

# Digital Competencies in University Students through Educational Innovations: A Review of the Current Literature

## Competencias digitales en universitarios a través de innovaciones educativas: una revisión de la literatura actual

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### ABSTRACT

#### Keywords

Educational innovation;  
digital skill; educational  
software

Technological advances have had a significant impact on education, leading to increased attention on the development of digital skills in university students. The objective of this article was to conduct a review of current literature related to educational innovations aimed at promoting digital competencies in university students, in order to identify current approaches and provide a comprehensive and updated insight into the topic. This research is qualitative, applied, and bibliographic in nature, with a descriptive scope, under a non-experimental, cross-sectional design that employs the analytical-synthetic method. The main findings highlight that educational software, educational platforms, and social networks can be valuable tools that benefit students in their learning and acquisition of competencies in various fields, as long as they are used responsibly, critically, and as a complement to face-to-face teaching.

### RESUMEN

#### Palabras clave

Innovación educativa;  
competencias digitales;  
software educativo

*Los avances tecnológicos han tenido un impacto significativo en la educación, lo que ha llevado a poner más atención en el desarrollo de habilidades digitales en los estudiantes universitarios. El objetivo de este artículo fue realizar una revisión de la literatura actual relacionada con las innovaciones educativas orientadas a promover competencias digitales en universitarios, con el fin de identificar los enfoques actuales y proporcionar una visión integral y actualizada sobre el tema. Esta investigación es de naturaleza cualitativa, aplicada y bibliográfica, con un alcance descriptivo, bajo un diseño no experimental, transeccional, que emplea el método analítico-sintético. Los principales resultados destacan que los software educativos, las plataformas educativas y las redes sociales pueden ser herramientas valiosas que beneficien a los estudiantes en su aprendizaje y en la adquisición de competencias en diversos ámbitos, siempre y cuando se utilicen de manera responsable, crítica y complementaria a la enseñanza presencial*

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## INTRODUCTION

Currently, the use of digital technologies has gained ground in the academic world. In response to this trend, educational institutions are looking for innovative ways to promote teaching and learning by making use of educational software and computer programs that allow the integration of various tools, resources and interactive activities that promote the development of digital skills and competencies in students. Some of the innovations that have been adopted are: the integration of digital technologies in the classroom, the implementation of *virtual* courses, the promotion of online collaboration and the teaching of programming skills and data analysis.

Specifically, there have been numerous studies that have demonstrated the benefits of the use of technology in higher education. Since a few years ago Fraillon *et al.* (2014) found among 60 thousand students, from more than 3 300 schools and 21 educational systems worldwide, that students who use digital technologies in the classroom on a regular basis have better academic performance than those who do not; similar results to those of Martin *et al.* (2018), who detected that graduate students in higher education institutions in the United States who participate in online courses and employ digital tools for collaboration and learning, report a higher course completion rate and better academic performance than those who do not use these tools. Thus, it can be stated that technological advances have had a significant impact at this level.

This research seeks to analyze and synthesize the different existing documents and studies aimed at promoting digital competencies in university students. Of a qualitative, applied and bibliographic nature, a systematic and critical review of the literature published between 2009 and 2022 related to the topic of interest was carried out for this work, in order to identify current approaches in the area and provide a comprehensive and updated view on the use of educational innovations for the development of digital competencies at the higher education level. This research presents a descriptive scope, under a non-experimental, trans-sectional design, employing the analytical-synthetic method.

## DIGITAL COMPETENCIES

Digital competencies are skills and knowledge necessary for the critical and reflective use of technologies and communication. These include the search, selection, evaluation and use of digital information, remote communication, remote problem solving and the use of software and digital applications for the production and creation of content (Unesco, 2019).

Various research in the area has shown that promoting these competencies has a significant impact on students' academic performance and employability, which makes them an area of interest for educational research and pedagogical practice, especially in higher education. There is currently a growing awareness of the importance of developing these skills, which is demonstrated by the increased adoption of tools for school work and homework that promote digital competencies among students.

