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ORIGINAL

Enhancing online learning quality through digital competencies of students

Mejorar la calidad del aprendizaje en línea a través de las competencias digitales de los estudiantes

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ABSTRACT

In the era of post-pandemic digitalisation, students' digital skills are increasingly vital for enhancing the quality of online learning. This article aims to analyse the influence of digital competence on the effectiveness of distance education and explores its future development. This article aims to analyse the impact of digital competence on the effectiveness of distance learning and its development prospects. The research aims to study modern approaches to forming students' digital competencies and their impact on the quality of the educational process. The methodology includes scenario analysis of the growth in online students, systematisation of critical skills, and evaluation of the online learning market. The article examines technical skills, digital literacy, critical thinking, self-regulation, and time management. The research results highlight the importance of integrating digital skills into educational programs, which enhances learning effectiveness and prepares students for the modern labour market. A promising direction is the development of innovative educational approaches that consider the rapid development of technologies and the requirements of the digital economy. The obtained results indicate the necessity of investing in the development of digital competencies among both students and teachers.

Keywords: Online Learning; Technical Skills; Digital Literacy; Critical Thinking; Self-Regulation; Digital Ethics; Distance Learning; Generic Competences; Doctor of Philosophy Degree Students; Interactive Teaching Methods.

RESUMEN

En la era de la digitalización pospandémica, las competencias digitales de los estudiantes son cada vez más vitales para mejorar la calidad del aprendizaje en línea. Este artículo tiene como objetivo analizar la influencia de la competencia digital en la eficacia de la educación a distancia y explorar su desarrollo futuro. Este artículo tiene como objetivo analizar el impacto de la competencia digital en la eficacia de la educación

a distancia y sus perspectivas de desarrollo. La investigación tiene como objetivo estudiar los enfoques modernos para formar las competencias digitales de los estudiantes y su impacto en la calidad del proceso educativo. La metodología incluye el análisis de escenarios del crecimiento de los estudiantes en línea, la sistematización de las habilidades críticas y la evaluación del mercado de aprendizaje en línea. El artículo examina las habilidades técnicas, la alfabetización digital, el pensamiento crítico, la autorregulación y la gestión del tiempo. Los resultados de la investigación destacan la importancia de integrar las competencias digitales en los programas educativos, lo que mejora la eficacia del aprendizaje y prepara a los estudiantes para el mercado laboral moderno. Una dirección prometedora es el desarrollo de enfoques educativos innovadores que consideren el rápido desarrollo de las tecnologías y los requisitos de la economía digital. Los resultados obtenidos indican la necesidad de invertir en el desarrollo de competencias digitales tanto entre los estudiantes como entre los profesores.

Palabras clave: Aprendizaje en Línea; Habilidades Técnicas; Alfabetización Digital; Pensamiento Crítico; Autorregulación; Ética Digital; Educación a Distancia; Competencias Genéricas; Estudiantes de la Carrera de Doctor en Filosofía; Métodos de Enseñanza Interactivos.

INTRODUCTION

Digital literacy has become one of the critical skills for modern students, as it encompasses a wide range of abilities and knowledge necessary for successfully navigating and using digital technologies. Giday and Perumal[1] believe that it includes technical skills for working with computers and software and the ability to effectively search for, evaluate, and use information from the Internet. Digital activity is the foundation for successful learning and professional development in the modern world, where information technology is crucial in all areas of life. The importance of digital competence cannot be overstated, as it contributes to students' academic success and ensures their competitiveness in the job market, where knowledge of digital technologies is a mandatory requirement.

Digitalisation accelerated significantly after the COVID-19 pandemic, forcing educational institutions worldwide to adapt to new conditions and implement digital technologies in the educational process. According to UNESCO, over 1,6 billion students in more than 190 countries were forced to switch to distance learning during the pandemic. This statistic highlights the need to develop digital competences among students and teachers. According to Subiyantoro et al.[2] this period was a test for many educational systems, which faced challenges such as access to technology, insufficient teacher preparation, and inequality in student opportunities. At the same time, the pandemic became a catalyst for accelerating the implementation of innovative solutions and expanding the use of digital tools, changing the approach to education on a global level.

