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The importance and models of forming the digital competence of teachers

The article is devoted to the current problems of the education system. In the process of digitalization, there is a fundamental change in the structure of training and the organization of the educational process. In this regard, one of the urgent problems is to update the methods of creating and providing educational content to students using digital technologies. There is a need for means to create accessible and optimal learning materials, content for effective learning, and means to effectively transfer students' knowledge. Digital technologies allow you to easily and quickly, conveniently transfer to the student the content of training, a variety of educational content. It also requires digital pedagogical competence from education professionals. The conclusions of researchers in defining the essence of the concepts of digital competence, pedagogical digital competence are presented. The main models of formation of digital competence of teachers are given, the necessity of improving the content of domestic methodological sites is justified.

Keywords: competence, digital competence, digital pedagogical competence, model, SAMR, TPACK, DigCompEdu, DigEuLit.

Introduction

The modern development of digital technologies requires professional teachers with a personal and professional approach to global issues of civilization in the context of rapid integration processes at the world level, digital competence for the optimal use of digital technologies in education and upbringing.

The main consumer of the products of the education system is the state, which provides higher education institutions with the necessary property and current funding. The requirements for the results of educational activities are reflected in the state educational standards, and the process itself is controlled by regulations. The short-term goals of the state partially overlap with the goals of another group of consumers – employers. The provision of the developing economy with personnel in accordance with current needs, a high level of their readiness to perform the functions of work in professional competencies [1].

Using the SAMR model developed by Ruben Puentedura, we can describe how digital technology affects education and learning. SAMR: Substitution, Augmentation, Modification, Redefinition (<https://www.21c-learning.com>).

The model consists of four stages: 1) Substitution: digital technologies replace traditional technologies (for example, typing in Word). 2) Augmentation: digital technologies become a means of optimization in solving educational problems (for example, current, diagnostic or final assessment using Google forms, mobile applications Kahoot, Plikers, etc.) 3) Modification: significant functional changes in the educational process and its interaction participants (for example, the use of blended learning technologies or transfer classes). 4) Redefinition: setting and solving previously unsolved new and new pedagogical problems.

Research methods: systematization and formulation of theoretical information (analysis, synthesis, abstraction).

Discussion

Today, the scientific community conducts a wide range of fundamental research to identify the essence and content of the concepts of “digital competence”, “digital pedagogical competence”, its components, the formation of digital competencies of teachers.

According to the recommendation of the European Commission [2], competence is defined as a set of knowledge, skills and attitudes, where knowledge is a set of facts and numbers, concepts, ideas and theories necessary to understand something; skills are defined as the ability to apply knowledge to perform actions and achieve results; attitudes describe tendencies, desires, and ways of thinking that determine how to react or respond to an idea, person, or situation.

The term “digital competence” appeared in the European scientific community in 2000, when the pre-conditions for lifelong learning began to form, and the term was further expanded when it was introduced as one of the eight core competencies in the 2006 EU guidelines. An approximate definition of the concept of digital competence (DC) is associated with the ability to use ICT (Table 1). Competence, including digital competence, is a category that refers to the relationship between human knowledge and practice. It combines knowledge, acquired methods and skills of action in real situations [3].