The impact of technology on learning has been evaluated with Puentedura's (2014) SAMR (substitution, extension, modification and redefinition) model, which has shown that the use of digital technologies can transform the way teaching and learning take place in education. Among the main technological tools integrated in education are identified:

- Educational simulations: allow students to learn in an active and exploratory way, which is especially useful for science learning (Dávila-Cervantes, 2014); it fosters the ability to interact with interfaces and handle technological tools.
- 3D virtual environments: promote the ability to navigate in complex digital environments and interact in real time with other users, as well as the ability to build and manipulate virtual objects (Dalgarno and Lee, 2010).
- Online learning platforms: foster the ability to collaborate online and participate in virtual learning communities, together with the management of technological tools for knowledge management (Pazmay-Pazmay, 2023).
- Digital learning ecosystems: boost the ability to collaborate in digital environments, the ability to access and evaluate information online, and to learn autonomously in virtual environments (Islas and Carranza, 2017).
- Gamification: in the educational context it can be a useful strategy to foster motivation and learning (Kapp, 2012); in addition to navigating in virtual environments, it encourages interaction with game interfaces and the application of logical and critical thinking.

Likewise, it has been proven that the active learning approach, as well as problem-based learning (PBL) and project-based learning (PBLP), are effective in encouraging the development of digital skills in university students (Amador *et al.*, 2023).

## EDUCATIONAL SOFTWARE

One of the key tools for the promotion of digital skills in university students are educational software, which offer a large number of resources, tools and interactive activities that allow interacting with the contents in a dynamic and participatory way (Navarro *et al.*, 2022); in turn, they contribute to the development of digital skills such as programming, graphic design and video editing (Navarro, 2022). These software have their own characteristics and learning objectives, in some cases they are personalized and adapted to the needs of students and teachers, which facilitates the diversification of teaching-learning strategies (Navarro, 2022).

Broadly speaking, the software promotes a variety of digital competencies in university students, such as digital literacy (using and understanding digital technologies), critical thinking (analyzing and evaluating information objectively), problem solving (identifying and solving problems using digital technologies), online collaboration (working in teams and collaborating with others using digital tools), and creativity (using digital tools to create and produce original content).

### *Educational games*

Designed for learning through play, these types of programs allow the student to learn in a playful and fun way (Hailey *et al.*, 2016). Some examples of these are:

- Minecraft Education Edition: construction and adventure game where students learn collaboration, problem solving and critical thinking skills while building and exploring virtual worlds.
- Scratch: visual programming environment designed for children. It helps them create games, animations and interactive projects.
- Kahoot!: game-based learning platform where educators create quizzes, polls, and trivia games to engage students in the learning process.
- Prodigy: online math game that uses quests and combat to teach basic math skills.
- Duolingo: mobile app that uses games and rewards to teach languages in a fun and effective way (Bragg & Connor, 2017; Hailey *et al.*, 2016; Kapp, 2012; Miller, 2018; Papastergiou, 2009).

### *Educational simulations*

Educational simulations are programs that allow the student to interact with a virtual model of a real situation or process, which facilitates the understanding and learning of complex concepts (Magallanes, *et al.*, 2021). Some of the main software include:

- PhET: set of free interactive simulations developed at the University of Colorado Boulder, ranging from physics and chemistry to biology and mathematics.
- Labster: allows students to conduct scientific and medical experiments online.
- Smart Sparrow: adaptive simulation platform that allows instructors to customize learning and assessment for students in a variety of disciplines.
- ChemCollective: set of free, web-based chemistry simulations and tutorials developed by Carnegie Mellon University.
- BioDigital: 3D visualization platform of the human body that allows students to explore anatomy and physiology in an interactive way (Schwartz *et al.*, 2016; Dalgarno & Lee, 2010; Lajoie & Derry, 2014; Klahr & Nigam, 2004).

