Digital competencies in higher education: implications for the teaching-learning process of professors and students

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Abstract

The development and integration of digital competencies in higher education are essential in the current era. Technological changes, driven by ICTs, the internet, virtual learning environments, robotics, and artificial intelligence, demand the development of new professional competencies. The main objective of this study is to evaluate the influence of three digital competencies on university students' learning process and professors' performance. The results obtained through Structural Equation Modeling (SEM) show that digital competencies influence both students' perceived learning and professors' perception of learning. The findings underscore the importance of effective interaction between students and professors in virtual environments, and the need for constant updating in digital competencies to optimize the teaching-learning processes.

KEYWORDS: ONLINE LEARNING, TEACHING COMPETENCE, STUDENT COMPETENCE

Introduction

According to Sanaa (2019), among the most relevant aspects in higher education are the shift from a face-to-face model to a virtual one, the demand for professions required by the productive sector, and the training of university professors to meet these demands.

In this context, Picatoste et al., (2018) indicate that universities must face disruptive environments due to the ICT revolution, which should be considered an integral part of student training, particularly for the so-called "millennial generation" or the first generation native to new technologies.

Meanwhile, Ocaña-Fernández et al., (2020) mention that digital competence from a functional perspective for university professors means their approach to adequate integration of ICTs in their teaching function.

Theoretical framework

Digital competence is the creative, critical, and safe use of information and communication technologies to achieve objectives related to work, employability, learning, leisure, inclusion, and participation in society (INTEF, 2017).

On the other hand, digital competence is defined as the set of knowledge, skills, attitudes, strategies, values, and awareness required when using ICT and digital media to perform tasks, solve problems, communicate, manage information, collaborate, create and share content, and build knowledge in an effective, efficient, appropriate, critical, creative, autonomous, flexible, ethical, and reflective manner for work, leisure, participation, learning, socialization, consumption, and empowerment. For the present study, three basic digital competences are considered: digital information, communication, and digital creation.

Digital information

Digital information is the set of processed data that constitutes a message transmitted through a digital medium, represented by text, images, and sound, which can be accessed from a computer and does not have limitations in terms of the volume of information in the virtual realm (Peng et al., 2017).

The indicators considered for the present study are information and data literacy, evaluation and management of data and information, and digital content. In this regard, the following hypotheses are proposed:

- Model 1 H1: Digital information positively influences the perceived learning outcomes of university professors.
- Model 2 H1: Digital information positively influences the perceived learning outcomes of university students.

Digital communication

Digital communication is defined as the ability to communicate in digital environments, share resources through online tools, connect and collaborate with others through digital tools, as well as interact and participate in communities and networks (Oliva et al., 2014).

Taking the above into account, the following hypotheses are proposed: • Model 1 H2: Digital communication positively influences the perceived learning outcomes of university professors.

- Model 2 H2: Digital communication positively influences the perceived learning outcomes of university students.

Digital creation

Digital creation is the ability to create and edit new content (texts, images, and videos), integrate and rework prior knowledge and content, produce artistic works, multimedia content, and basic computer programming, as well as to know how to apply intellectual property rights and usage licenses (Delgado and Alvarado, 2016). Thus, the following hypotheses are proposed:

- Model 1 H3: Digital creation positively influences the perceived learning outcomes of university professors.
- Model 2 H3: Digital creation positively influences the perceived learning outcomes of university students.

Based on the previously proposed hypotheses, the complete models are presented below (Figure 1):

Fig 1. Proposed structural models
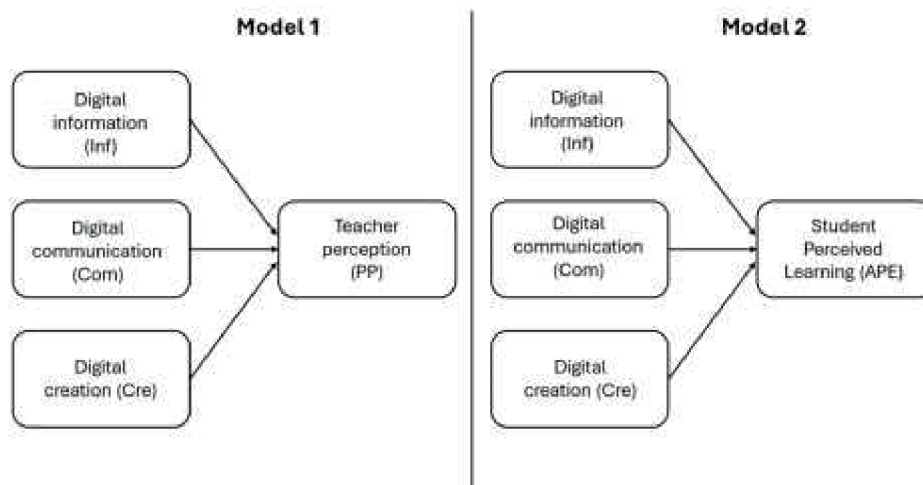
Method

Questionnaire development

An extensive literature review is conducted on the variables of interest in this study to develop a questionnaire, which is reviewed by experts in the field who provide recommendations on the terminology used and the clarity of the instructions. Additionally, a validation pre-test is administered to a significant sample. This allows for the identification of opportunities for improvement, especially in the control variables and the number of indicators of the exogenous constructs.