The growth in the quality and popularity of digital education has become noticeable worldwide as more educational institutions and students see the advantages of this approach. According to the research company Research and Markets, the global online education market will reach $350 billion by 2025, indicating a significant demand for digital educational resources and technologies. According to Masters et al.[3] remote learning provides access to quality education regardless of geographical location, reduces education costs, and offers flexibility in choosing educational programmes. Digital education promotes the development of individual learning trajectories, allowing students to study at a convenient pace and according to their interests. As a result, improving the quality of digital education and its popularisation create new opportunities for international student academic and professional development.

The article's research aims to identify the impact of students' digital competences on improving the quality of online learning, outlining key trends and factors that contribute to the effectiveness of the educational process. The research problem focuses on identifying and analysing the primary digital skills that affect students' success in distance learning, including technical literacy, critical thinking, self-regulation, and communication skills. A promising research direction is the development of strategies for integrating digital competences into educational programmes to maximise their positive impact on students' academic results. The research aims to determine effective methods for developing digital skills among students and teachers in the modern digital educational environment. The practical significance of the research is expressed in the potential application of its results to optimise educational approaches, which will contribute to effective interaction in the digital environment.

Students' digital skills are a primary factor in improving the quality of online learning and ensuring the effective use of digital resources and tools in the educational process. The research work[4] analyses the impact of digital abilities on students' academic performance, indicating a significant influence on technical literacy and the ability to work with information systems. Demirelli and Karaçay[5] emphasise the importance of critical thinking and self-regulation in a digital environment. The study[6] examines the role of digital ethics in online

learning, stressing the necessity of fostering a responsible attitude towards using technologies among students. According to Kocak,[7] students' digital literacy is a decisive factor in successfully integrating online resources into educational programmes. Getenet et al.[8] note that developing self-regulation and time management skills is critical for effective learning in the modern education system. The research[9] highlights the significance of online collaboration and the ability to work in virtual teams, which is essential in a globalised world. The work[10] discusses methods for integrating digital tools into the educational process, emphasising the importance of continuous professional development for teachers. Gao et al.[11] study the impact of digital competences on the quality of online learning, asserting that a high level of digital literacy contributes to a high level of student engagement in the educational process. Perez-Aranda et al.[12] explore methods for developing critical thinking in students through the use of digital technologies. Kryshtanovych et al.[13] analyse the impact of digital competences on the labour market, pointing to the growing demand for specialists with a high level of digital literacy. Bono et al.[14] underscores the importance of innovative educational approaches that consider the rapid development of technologies and the requirements of the modern labour market. Bielialov et al.[15] believe that the active use of digital tools in education prepares students for the challenges of the digital economy. The authors Beik and Cho[16] point to the effectiveness of interactive technologies in enhancing the quality of learning, noting the importance of their integration into educational programmes. According to the research,[17] it is essential to implement interactive teaching methods and engage students in active participation in the digital learning process, as this enhances their interest and success. The analysis[18] shows that the personalisation of learning materials and the use of adaptive technologies increase the effectiveness of students' knowledge acquisition. According to Getenet et al.[19] the role of digital platforms in creating an interactive learning environment cannot be overestimated, as it strengthens motivation. Key points[20] form an understanding of the importance of visual content in supporting the educational process of students. Fidan and Koçak Usluel[21] highlight the success of using gamification and other interactive elements to increase student engagement in learning new material. The work of Bravo-Sanzana et al.[22] emphasises the necessity of integrating digital skills into all aspects of educational programmes, including practical classes and laboratory work. According to Semenets-Orlova et al.[23] the development of teaching materials and teaching methods requires educational institutions to update and adapt to the latest digital trends continuously. The study by Ismail et al. [24] emphasises the importance of an interdisciplinary approach to developing digital competences, including technical skills, critical thinking, and communication abilities. Considering the dynamics of digital transformation in education, the importance of constantly monitoring innovations in educational technologies and their impact on improving the quality of the educational process arises. Researchers agree that the successful implementation of digital technologies in education requires the integration of digital technologies, which needs additional attention.

METHOD

Research Design

The research was structured in four consecutive stages aimed at analysing students' digital competences and their impact on the quality of online learning.

Data Collection

Data for the analysis was collected from publicly available sources on digital platforms used in leading universities worldwide, such as Coursera, edX, Udacity, and others. These platforms were selected due to their wide popularity and accessibility to students globally. Additionally, data from research companies such as Research and Markets and Statista was used to evaluate the online education market.

