' professional

Table 5 Estimated layout coefficients of DigCompEdu areas with Perception of learning Improvement and Grade Point Average (GPA)

	Path Coefficients	P values
A.1. Professional engagement -> Learning improvements	0.156	***0.026***
A.1. Professional engagement -> GPA	0.156	0.105
A.2. Digital Resources -> Learning improvements	0.073	0.376
A.2. Digital Resources -> GPA	-0.100	0.260
A.3. Teaching and learning -> Learning improvements	0.121	0.149
A.3. Teaching and learning -> GPA	-0.044	0.671
A. 4. Assessment -> Learning improvements	-0.030	0.690
A. 4. Assessment -> GPA	0.121	0.315
A.5. Empowering students -> Learning improvements	0.228	***0.003***
A.5. Empowering students -> GPA	-0.012	0.933
A.6. Facilitating learners' digital competence -> Learning improvements	0.192	0.053
A.6. Facilitating learners' digital competence -> Average grades	-0.124	0.255
Learning improvements -> GPAs	0.051	0.530

Source: Prepared by the authors

beliefs, motivation, and self-regulation impact students more than other aspects when assessing teacher competencies and instructional quality at the school level.

Regarding the second link observed between EDC and learners' digital skills, this is also consistent with other studies regarding the DigCompEdu model (Núñez-Canal et al., 2022), as well as in online education literature (Elçiççek & Erdemci, 2021), showing that more digital capabilities in all academic environments are needed to enhance future digital development (Dima et al., 2022).

Regarding the non-conclusive results, we can see how clusters *2 Creating digital resources*, *3 Teaching and learning* and 4 *Assessment* do not influence students' perception of learning. In the new educational paradigm of technology and the student-centered approach, all elements of the teaching and learning process are crucial (Pérez & Torelló, 2012). Therefore, the non-existence of relationships between assessment, digital resources and other elements and students' perception of learning must be highlighted as relevant and different from other studies where such a relationship is found (Begnum & Foss-Pedersen, 2017). We should emphasize this

aspect, since these areas are considered crucial in the pedagogical side of the models, and according to the test results, they seem to have less impact on the perception of learning than other educators' key competences. This could be explained because, at higher education levels, the figure of the professor at university is more important than the content and the learning process itself, comparted to primary or secondary levels (Chang et al., 2011). In addition, the teaching connection is more important than other elements in face-to-face learning than in online learning, as the literature has proven, where the course design and the digital resources are more relevant to maintain good quality (Zhao et al., 2021).

On the other hand, the novelty of this study is to look for a significant relationship between educators' digital skills and students' academic performance. In this sense, this research finds no link between EDC assessed by students and their learning outcomes measured as GPA. It is worth mentioning that we cannot compare these results with previous studies as no literature has been found by authors. It is recommended that further studies be conducted in this line of research as it would be a valuable contribution to the field. This is especially important considering the significance of technology in education and the relevance of teaching digital skills in higher education. In addition to this conclusion, it is important to explore other ways of measuring learning outcomes, as well as to question the assessment methods and factors that may affect students' performance (Abu Saa et al., 2019). Since education is a complicated construct to measure, assessing the effectiveness of teaching and learning is necessary. This study confirms that academic achievements are not the most relevant factors in evaluating the productivity of educational elements, including teachers' interventions. It is worth mentioning other proposals for evaluating academic success, which include the attributes defined by engaged students analyzed in the work of Lynam et al. (2022).

According to existing research on education-based evidence, we cannot establish a correlation between educators' digital skills and students' academic performance. None of the six areas of competence have a significant impact on students' grade point average (GPA). In other words, there is no evidence that improvement in educators' digital competencies leads to any quantifiable improvement in students' academic performance. This implies that students who perform better academically do not necessarily rate their educators' digital competences higher, and those who perform poorly do not necessarily rate them lower. Similarly, there is no conclusive relationship between these variables. Therefore, we can conclude that having high digital teaching skills does not necessarily translate into improvement in learning as measured by students' grades.