A five-point Likert scale was used, ranging from (5) "strongly agree" to (1) "strongly disagree." The instrument is divided into two parts: the first part with 14 items distributed among three exogenous latent variables: Digital Information (Inf), Digital Communication (Com), and Digital Creation (Cre) according to the competencies described in the INTEF (2017) document:

- Digital Information (Inf): comprised of three indicators: (Inf1) information and data literacy, (Inf2) data evaluation and management, (Inf3) digital information and content.
- Digital Communication (Com): comprised of six indicators: (Com1) communication and collaboration, (Com2) interaction through digital technologies, (Com3) information sharing, (Com4) collaboration, (Com5) behavioral standards, (Com6) digital identity management.
- Digital Creation (Cre): comprised of five indicators: (Cre1) digital content creation, (Cre2) digital content development, (Cre3) integration and reworking of digital content, (Cre4) copyright and different types of licenses, (Cre5) programming.

Regarding endogenous latent variables, there are four items distributed across two constructs: Professors' Perception (PP) and Students' Perceived Learning (SPL). Control variables (demographic data) to include would be: gender, age, career, education level, and years of experience (for professors).

Sample selection

Due to the characteristics of the research, the sample is a non-probabilistic cluster sample. According to Hernández et al. (2018), this type of sampling reduces costs, time, and energy by considering that the sampling units (teachers and students) are encapsulated or enclosed in certain physical or geographical locations, referred to as clusters. This refers to the campuses and schools/depart-

ments of the three universities participating in this study: Costa Rica Institute of Technology, National University, and University of Costa Rica.

Procedurally, this sampling requires a first stage in which the number of participants per university is defined using probabilistic methods. Then, each university campus becomes a universe, and academic units/schools/departments included in the study are randomly selected; in the next stage, the programs and courses considered as a universe or population are selected. Finally, a random selection of teachers and students to whom the questionnaires designed to test the hypotheses of the theoretical model shown in Figure 1 is made.

Data analysis method

According to the literature, Structural Equation Modeling (SEM) is the most suitable method to evaluate causal relationships between unobservable variables. Furthermore, this method has proven to be highly effective in analyzing the use, impact, and influence of ICT in education from different perspectives (Lee et al., 2017; Milosevic et al., 2015; Varela-Candamio et al., 2014). According to Martínez and Fierro (2018), this technique allows for the analysis of complex relationships between the proposed latent variables, thus explaining the observed data and predictive analysis as a relevant element in scientific research.

Results and discussion

The results in this study corroborate the importance of digital competencies in the teaching-learning process in higher education. The competencies of digital information, digital communication, and digital content creation showed significant positive influences on both students' perceived learning and professors' perception of effectiveness, underlining their relevance in contemporary academic contexts.

Digital information competency revealed a significant influence ($\beta = 0.45$, $p < 0.001$) on students' perceived learning and ($\beta = 0.43$, $p < 0.001$) on professors' perception. This finding highlights the relevance of digital information management and evaluation in improving learning and teaching, aligning with Cejudo and Almenara's (2015) mention of effective ICT application in teaching.

On the other hand, digital communication was identified as the competency with the greatest effect in both models ($\beta = 0.50$, $p < 0.001$ and $\beta = 0.47$, $p < 0.001$, respectively). This result emphasizes the need for communication skills in digital environments for more effective teaching, as suggested by Oranas et al. (2012), who argue that effective communication in digital education is crucial for facilitating teaching-learning processes.

Digital content creation also showed significant positive effects ($\beta = 0.40$, $p < 0.001$ and $\beta = 0.42$, $p < 0.001$), highlighting the importance of professors mastering digital content creation and editing as part of their teaching practice; this supports Ocaña-Fernández et al.'s (2020) statements about digital creation being a fundamental competency for teachers in the digital age.

These results support Picatoste et al.'s (2018) observations and their emphasis on the need for universities to face disruptive educational environments through ICT integration. The COVID-19 pandemic has accelerated this transition, making a continuous and dynamic approach to developing digital competencies in professors imperatively, as captured in recent literature (INTEF, 2017; Davies, 2017).

Moreover, the similarity in the results of both models suggests that both students and professors benefit from an educational environment where these digital competencies are effectively integrated, aligning with Peng et al.'s (2017) studies on teachers' adaptation to emerging technologies.

Conclusions

This study confirms the hypothesis that digital competencies positively influence the teaching-learning process in university settings. Proper management and application of digital information, digital communication, and digital content creation competencies are essential to improving both students' perceived learning and professors' perception of effectiveness.