Table 1

Content analysis of the concept of digital competence

№	Digital competence is	Researcher
1	2	3
1.	skills, knowledge, creativity and approach to using digital media for learning and understanding in society	ITU, 2005, p. 7
2.	flexible exploration of new technological conditions and familiarity with new technological conditions, analysis of data and information, selection and critical assessment, use of technological potential to formulate and solve problems, create common and shared knowledge by encouraging knowledge of individual tasks and mutual respect for rights /obligations.	Calvani, A., Cartelli, A., Fini, A., & Ranieri, M. (2008). Models and instruments for assessing digital competence at school. <i>Journal of E-Learning and Knowledge Society</i> , 4(3), 183 – 193 [in Italy].
3.	-based on the constant acquisition of competencies (relevant knowledge, skills, incentives and responsibility), a person's ability to confidently, effectively, critically and safely choose and use infocommunication technologies in various spheres of life (content, communication, consumption, technosphere), as well as his\her readiness for such digital competence service.	Tsifrovaia kompetentnost podrostkov i roditel'ei. Rezultaty vs Rossiiskogo issledovaniia / G.U. Soldatova, T.A. Nestik, E.I. Rasskazova, E.Iu. Zotova. — M.: Fond Razvitiia Internet, 2013. -144 s.
4.	the ability to effectively and responsibly use digital technologies, media and other digital resources for solving practical problems, searching for information, creating digital products and communicative content	Engen, B. K., Giæver, T. H., Gudmundsdottir, G. B., Hatlevik, O. E., Mifsud, L. & Tømte, K. (2014). Digital natives: Digitally competent? In M. Searson & M. N. Ochoa (Eds.), <i>Proceedings of Society for Information Technology & Teacher Education International Conference 2014</i> (pp. 2110-2116). Association for the Advancement of Computing in Education. SITE 2014. [in USA]
5.	the ability to use knowledge, business, personal, social and (or) methodological skills in a work or study environment, as well as in professional and personal development.	Terminology of European education and training policy (2014). European Centre for the Development of Vocational Training (CEDEFOP). Retrieved from https://www.cedefop.europa.eu/files/4117_en.pdf .
6.	the ability of a person to critically, hopefully, safely and effectively use and choose information and communication technologies in all spheres of life, as well as their readiness for such activities	Gaidamashko I. V., Chepurnaia Iu. V. Tsifrovaia kompetentnosti onlain-riski studentov obrazovatelnoi organizatsii vysshego obrazovaniia // <i>Chelovecheskii kapital</i> . 2015. №10 (82). -S. 18—21.
7.	reliable and effective use of information and communication technologies (ICT) for work, leisure and communication.	Shmelkova L.V. Kadry dlia tsifrovoi ekonomiki: vzgliad v budushchee // <i>Dopolnitelnoe professionalnoe obrazovanie v strane i mire</i> , 2016 №8 (30). –C. 1-4.
8.	in a broad sense, ICT can be defined as confident, critical and creative use to achieve goals related to work, employment, study, leisure, inclusion and/or participation in society.	DigComp Framework. Retrieved from https://ec.europa.eu/jrc/digcomp
9.	the ability to solve various problems in the field of information and communication technologies (ICT): the use and creation of	Obuchenie tsifrovym navykam: globalnye vyzovy I peredovye praktiki. <i>Analiticheskii</i>