Data Analysis

In the first stage, a scenario analysis was conducted to forecast the increase in online students from 2017 to 2033. This involved using statistical data and building projections regarding trends and anticipated changes in the number of students opting for online education. The second stage involved systematising the generic competences of students and analysing their impact on online learning. A literature review and analysis of existing research were conducted to identify the key digital competences necessary for successful learning in a digital environment. The third stage involved evaluating the online learning market to understand the potential opportunities of distance learning. This included assessing the market's size, growth rates, key players, and trends, with a particular focus on regional differences and features affecting the accessibility and popularity of online learning globally.

Statistics and Variables

The analysis included variables such as the number of online students, key digital competences (e.g., technical skills, digital literacy, critical thinking, self-regulation, time management), and market metrics (e.g.,

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market size, growth rates). The data was analysed statistically to build forecasts and identify significant trends.

Subjects of Participants

The study focused on students enrolled in online courses offered by digital platforms such as Coursera, edX, and Udacity. These platforms were chosen due to their extensive use by students globally, representing a diverse and comprehensive sample.

Procedure

The research was conducted in four stages. First, a scenario analysis was performed to forecast the increase in online students using statistical data. Second, the generic digital competences of students were systematised through a literature review to identify those critical for successful online learning. Third, the online education market was evaluated by analysing its size, growth rates, key players, and regional differences, using data from research companies. Finally, based on the findings, recommendations were developed for educational institutions, government bodies, and other stakeholders to improve digital competences and enhance the quality of online learning.

Materials

The study utilised publicly available data from digital platforms and research companies, as well as existing literature on digital competences and online education. This structured approach ensures a comprehensive analysis of the factors influencing online learning quality and provides actionable insights for stakeholders.

RESULTS

Educational platforms such as Zoom, Microsoft Teams, and Google Classroom became an integral part of the learning process, providing opportunities for conducting lectures, seminars, and practical classes online. As a result, distance learning became a necessity rather than an alternative, highlighting the importance of developing digital competences among students and teachers.

Parallel to the educational sector, businesses experienced significant changes due to the pandemic. Many companies were forced to switch to remote work, stimulating the mass digitalisation of business processes. The proportion of students choosing distance learning is growing yearly, as shown in figure 1.

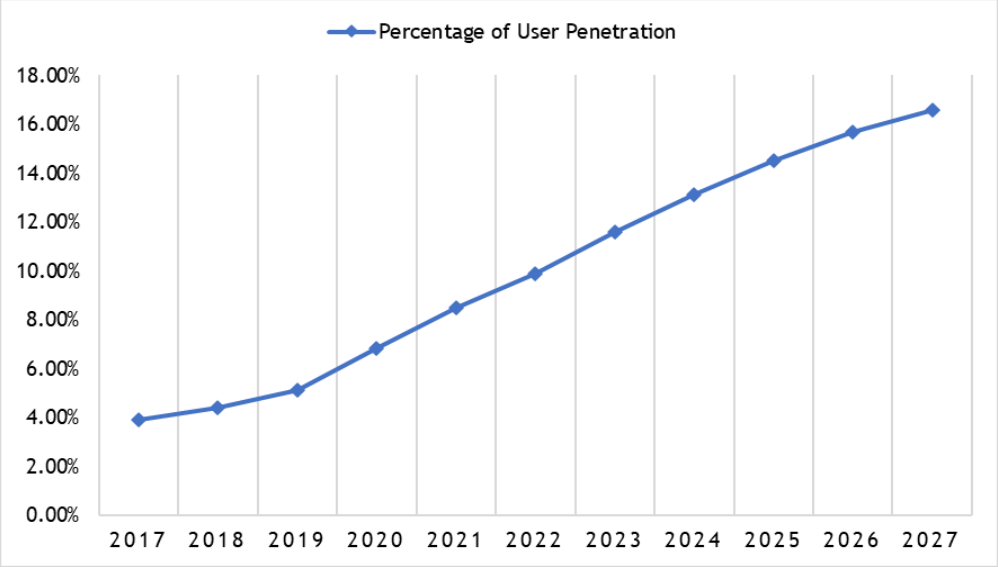

Figure 1. The Penetration Rate of Online Learning Platform Users Over The years, %
Source: compiled from the [25]

As a result, digital competence has become one of the most critical skills needed for both students and workers.

