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Model of Student Digital Competencies in the Development of New Generation Universities

Abstract

The *objective of the present study* is to summarise and present a conceptual model of student digital competencies in the development of new generation universities. The research will analyse the structural elements of digital competence, the factors that influence its formation, and the mechanisms for assessing the level of digital competencies in the modern educational environment. *Methodology*. The research employs a systematic approach that considers digital competence to be a dynamic multicomponent structure, incorporating theoretical, activity, and evaluation components. The analysis has been conducted through an interdisciplinary lens, integrating the theoretical underpinnings of digital education, practical methodologies for cultivating digital competencies, and contemporary trends in the digital transformation of university education. *Results*. The research confirmed that students' digital competencies are a multidimensional formation that includes theoretical, activity, and evaluation components. The theoretical component provides a systematic understanding of digital literacy, the activity component covers methods and means of developing digital skills, and the evaluation component determines the level of digital competencies. The digital university has been identified as the predominant environment for the development of students' digital competencies, given its promotion of modern educational technologies, encompassing digital platforms, adaptive teaching methods, virtual environments, and gamification. *Practical significance*. The proposed model of digital competencies has the potential to be utilised in the enhancement of educational programmes, the development of digital learning platforms, and the implementation of innovative approaches to the cultivation of digital literacy in students. The identified patterns can serve as a basis for strategic planning of the digital transformation of higher education institutions. *Scientific novelty*. The research contributes to the scientific understanding of students' digital competencies, substantiates their structure, and identifies key factors that influence their development within a digital university. The conceptual model presented herein can serve as a foundational framework for future empirical research in the domain of digital education.

1 Introduction

The digitalisation of higher education has become a key trend in the modern development of the educational sphere, necessitating the development of appropriate digital competencies among students. The integration of digital technologies into the learning process gives rise to new opportunities for the organisation of the educational environment, the optimisation of teaching methods, and the improvement of learning efficiency. Concomitantly, the cultivation of these competencies is a multifaceted process entailing adaptation to a shifting digital terrain, mastery of novel technologies, and the development of the capacity to critically evaluate and effectively utilise digital instruments.

Current research findings indicate that the digital competence levels of students exhibit significant variations, contingent on their digital literacy, technical training, and personal inclination to engage

with digital environments (Sklyarenko et al., 2024). Furthermore, a pivotal element in the cultivation of digital competencies lies in the evolution of a digital university as an integrated educational milieu, amalgamating digital technologies, adaptive educational platforms, gamified learning instruments, and artificial intelligence to personalise the learning process. Concomitantly, the issue of the structural organisation of student digital competencies, and their relationship with traditional educational models, remains unresolved. The question arises as to whether digital competencies are a universal skill for all students, irrespective of their particular field of study, or whether their development should occur differentially depending on the field of study. Furthermore, the impact of a digital university on the development of digital literacy and students' adaptability to new learning environments is a crucial consideration. The following research problem is thus formulated: what are the main structural elements of the model of student digital competencies, and what factors influence their effective implementation in a digital university?

The objective of this research is to develop a conceptual model of student digital competencies in the context of the development of new generation universities. In particular, the main components of digital competencies, factors that influence their formation, as well as mechanisms for their assessment and improvement are analysed. The research adopts an interdisciplinary approach, integrating theoretical aspects of digital education, practical approaches to the development of digital skills, and current trends in the digital transformation of university education.

2 Conceptual Model of Students' Digital Competencies

The contemporary conditions of development necessitate the integration of digital transformation technologies as a pivotal element for enhancing the quality of education. This transformation encompasses a wide range of innovations, including cloud computing, big data, predictive analytics, and integration platforms, which are creating new opportunities for educational activities (Sklyarenko et al., 2024). However, it is important to note that the implementation of these technologies is not without challenges. These challenges are related to the adaptation of society to rapid changes in the digital economy and education.

The establishment of a conceptual model of student digital competencies is founded upon a systematic approach, according to which digital competence is a holistic structure consisting of interconnected components, each of which contributes to the functioning of the overall system. Concurrently,

this competence is a constituent of a more extensive level, namely the digital educational environment.