### **ONLINE LEARNING PLATFORMS**

Online learning platforms are programs that allow the creation and management of online courses, which facilitates distance teaching and learning (Alario-Hoyos *et al.*, 2014) and, therefore, the exercise of digital competencies. Some of the main platforms are Moodle, Canvas, Blackboard, Google Classroom and Edmodo (Bozkurt & Sharma, 2020; Deng & Yuen, 2019).

Moodle is an open source learning management platform used mainly in educational environments that allows creating online courses, managing content, interacting and assessing students' progress. Canvas is a learning management platform that provides tools for creating and managing online courses, real-time collaboration, and tracking student progress.

Blackboard is an online learning platform that provides tools for course creation, collaboration and student assessment. Google Classroom is an online classroom management platform designed to facilitate communication and collaboration between teachers and students. Edmodo is an online learning platform focused on communication and collaboration between teachers, students and parents.

## SOCIAL NETWORKS

A social network is an online platform or tool that makes it possible to connect, communicate and share materials with other users through the Internet. These platforms simplify interaction, the formation of groups and the transfer of data, whether in the form of text, images, videos or other types of content. Social networks can be used for a variety of purposes, from maintaining communication with friends and relatives, to establishing professional relationships, to promoting ventures or supporting causes, and even for fun or social contact. Among the most popular social networks are Facebook, Instagram, WhatsApp, LinkedIn, TikTok, YouTube and X (formerly Twitter).

Baron *et al.* (2021) underlines the role of social networks in education as a tool to promote communication and collaboration between students and teachers, as well as the acquisition of digital skills. In this regard, Lledó (2020) emphasizes that social networks can be used as an educational tool to promote the production and dissemination of scientific knowledge, and facilitate the acquisition of skills in the field of research.

Espinoza-Guillén (2021) adds that the appropriate use of social networks promotes gender equity in education and in the acquisition of competencies in digital skills. Specifically, Claudio Restrepo, rector of the EAFIT University, highlights the potential of Twitter in the acquisition of skills in education, politics and marketing, to promote collaboration and knowledge sharing in these areas.

## RESULTS

Massive adoption of educational technologies and innovative approaches in education was a gradual process that developed over several years. Therefore, for the literature review we considered works from 2009 to 2022 aimed at promoting digital competencies among university students. From the results, the main educational innovations used in the last decades are extracted, together with the competencies generated by each of these.

It is clear that there is no specific year in which all technological trends detonated massively; it was a gradual process within which milestones and key periods in which trends gained momentum are identified. In the late 2000s and early 2010s, the availability of mobile devices such as smartphones and tablets increased significantly. At the same time, internet connectivity expanded, allowing more people to access online educational resources and collaborate in virtual environments. Around that time, online learning platforms such as Khan Academy (2008) and Coursera and edX (2012) began to emerge, offering online courses and

educational materials on a massive scale, providing access to education to people all over the world.

By the second half of the 2010s, the incorporation of gaming elements in education (gamification) and the personalization of learning through adaptive technologies intensified, approaches that sought to make the learning process more engaging and effective for students. In 2020, the covid-19 pandemic accelerated the adoption of educational technologies in the face of the need for distance education, prompting schools, universities and teachers to use online tools and virtual teaching methods.

Table 1 shows a chronological evolution of the various educational innovations according to the literature review, with the technological advances involved and the competencies generated with their use.

**Table 1.** Chronological evolution of the various educational innovations and the skills generated with their use

Author	Year of publication	Educational Innovation	Competition generated
Papastergiou	2009	Digital educational games	-Digital literacy
		<i>Minecraft</i>	-Problem resolution -Technological skills
Yaron & Karabinos	2009	Simulations	-Scientific literacy
		PhET	-Technological skills -Critical thinking -Problem resolution
Dalgarno & Lee	2010	3D virtual learning environments	-Critical thinking -Technological skills
		Second Life	