Enhancing the quality of students' digital skills is critically important for their successful adaptation to the modern labour market and constantly changing society. Practical classes using simulations, virtual reality, online laboratories, and other innovative teaching methods significantly enhance learning effectiveness. Virtual reality technology in medical education allows students to perform virtual surgeries and diagnostic procedures, improving their practical skills and preparation for real work. Such approaches improve the quality of education and provide students with competitive advantages in the job market, helping them become

successful professionals in their fields. The leading digital competences and their impact on online learning are presented in table 1.

Table 1. Characteristics and Impact of Students' Digital Competences on Online Learning

Competence	Features	Impact on online learning
Technical skills	Ability to use computers, software, and online learning platforms.	High technical skills allow students to adapt to new tools and platforms quickly.
Digital literacy	Ability to find, evaluate and use information on the Internet.	Digital literacy is the basis for successful learning and development in the modern world.
Critical thinking skills	Ability to analyse, evaluate and synthesise information to make informed decisions.	Critical thinking contributes to a deeper understanding of the learning material and improves the quality of education.
Self-regulation skills	Skills of self-control and independent organisation of the learning process.	Self-regulation skills allow students to be more independent and responsible.
Effective time management	Ability to plan and allocate time to complete tasks in the online environment.	Effective time management helps to complete tasks on time and reduce stress.
Use of digital tools	Ability to effectively use various digital tools for learning.	The use of digital tools increases learning efficiency and facilitates access to resources.
Working with information	Skills of searching, critical evaluation and correct interpretation of information.	Working with information contributes to the development of research skills and critical thinking.
Digital ethics	Understanding of ethical norms and principles when working with digital technologies.	Digital ethics is essential for developing a responsible and conscious user of digital technologies.
Communication skills	Practical communication skills in the digital environment.	Communication skills are essential for effective interaction and knowledge sharing in the digital environment.

One of the most significant advantages of digital education is the ability to master a wide range of professions, opening new horizons for students. Digital educational platforms offer courses in various fields, including information technology, business, medicine, engineering, art, humanities, etc. The rigorous coursework and dissertation requirements for Doctor of Philosophy degree students prepare them for careers in academia, research, and industry leadership.

The digital education market is showing rapid growth, driven by the continuous development of technologies and the growing popularity of distance learning. According to research, the size of the e-learning services market in 2023 was $215,65 billion, and it is expected to reach $1374,67 billion by 2033. The detailed growth dynamics of the online learning market are shown in figure 2.

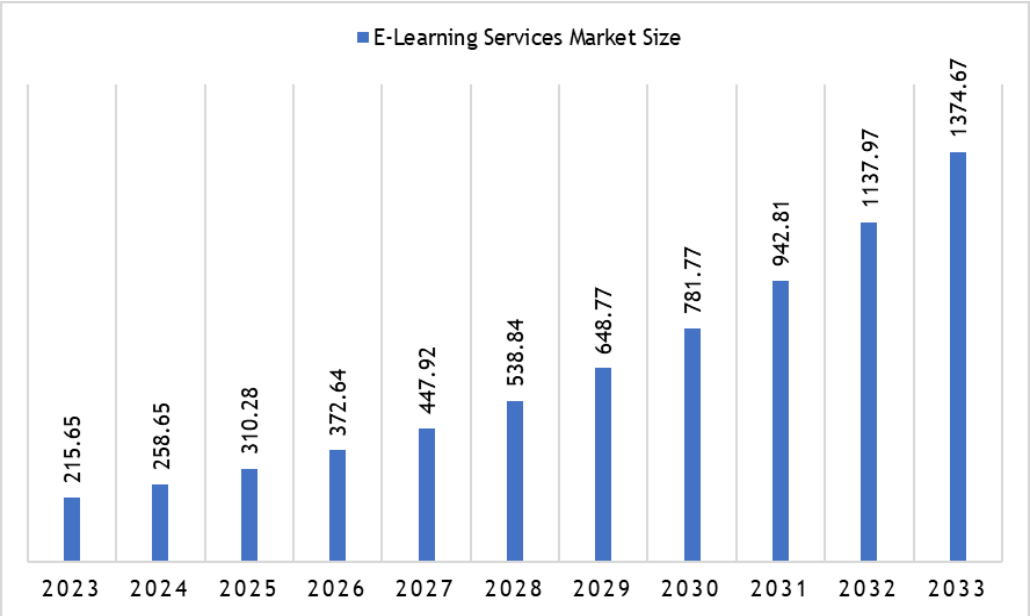

Figure 2. E-Learning Services Market Size 2023 to 2033 (USD Billion)
Source: compiled based on[26]

Such rapid market growth provides students anywhere in the world access to courses from leading universities

and educational platforms, significantly expanding their learning and professional growth opportunities. Digital educational tools and resources ensure high-quality learning and make acquiring knowledge more engaging.