In accordance with the prevailing classical understanding of the model as a conditional image, the model of student digital competencies is dynamic, a quality that permits its adaptation to the evolving conditions of the digital educational space (Dushchenko, 2021; Khomenko et al., 2024). The proposed model of student digital competencies comprises three primary components: theoretical, activity, and evaluation (see Figure 1).

The theoretical component constitutes a system-forming element of the model of student digital competencies, around which other components are formed. The activity component encompasses the forms, methods, and means by which student digital competencies are formed and developed. The evaluation component, in turn, reflects the final expected results and methods of assessing the level of student digital competencies. The adoption of this multifaceted approach in constructing the model of student digital competencies endows it with several salient properties, namely non-additivity, emergence, continuous development, multidimensionality, synergy, and adaptability.

3 Analysis of the Theoretical Component of the Model of Students' Digital Competence

The following discussion will consider the content of the theoretical component of the model of student digital competencies of new generation universities. This component includes the definition of digital competence, its types, the main subjects of the model, principles and factors that influence the formation and development of student digital competencies.

In the contemporary information and knowledge society, characterised by rapid technological evolution and permeation across all facets of life, the discourse on digital competencies has gained significant prominence (Lopuschnyak, Chala, & Poplavska, 2021). Accelerated digitalisation has given rise to an increased demand for competencies related to digital technologies. This phenomenon can be attributed to two interrelated factors. Firstly, digital technologies have become an integral part of everyday life. Secondly, the professional development of many individuals is increasingly dependent on the effective and appropriate use of digital technologies. In this regard, digital competence is recognised as a pivotal skill for the effective functioning of individuals in the future society (Williamson, Eynon, & Potter, 2020).

In light of these circumstances, digital competence is assuming an increasingly significant role within the educational environment. Its comprehension is predicated on a novel approach to learning, which involves determining the set of skills and
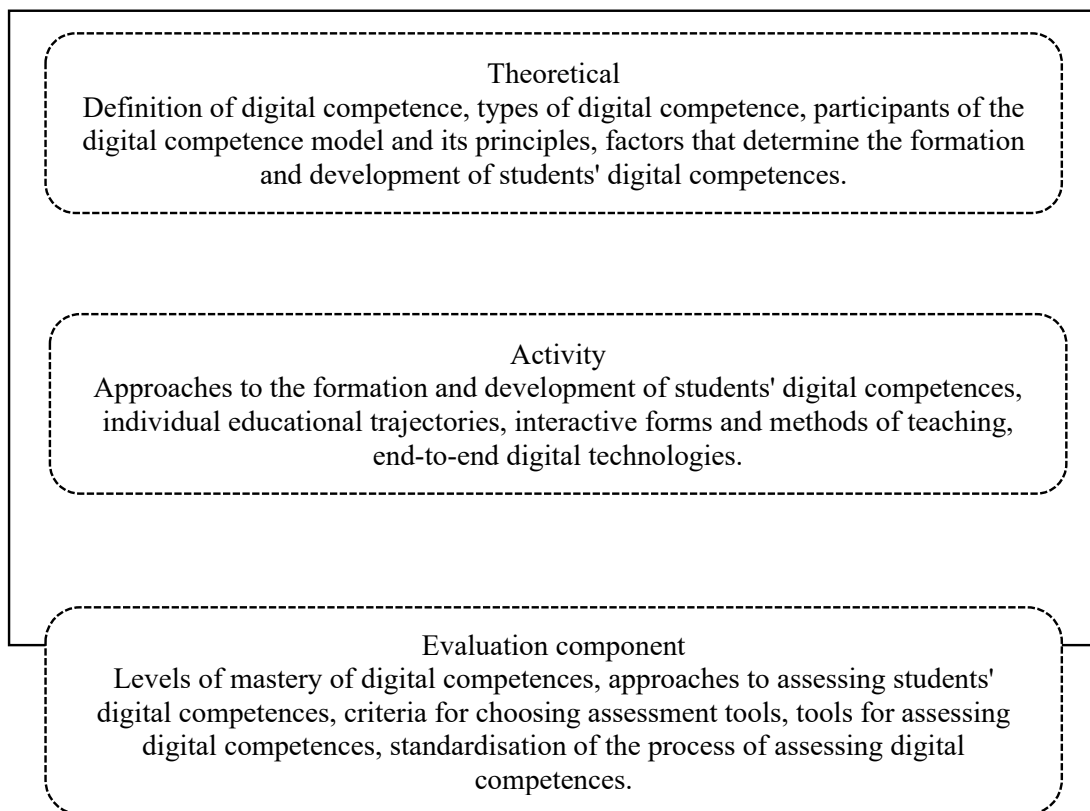
Theoretical
Definition of digital competence, types of digital competence, participants of the digital competence model and its principles, factors that determine the formation and development of students' digital competences.