1	2	3
	content using digital technologies, such as searching and sharing information, answering questions, interacting with others and computer programming.	otchet. M.: ANO DPO “Korporativnyi universitet Sberbanka”, 2018. - 136 s.
10.	knowledge and skills necessary for the use of technology in the process of creating and formalizing new knowledge	Kalimullina O.V., Trotsenko I.V. Sovremennye tsifrovye obrazovatelnye instrument I tsifrovaia kompetentnost: analiz sushchestvuiushchikh problem itendentsii // Otkrytoe obrazovanie. 2018. T.22, № 3. - S.61– 73. DOI: http://dx.doi.org/10.21686/1818-4243-2018-3-61-73 .
11.	high-level meta-capabilities for the presence of highly mobile intelligent devices in the digital space	Afanaseva G.A., Ziablov A.A. Razvitie obrazovatel'nogo protsessa v novoi tsifrovoi srede // Ekologiya urbanizirovannykh territorii. 2018. №2. -S.105– 106. DOI: 10.24411/1816-1863-2018-12105.
12.	confident and critical student use of computers, mobile phones, tablets, and interactive whiteboards. This competence is based on logical thinking, a high level of information management and highly developed digital skills. Digital competence includes understanding the general structure and interaction of computer devices; understanding the potential of digital technologies for innovation; a basic understanding of the reliability of the information received, the ability to use programs for designing lessons.	Iachina N.P., Fernandez G.G. Razvitie tsifrovoi kompetentnosti budushchego pedagoga v obrazovatel'nom prostranstve vuza. - Vestnik VGU, Seriya: Problemy vysshego obrazovaniia. № 1. 2018. S. 134–138.
13.	ability to work with digital devices; the ability to creatively modify the information received, protect copyrights and defend against viruses and Internet attacks; a set of skills and competencies such as programming, application development and others.	Gavrilenko N.N. Tsifrovaia kompetentnost – kliuchevoi component professionalizma perevodchika // Vestnik PNIPU. Problemy iazykoznanii i pedagogiki. 2018. № 3. -C. 139–150.
14.	skills for effective use of technology, which include information retrieval, use of digital devices, use of social networking functions, financial transactions, online shopping, critical perception of information, production of multimedia content, synchronization device.	Pogozhina I. N., Sergeeva M. V., Egorova V.A. Tsifrovaia kompetentnosti detstvo – unikalnyi vyzov 21 veka (analiz sovremennykh issledovaniy) Vestnik Moskovskogo universiteta. Seriya 14. Psikhologiya. 2019. № 4. -S. 80–106
15.	- these are the skills of effective use of technologies, which include: - information search, - use of digital devices, - use of social network functionality, - financial transactions, - online purchases, - critical perception of information, - production of multimedia content, - device synchronization.	Regionalnaia obshchestvennaia organizatsiia “Tsentri Internet-tekhologii” (ROTsIT).- [Elektronnyi resurs]. URL: http://xn--80aaefw2ahcfbneslds6a8jyb.xn--p1ai/ .
16.	the user's ability to confidently, effectively and safely choose and apply information and communication technologies in various spheres of life is based on the continuous acquisition of knowledge, skills, motivation, responsibility	Model kompetentsi I komandy tsifrovoi transformatsii v sisteme gosudarstvennogo upravleniia/pod red. Shkliaruk M.S., Garkushi N.S. — M.: RANKhiGS, 2020. — 84 s.

The analysis of the results of the researchers presented in Table 1 showed that digital competence includes free and safe work of users with information and digital devices.

Public access to digital technologies, improving the quality of Internet access, increasing pedagogical potential have led to the emergence of the phenomenon of digital transformation of education and the rapid development of new areas of pedagogy in science, in particular, digital pedagogy, cyber pedagogy, electronic didactics.

In addition to the above, the spread of the COVID-19 corona virus infection in the world in late 2019 – early 2020, the massive closures of educational institutions posed great problems for teachers in the country. On March 13, 2020, the country registered the first COVID-19 corona virus infection and declared a state of emergency in the country. The necessary normative and organizational work has been adopted at the national

level. From March 23 to March 27, 2020, pilot classes in a streaming format were held in the country. Based on the results of the online lessons of the competition, the Ministry of Education and Science of the Republic of Kazakhstan decided to cancel the lessons in streaming format. This is due to the fact that the Internet in the country does not provide real-time education for 2.5 million children. The capabilities of social networks, cloud educational services, e-mail and special electronic programs are mainly used. This, in turn, highlighted the relevance of the transition to digital learning technologies, the creation of conditions for their creation, the introduction of a combination of new and traditional teaching methods to solve a number of psychological, pedagogical, educational and other problems.

According to the researchers, the digital transformation of education should be ensured, first of all, by strategic plans that will determine the educational policy in this area and test it from top to bottom in the entire education system. New digital technologies for the interaction of participants in the educational process help automate internal processes in educational institutions, facilitate repetitive daily activities and improve interaction between students, teachers and parents [4].

According to the state program “Digital Kazakhstan”, “... efforts to digitize actively develop human capital – knowledge and skills of the future are instilled from an early age, the efficiency and speed of business are increased through automation and other new technologies, and the dialogue of citizens with their countries is simple and leads to the creation of a new open society” [5]. In addition, the formation of digital competencies of teachers is the responsibility of teachers specified in Article 15 of the Law of the Republic of Kazakhstan “On the status of teachers”; development of life skills, competencies, independence, creative abilities of students at their own level [6], indicated in the content of the professional standard “Teacher” 1) training; 2) education; 3) methodical; 4) a high level of research and development work [7].