Limitations and future research

This study exclusively focused on the faculty and student population of three academic units in three public universities, so other schools or departments of other public and private universities were not considered. Further research in this area should be encouraged to identify strategies and best practices that can further improve the integration of digital competencies in higher education.

References

Cejudo, M. y Almenara, J. (2015). Tecnologías de la información y la comunicación (TIC): Escenarios formativos y teorías del aprendizaje. Revista Lasallista de Investigación, 12(2), 25-36.

Davies, H. (2017). Competence-Based Curricula in the Context of Bologna and EU Higher Education Policy. Pharmacy, 5(17). doi: https://doi.org/10.3390/pharmacy5020017

Delgado, J. y Alvarado, M. (2016). Propuesta metodológica de enseñanza y aprendizaje para innovar la educación superior. InterSedes, 17(36), 48-60

Hernández-Sampieri, R., & Torres, C. P. M. (2018). Metodología de la investigación (Vol. 4). México eD. F DF: McGraw-Hill Interamericana.

INTEF (2017). Marco Común de Competencia Digital Docente – Septiembre 2017

Milošević, I., Živković, D., Arsić, S., & Manasijević, D. (2015). Facebook as virtual classroom–Social networking in learning and teaching among Serbian students. Telematics and Informatics, 32(4), 576-585.

Lee, F. L., Chen, H. T., & Chan, M. (2017). Social media use and university students' participation in a large-scale protest campaign: The case of Hong Kong's Umbrella Movement. Telematics and Informatics, 34(2), 457-469.

Ocaña-Fernández, Y., Valenzuela-Fernández, L., Morillo- Flores, J. (2020). La competencia digital en el docente universitario. Propósitos y Representaciones, 8(1), e455. doi: http://dx.doi.org/10.20511/pyr2020.v8n1.455

Oliva, M. A., Coronas, T. T., & Luna, J. C. Y. (2014). El desarrollo de competencias digitales en la educación superior. Historia y comunicación social, 19, 355-366.

Oramas González, R., Jordán Severo, T., & Valcarcel Izquierdo, N. (2012). Propuesta de modelo del profesor universitario en la carrera de Medicina. Educación Médica Superior, 26(4), 618-634.

Peng, F., Anwar, S., & Kang, L. (2017). New technology and old institutions: An empirical analysis of the skill-biased demand for older workers in Europe. Economic Modelling, 64, 1-19.

Picatoste, J., Pérez-Ortiz, L., Ruesga-Benito, S. M. (2018). A new educational pattern in response to new technologies and sustainable development. Enlightening ICT skills for youth employability in the European Union. Telematics and Informatics, 35(4), 1031-1038.

Sanaa, A. (2019). How technology has shaped university students' perceptions and expectations around higher education: an exploratory study of the United Arab Emirates. Studies in Higher Education, 1-14. doi: https://doi.org/10.1080/03075079.2019.1617683

Varela-Candamio, L., Novo-Corti, I., & Barreiro-Gen, M. (2014). Do studies level and age matter in learning and social relationship in the assessment of web 3.0? A case study for 'digital natives' in Spain. Computers in Human Behavior, 30, 595-605.

Annex

Below is the questionnaire designed to assess the influence of digital competences on university students' learning, using a five-point Likert scale ranging from (5) "strongly agree" to (1) "strongly disagree."

PART 1 DIGITAL COMPETENCES (EXOGENOUS LATENT VARIABLES)

Digital Information (Inf)

Inf1: I frequently use digital tools to search for and evaluate relevant information for my academic activities.

Inf2: I am confident in my ability to manage and organize digital data efficiently.

Inf3: I am competent in creating and managing digital content such as texts, images, and videos.

Digital Communication (Com)

Com1: I feel comfortable collaborating and communicating with others through digital tools.

Com2: I actively participate in online discussions and virtual communities related to my studies.

Com3: I regularly use digital platforms to share information and resources with my classmates and professors.

Com4: I collaborate effectively with others through digital tools and platforms.

Com5: I follow appropriate behavioral standards in digital environments.

Com6: I appropriately manage my digital identity and take care of my online reputation.

Digital Creation (Cre)

Cre1: I regularly create new digital content, including texts, images, and videos.

Cre2: I develop and edit high-quality digital content for my academic projects. • Cre3: I effectively integrate and rework knowledge and digital content.

Cre4: I am aware of and respect intellectual property rights and appropriately use different usage licenses.

Cre5: I have basic programming knowledge and use digital tools to create content.

PART 2 ENDOGENOUS LATENT VARIABLES

Faculty Perception (PP)

PP1: The digital competences I possess help me perform better in my teaching role.

PP2: I believe that my ability to use digital technologies enhances teaching in my courses.

Perceived Student Learning (APE)

APE1: I perceive that my skills in digital competences significantly improve my learning.

APE2: Faculty's digital competences positively influence my academic performance.

PART 3 CONTROL VARIABLES (DEMOGRAPHIC DATA)

- Gender:
- Age:
- Program:
- Educational level:
- Teaching experience (for professors)