Activity
Approaches to the formation and development of students' digital competences, individual educational trajectories, interactive forms and methods of teaching, end-to-end digital technologies.

Evaluation component
Levels of mastery of digital competences, approaches to assessing students' digital competences, criteria for choosing assessment tools, tools for assessing digital competences, standardisation of the process of assessing digital competences.

FIGURE 1 Components of the model of student digital competence

Source: created by the author independently

knowledge that an individual must acquire for successful learning at any stage of the educational process and throughout life.

A review of the scientific literature reveals a plethora of definitions of digital competence, with varying foci, making it challenging to offer a comprehensive overview of the extant approaches. A review of the extant scientific research on this topic reveals that there is no single approach to the definition and content of the concepts of "digital competence", "digital literacy" and "digital skills". Often, these concepts are used synonymously in various scientific sources.

Scientific research indicates that the digital competence of students is becoming increasingly important in addressing global problems in modern society (Bobro, 2024). In scientific publications, the concepts of "digital competence", "digital literacy," and "digital skills" are often considered to be related, although there are differences between them in different research approaches. There is an ongoing debate in the education sector as to which of these terms is more relevant: in particular, digital competence covers a wider range of skills and includes ethical aspects, security and social factors, while digital literacy focuses mainly on technical skills in working with digital technologies.

Digital competence should be considered as a key skill for living in the digital age, which includes the ability to learn, work, relax, apply digital tools creatively and use them confidently and safely (Yahodzynskyi, 2015).

It is imperative to comprehend digital competence not as a distinct skill but rather as a composite of skills that contribute to the effective utilisation of digital technologies, effective teamwork, the cultivation of critical thinking, creativity, and communication. Within the educational context, digital competence is regarded as the capacity to not only possess theoretical knowledge but also to apply this knowledge and skills to plan, implement, evaluate, and continuously improve educational processes using digital technologies.

Digital competence is a concept that is subject to constant change in line with developments in digital technologies and the transformation of the knowledge society. It is determined not only by the level of proficiency in digital tools, but also by the ability to critically evaluate, adapt, and apply digital technologies in the learning and professional environment. In this context, digital literacy is regarded as a broader concept than digital competence, insofar as it encompasses a set of knowledge and skills deemed necessary for effective life in a digital society. Concomitantly, digital competence comprises discrete components, with digital skills playing a pivotal role. Given that digital literacy, digital competence, and digital skills are dynamic

categories, their content is in a constant state of evolution and expansion in accordance with the development of digital technologies. This necessitates the integration of novel practices and competencies to ensure the effective utilisation of digital resources across diverse domains of activity.

A review of the extant literature on scientific research in education reveals that the concept of digital competence is interdisciplinary and encompasses a broad spectrum of skills related to digital technologies (Kozhyna, 2022). Its formation is based on knowledge from such fields as media research, computer science, information and library affairs, and literacy research. A review of the extant literature reveals a significant variation in terminology, with more than three dozen different definitions being used to describe digital skills and competencies.

In this study, digital literacy is defined as the ability to manage, analyse, integrate, evaluate, create, and receive information using digital technologies to actively participate in economic and social life. Digital competence, in turn, is defined as a set of knowledge and skills related to working with information in a digital environment, effective use of digital tools for project and process management, solving complex professional problems, digital interaction, as well as adherence to digital security principles and understanding the technical capabilities of modern digital technologies.