Finally, as a limitation of this study, there are several factors that need to be taken into account for further and more in-depth research. Firstly, expanding the sample size by including more data and covering a wider range of countries would be beneficial. Secondly, since this study was primarily focused on business management, it would be preferable to extend it to other fields of knowledge, such as health sciences and technical sciences. Thirdly, using other quantitative and qualitative analysis methods to better understand the relationship between learning efficacy variables would be advantageous. In addition, we can also consider other variables to evaluate education efficacy, as academic performance is currently being debated as a primary

educational outcome. In this sense, the way students are assessed and the evaluation methods should be questioned. Moreover, in this research, the assessment has been made on grade average points as a general outcome of students' academic performance. As a proposal for future work, it would be useful to compare results by subjects, the field of studies, gender, nationalities etc.

Conclusions

The role of education is essential as an instrument to build a more dynamic society. With this purpose, education has been studied from theories looking for causalities to reinforce the system's efficiency. In addition, the digital transformation of all human endeavours has shaken out, particularly education at all levels. The university environment, driven by the inexorable introduction of technology, has suffered enormous pressures and changes in different perspectives: new management systems, online education, digital resources, methodologies, pedagogical elements, artificial intelligence, etc. All this has been abruptly escalated by the recent health crisis that forced a necessary transformation of all educational agents. These changes have created new demands for the university as a multifaceted organization and its faculty as a paramount concern.

Moreover, the role of universities in building more digital citizenship has broadened the mission of higher education to serve as an engine for innovation and economic development. However, academics were accustomed to being primarily concerned with their branch of knowledge and not with technological elements to connect with their audiences. In this scenario, this study aimed to determine the level of performance of educators' digital competences on students' learning outcomes. It is essential to highlight that authors are unaware that other studies have tried to seek a relationship between educators' digital competence and student outcomes. Therefore, to complete this research gap, an empirical study is carried out using a consolidated tool design for European Union to measure educators' digitalization. Two variables have been used that differ in terms of the precision of the measurement. Firstly, the relationship between the educators' digital competence and the students' perception of learning improvement, and secondly, on a more objective variable, the academic performance, based on students' GPA.

The main findings of our study drive a significant conclusion that there is a relationship between the digital competencies of educators and students' perception of learning regarding only two areas of the well-known DigCompEdu framework to measure educators' digital skills. Those areas of competences are professional engagement and empowering students. However, there is little relevance when it comes to other competencies related to the pedagogical side, such as content creation, teaching and learning, and assessment. This is consistent with other studies in educational efficacy that highlight the attitude and the professional motivation of teachers as the most relevant attributes to achieve students' learning outcomes.

Another conclusion, perhaps the most important, is that findings do not show any relationship, either through the correlations of the variables or their linear

relationships, between the level of performance of the faculty's digital skills as perceived by students, with the students' academic performance. According to evidence-based education theory, measuring teaching efficacy is essential. Quality of teaching can be assessed in various forms, being an objective way to consider as an indicator to observe the student's academic performance. In this sense, our study reflects that no connection was found. These results are not surprising given the enormous difficulty of finding causal relationships in such a complex and multidisciplinary field as education.

Possible implications of our study include the need for further research and strategies to better understand the connection between student outcomes and educators' intervention. This is particularly important because artificial intelligence and freely available educational content are threatening to replace the traditional role of teachers in conveying knowledge. Therefore, it is crucial to examine the causal links of effectiveness between teaching and student outcomes.

Additionally, it is necessary to question current evaluation methods of educational performance. While academic results are important, a more subjective measure, such as the feeling of having learned, should also be taken into consideration. This feeling is reflected in an increase in educators' digital skills, which eventually has an impact on student learning outputs.

These conclusions and suggestions pave the way for a new line of research on the link between digital teaching skills and student learning outputs. They also have significant implications for education policymakers and university administrators.

Declarations

Competing interest The authors declare no competing of interest.

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