		Quest Atlantis	-Problem resolution
		River City	
		Active Worlds	
Islas & Carranza	2011	Social networks	-Learning strategies
Kapp	2012	Simulations	-Technological skills -Critical thinking
		Educational games	-Problem resolution -Collaboration
Lajoie & Derry	2014	Use of the computer	-Management of technological tools for teaching
			-Technology in learning
Chávez-Márquez y Gutiérrez	2015	Social networks	-Learning skills
			-Communication
Joksimović <i>et al.</i>	2015	Coursera	-Collaboration
		edX	-Critical thinking
		LinkedIn	-Problem resolution
		Learning	-Technological skills

		FutureLearn	
Schwartz <i>et al.</i>	2016	Simulations	-Scientific literacy
		Virtual learning environments	-Critical thinking
		ABC (competency-based learning)	-Problem resolution -Technological skills
Hainey <i>et al.</i>	2016	Educational games	-Digital literacy -Critical thinking -Problem resolution -Collaboration
Kirschner <i>et al.</i>	2016	Simulations	-Problem resolution -Critical thinking
		Educational games	-Technological skills
Bragg & Connor	2017	Unity	- Technological skills
		Construct 2	- Critical thinking
		Scratch	- Problem resolution
		GameMaker Studio	- Collaboration
		Twine	
		Educational games	

Miller	2018	<i>Minecraft</i>	-Programming and coding skills -Creativity and problema solving -Habil Technological skills
Shah	2018	Coursera	-Online learning
		edX	-Online teaching -MOOC
		Udacity	-Management of educational technology
		FutureLearn	-Intructional desing
		Open edX	
		Canvas	
Ocaña-Fernández <i>et al.</i>	2019	Teching platform	-Digital language processing
		Artificial intellingence	
Deng & Yuen	2019	Facebook	-Communication
		Twitter	-Collaboration
		YouTube	-Digital literacy
		Instagram	
		LinkedIn	

		WeChat	
		WhatsApp	
		Blogs	
		Wikis	
Ruiz	2020	Organic chemistry learning platform	-Scientific literacy
		Augmented reality	
Bozkurt & Sharma	2020	LMS (Learning Management Systems)	-Pedagogy
		Zoom	-Design instructional
		Microsoft Teams	-Educative technology
		Google Meet	-Online learning
		Google Classroom	-Remote teaching
		Blackboard	-Higher education
		Canvas	-Adaptability
		Moodle	-Creativity
			-Colaboration
			-Problem resolution
			-Technological skills
Restrepo	2020	Twitter	-Effective and strategic communication in the academic,

			political and marketing fields
Lledó	2020	Online learning platforms	-Collaborative and participatory learning online
		Social networks	
Galán <i>et al.</i>	2021	Professional internship platform	-Digital model of professional practices using the Gesell digital camera
		Digital Gesell camera	
Guiñez-Cabrera & Mansilla-Obando	2021	Communication platform	-Use of digital camera for communication
		WhatsApp Web	
Martín-Herrera <i>et al.</i>	2021	<i>b-learning platforms</i>	-Adequate communication through the use of the Google Workspace platform in university students
		Google Workspace	
Rodríguez <i>et al.</i>	2021	Tutorial coaching system	-Select (coach) the appropriate materials for your needs
Arbeláez-Campillo <i>et al.</i>	2021	Teaching platform	-Understanding the human condition through the use of artificial intelligence
		Artificial intelligence	
Porcelli	2021	Artificial intelligence	-Knowledge and critical reflection

		Robotics	on ethics and the social impact of technology
Espinoza-Guillen	2021	Social networks	-Awareness-raising and reflection on the use of social networks from agender perspective
Barón, Duque <i>et al.</i>	2021	Social networks	-Development of communication and relational skills in the digital environment
López	2022	Educational platforms evaluation	-Implementation of educational processes using Kahoot, Plickers and Socrative tools
		Kahoot	
		Plickers	
		Socrative	
Becerril & Mendoza	2022	Chemistry teaching platform	-Scientific literacy
		TPACK	
Veytia & Bastidas	2020	Group work platform	-Group work in university students
		WhatsApp	
Aguilar-Tello & Angulo-Giraldo	2022	Twitter	-Scientific communication -Dissemination through social networks

The competencies identified by the authors range from critical reflection and the impact of technology to the development of communication and relational skills in the digital environment. It is important to mention that some authors do not specify a particular educational software or learning platform, but focused on the use of social networks and Twitter as communication and dissemination tools. It is considered that these technologies can also qualify as a learning platform and their use as a technological innovation.