Digital skills are defined not only as the ability to use digital tools, but also as a conscious understanding of their application to achieve specific results, solve problems in everyday life or professional activities, as well as a person's desire to acquire relevant knowledge and experience (Kubiv et al., 2020).

Digital skills are divided into two main categories:
– Basic digital skills ensure the conscious use of digital devices to perform general, non-specific tasks that most users face, regardless of their professional activities.
– Professional digital skills are specific and focused on performing tasks in a particular field of professional activity.

The next element of the theoretical component of the model of student digital competencies is the classification of digital competencies.

The development of students' digital competences should be aligned with current challenges and the demand for specific digital competences that are critical for future graduates and determine their competitiveness in the labour market. In view of this, two main types of digital competences can be distinguished in the model of students' digital competences:
– Digital competence of students as a universal competence includes general digital skills

necessary for effective activity in the information society.
– Digital competences of students as future professionals are specialised digital skills that provide professional training and meet the requirements of specific industries.
– Today, the achievement of digital competence can be assessed by three key indicators:
– Independent choice and use of digital technologies (the ability to effectively use digital means of communication, search and creation of content in accordance with the purpose of interaction, in particular for organising joint activities).
– Digital interaction skills (the ability to organise communication and co-operation using information systems, digital services and technologies).
– Application of digital tools in educational and professional activities (the ability to choose and effectively use information and communication tools to solve educational and professional problems).

Consequently, the cultivation of digital competencies that facilitate the effective integration of individuals into the digital environment emerges as an imperative outcome of higher education curricula.

4 Digital University as an Environment for Developing Students' Digital Competences

The contemporary labour market is experiencing substantial transformations. Employment is undergoing significant changes, new forms of work are emerging, and the sectoral structure of the economy is undergoing change. Concurrently, a discernible discrepancy is emerging between the competencies acquired by graduates and the expectations of employers. It is evident that the development of students' digital competencies as future professionals will be contingent on their respective academic disciplines. Nevertheless, it is imperative that the digital competencies of students are aligned with the fundamental competencies of the digital economy, encompassing communication and co-operation in the digital domain, self-development in uncertain environments, creative thinking, information and data management, and critical thinking in the digital sphere.

The development of students' digital competences should take place through the improvement of 21st century digital skills. Through self-development and self-education, students acquire digital skills that meet the requirements of the digital economy and are necessary for their future. In modern practice, key competences in the labour market are systematised into three main groups:

– Cognitive competences (problem solving, analytical and critical thinking, active learning and teaching, interdisciplinarity).
– Social and social-psychological competences (creativity and innovation, emotional intelligence, social intelligence, intercultural communication, virtual collaboration).
– Technical (hard) competencies (digital competencies).

It is expected that university students will possess the necessary digital competencies to facilitate their adaptation to the evolving educational system and the effective resolution of professional challenges.

The accelerated proliferation of digital technologies, notably mobile applications, is precipitating a paradigm shift in the realm of education, marked by the evolution of students into digital entities, schools into digital institutions, and universities into digital universities. The model of students' digital competence is comprised of three key participants: a digital university, a digital educator, and a digital student.

The mission of the digital university is to prepare the younger generation to function in a complex, globalised, and digitised labour market. A digital university is a paradigm of education that is positioned to evolve beyond the conventional educational models. It encompasses more than mere distance learning; rather, it is a virtual environment devoid of physical classrooms, permanent educators, and diplomas in their conventional sense. The entirety of the educational process is facilitated through digital networks.

A digital university cannot be seen simply as a virtual analogue of a traditional educational institution, since digital technologies allow not only to reproduce but also to radically change the processes of learning and management of the educational environment. In scientific research, the digital university is presented as an integrative methodological construct consisting of four interrelated components:
– Digital learning format combines forms of interaction based on digital technologies (how interaction is carried out) and defines educational content (what is the subject of interaction).
– Digital environment defines the spatial dimension of digital interaction (where the educational process takes place).
– Digital resources are tools for implementing the concept of a digital university (what participants of the educational process use).
– Digital platform is an algorithm for implementing the idea of a digital university (how interaction is organised) and at the same time an environment for educational communication (within which structure it is carried out) (Bobro, 2024).