Students' digital competences have become a fundamental condition for improving the quality of online learning, as they determine students' ability to use digital resources and tools for education effectively. One of the critical components of digital competences is the ability to adapt to a rapidly changing technological environment. This includes the ability to quickly master new platforms, programmes, and technologies that appear on the market and integrate them into the learning process. Developing cybersecurity and data protection skills becomes essential amid growing information security threats, highlighting the need to integrate relevant courses into educational programmes. Therefore, teachers who have undergone special training in using digital technologies demonstrate significantly higher effectiveness in teaching, underscoring the necessity of investing in the professional development of teaching staff.

DISCUSSION

The analysis of students' digital competences and their impact on the quality of online learning shows that modern skills are crucial for effectively mastering material, which aligns with the findings of other researchers. The COVID-19 pandemic radically changed approaches to education and business, causing a rapid transition to distance learning and the mass digitalisation of various industries. With the onset of the pandemic, most educational institutions worldwide were forced to close, pushing millions of students to switch to distance learning. Many universities provide substantial support and resources to Doctor of Philosophy degree students to aid in their academic and professional development. This transition required technical support and quick adaptation to new learning conditions, where digital technologies became the primary means of interaction between teachers and students.

According to Doo and Zhu,[27] high technical literacy among students significantly enhances their academic performance. Yuldashev et al.[28] emphasise that critical thinking and self-regulation are essential components of digital competences, corroborating our findings. Weidlich et al.[29] note that digital ethics is crucial for the responsible use of technology, which aligns with the conclusion about the need to integrate ethics courses into educational programmes. Peng et al.[30] state that digital literacy is the foundation for successfully integrating online resources into learning. Remote work became the new norm for many organisations, requiring technical support and developing new skills and competences among employees. Cloud services, video conferencing platforms, and online collaboration tools became crucial for ensuring business continuity.

According to Çakmakkaya et al.[31] developing self-regulation and time management skills is critically important for effective online learning. Our study's results confirm Xu et al.[32] conclusions, highlighting the significance of online collaboration and the ability to work in virtual teams. Kesumawati et al. [33] mention that integrating digital tools into the educational process is essential for comprehensive learning.

The development of distance learning and the digitalisation of business has highlighted the critical need for proficiency in digital technologies and tools. Students studying in an online environment must have a high level of technical skills. The need to transform educational programmes has become evident in the rapid digitalisation of education and society.

Huang et al.[34] show that a high level of digital literacy contributes to high student engagement. Zhang et al.[35] believe developing critical thinking through digital technologies is necessary for modern education. As identified in the study, Saleem et al. [36] note that digital competences significantly impact the labour market.

Preparing teachers to work in a digital environment is a reliable element of the successful implementation of online learning and improving its quality. The importance of the qualification process lies in providing teachers with the necessary knowledge and skills to use digital tools and platforms in their pedagogical work virtually. A critical component is the development of distance learning and communication skills, enabling teachers to interact with students effectively, support their motivation, and ensure high-quality education in a remote learning environment. Comparing our results with the findings of other researchers demonstrates that students' digital competences are crucial for improving the quality of online learning and ensuring their competitiveness in the labour market.

CONCLUSION

Thus, research on students' digital competences has shown that they are critically important for improving the quality of online learning. Digital skills play a crucial role in ensuring the effectiveness of the educational process and developing students as independent, critically thinking individuals. High technical abilities allow students to adapt to new tools and platforms quickly. Networking opportunities and collaborations with experts in the field are essential for the success of Doctor of Philosophy degree students. At the same time, digital literacy is the foundation for successful learning and development in the modern world. Critical thinking, self-regulation skills, and effective time management contribute to understanding educational material and improving the quality of education. Together, these competences enable students to be independent,

responsible, and ready to face the challenges of the modern digital world. Collaboration between educational institutions, government bodies, and the private sector will ensure a holistic approach to addressing the problems and challenges associated with students' digital competences.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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