## DISCUSSION

As found in the literature review, the use of educational software, educational platforms and social networks for the acquisition of competencies has been the subject of discussion by various authors. Bates (2018) mentions that it is necessary to establish how digital technology and online learning can provide greater support for the promotion of soft skills as competencies. This author indicates that the skills that will be required by the labor market will include critical thinking, coordination, social perception, active listening and complex problem solving, and that the ability to read and write digitally will be necessary for most new jobs. The most in-demand skills include language, adaptability and cultural awareness, which are of utmost importance for university students as they are close to their integration into the workplace.

More recently, emphasis has been made on the consolidation that computational thinking is an effective strategy that contributes to the development of digital literacy competence (Mantilla and Negre, 2021). Adell *et al.* (2019) indicate that this thinking helps develop valuable skills such as logic, creativity and the ability to work collaboratively; however, a fundamental point is that it cannot be taught as a separate subject, so the relevant discipline to promote would be computer science (Velázquez and Martín, 2021). For his part, Maggio (cited in San Román, 2019) emphasizes that classroom teaching has changed, giving rise to a student endowed with technological skills, but lacking in knowledge.

From another perspective, in his article on artificial intelligence and robotics, Porcelli (2021) suggests that technology can be a tool for the acquisition of competencies in the educational field, taking into account the social, ethical and legal dilemmas that this would generate. On this same line, it is pertinent to analyze the critical thinking that students should have through the use of technology, as well as to reach a consensus on an operational definition of programming competence, design specific

assessment tools for this competence, explore how educational robotics is implemented in the school environment, and move towards the creation of a practical conceptual framework to foster the development of programming competence through robotics (Adell *et al.*, 2019).

Observing the above, it is inferred that the authors agree that the use of educational software, educational platforms and social networks can be valuable tools for the acquisition of competencies in various fields, as long as ethical and social aspects are considered.

## CONCLUSIONS

After reviewing the selected articles, it is possible to conclude that the use of educational software, educational platforms and social networks has the potential to benefit the development of competencies in various fields, including education, research and scientific dissemination. The authors agree that the use of these digital tools can improve the effectiveness and efficiency of the teaching-learning process by facilitating greater interaction between students and teachers with access to more affordable educational resources, and the ability to customize the learning process according to individual needs.

The importance of using these tools in a responsible and critical manner, taking into account ethical, legal and information security aspects, is emphasized; in addition, it is stressed that these digital tools should not replace face-to-face teaching but complement it, since face-to-face interaction is essential for comprehensive learning. The accelerated and dynamic development of educational innovations in the use of digital tools and technologies reaffirms the importance of acquiring digital competencies and soft skills, which every professional must possess.

The incorporation of digital skills generated with the use of technological tools and the introduction of educational innovations such as simulations, social networks, educational games, b-learning platforms and artificial intelligence in the university context are crucial to equip students with the necessary skills. These skills are not limited to technical skills alone, but also encompass critical competencies such as analytical thinking, problem solving and communication in digital environments.

Higher education must maintain constant adaptation to cope with changing technological and occupational demands. Implementing innovations in education, such as adopting cutting-edge technology, offering online courses, and tailoring learning according to individual needs, has the potential to improve the quality of university education and foster student engagement and success.

In conclusion, digital skills and educational enhancements are essential elements in the integral formation of university students and in their preparation to face the challenges and take advantage of the opportunities of the digital and work environment. Therefore, it is crucial that educational institutions continue to adopt and adapt these practices to ensure that students are adequately prepared to face these challenges and take advantage of the opportunities that the future brings.



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