The components of the digital university are closely interconnected, forming a single system in which the interaction of all elements is fundamental to its existence. The concept of a digital university is predicated on the creation and development of digital services in science and higher education that encompass all educational processes and assist in meeting the requirements of all participants in the educational environment.

A digital educator is a new generation educator who has a modern digital mindset and actively integrates digital technologies into the learning process. This implies professional activity, responsibility for personal development, and the ability to independently manage educational projects both within and outside of formal institutional education. In the process of teaching, a digital educator applies the latest approaches to interacting with students, in particular:
– Constructive feedback;
– collaborative learning;
– technological support;
– modeling behavioural and emotional reactions in the digital environment;
– development of adaptive curricula;
– integration of open online resources and new platforms for teaching and learning;
– application of modern assessment methods.

To improve the quality of the educational process, a digital educator should create a favourable learning environment, plan lessons based on results, give students autonomy in learning, motivate their progress, provide clear instructions and prompt detailed feedback. It is also important to use innovative digital tools:
– Virtual and augmented reality (VR and AR).
– Adaptive learning systems.
– Interactive platforms for collaboration.
– Online simulators and virtual laboratories.
– Artificial intelligence in learning.
– Gamification of the learning process.

The effective utilisation of digital technologies by educators is instrumental in fostering students' digital competencies and preparing them to thrive in the digital era. The digital competence of educators is a pivotal factor in the development of student digital competencies. The utilisation of digital technologies in the learning process exerts a direct influence on the level of digital literacy of students; that is to say, the more actively educators employ digital teaching methods, the higher the level of digital competencies that students will acquire.

5 Findings

The findings of the research substantiate the notion that digital competence is a multidimensional concept, comprising three primary components: theoretical, activity, and evaluation. The theoretical component provides a systematic understanding of digital technologies and their impact on the educational process. The activity component,

meanwhile, encompasses methods and means of developing student digital skills in educational and professional activities. Finally, the evaluation component determines the level of mastery of digital competencies and mechanisms for their enhancement.

The research found that contemporary students are actively integrating digital technologies into the learning process. However, the level of digital literacy varies significantly depending on specialty, level of training, and personal motivation to develop digital skills. It has been determined that key competencies of the digital economy, such as communication in the digital environment, information management, critical thinking, and self-development, are crucial for the successful functioning of students in the digital university.

The research demonstrated that a digital university, in its conceptualisation, assumes a pivotal role in the cultivation of student digital competencies. This is achieved through the integration of digital technologies into all phases of the educational process. The study determined that the effectiveness of digital competencies formation is contingent on the level of digital readiness of educators, the implementation of adaptive learning technologies, the use of digital platforms, and the availability of personalised educational trajectories.

capacity to critically evaluate, adapt, and apply these competencies in both educational and professional contexts. The proposed conceptual model of student digital competencies should be applied in the context of the digital transformation of university education, since such a model considers modern challenges and trends in the development of the digital educational environment.

It has been established that the digital university, as a new educational paradigm, ensures the integration of digital technologies into all aspects of the learning process, thereby creating prerequisites for the development of student digital competencies. Concomitantly, the role of the digital educator as the pivotal agent of this transformation is paramount, given that their proficiency in utilising digital tools exerts a direct influence on the students' digital literacy levels. The research also confirmed the necessity for further development of mechanisms for assessing the digital competence of students. This will assist in improving the quality of education and the relevance of the knowledge and skills acquired to the requirements of the digital economy. The study established that digital competence is a significant predictor of graduate employability, emphasising the necessity for ongoing enhancement of curricula to align with contemporary digital transformation imperatives.

Prospects for further research include the development and approval of a methodology for the assessment of students' digital competence, the analysis of the effectiveness of the implementation of digital platforms in the learning process, and the study of the impact of digital tools on the quality of educational outcomes within a digital university.

6 Conclusions

The results of the analysis demonstrate that the digital competence of students is a multifaceted phenomenon encompassing not only knowledge and skills in digital technologies but also the

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