This confirms that digital technologies have a positive effect on student activity and learning, providing ample opportunities for individual and combined learning [8]. The task of the teacher is to develop in students the desire for success, to encourage even small achievements, not to pay attention to failures. This task requires a high level of digital competence and continuous improvement of teachers. Today, fundamental research is being carried out in the field of the formation of digital pedagogical competence of teachers (Table 2).

Table 2

Content analysis of the concept of pedagogical digital competence

№	Digital pedagogical competence is	Research scientist
1	2	3
1.	set of components: general (general knowledge and skills necessary for teachers to work as a digital teacher); didactic (defines the digital characteristics of each subject) and professionally oriented (describes the digital characteristics of the extended teaching profession).	Ottestad, G., Kelentrić, M., & Guðmundsdóttir, G. (2014). Professional digital competence in teacher education. <i>Nordic Journal of Digital Literacy</i> , 9(4), 243–249 [in Norway]
2.	the ability to consistently apply the principles, knowledge and skills needed to plan and conduct, and a continuous learning assessment concept based on information and communication tools, theory, ongoing research and proven experience, and better support for student learning.	From, J. (2017). Pedagogical digital competence—between values, knowledge and skills. <i>Higher Education Studies</i> , 7(2), 43–50 [in Sweden]
3.	training, skills in the use of digital technologies, allowing professionals to work with modern information and communication technologies, computers, software applications and databases, helping to implement ideas and tasks in their work.	Tsankov, N. & Damyanov, I. (2017). Education Majors’ Preferences on the Functionalities of E-Learning Platforms in the Context of Blended Learning. <i>International Journal of Emerging Technologies in Learning (iJET)</i> , 12(5), 202-209. [in Germany] Retrieved from https://www.learntechlib.org/p/180180/ .
4.	the ability and preparation of teachers to perform labor functions used in the field of education. Digital pedagogical competencies are a dynamic set of subject competencies that currently determines the level of teachers’ ability to implement various types of professional activities in the field of education, which are effectively, responsibly and safely implemented on the basis of digital technologies.	Tsentrt sifrovyykh pedagogicheskikh kompetentsii http://www.kspu.ru/division/403/

1	2	3
5.	the ability and willingness of teachers to carry out job responsibilities that meet professional standards, taking into account the requirements of the digital economy.	Bocharova Iu.Iu., Lomaskolu.Iu., Simonova A.L. Model realizatsii podgotovki uchitelei-nastavnikov I studentov-internov sfere tsifrovoykh pedagogicheskikh kompetentsii. Vestnik krasnoarskogo gosudarstvennogo pedagogicheskogo universiteta im. V.P. Astafeva. №3(45), -S.6-19. Krasnoarsk, 2018.
6.	willingness and ability to use digital resources, use computers, mobile devices and cloud technologies in the educational process, as well as create and effectively use the capabilities of the digital learning environment and all its components in the educational process.	Goriunova M.A., Lebedeva M. B., Toporovskii V.P. Tsifrovaia gramotnost I tsifrovaia kompetentnost pedagoga v sisteme srednego professionalnogo obrazovaniia. Chelovek i obrazovanie, №4 (61), 2019, pp. 83-89.
7.	the ability to professionally develop/improve pedagogical work, primarily with the help of digital technologies in web courses/online training. In a broad sense, digital competence encompasses all types of pedagogical work in a professional context in which digital technologies are used.	Valiavskii, A. Iu. Pedagogicheskaiia tsifrovaia kompetentnost // Nauka. Informatizatsiia. Tekhnologii. Obrazovanie: materialy XIII mezhdunarodnoi nauchno-prakticheskoi konferentsii, 24-28 fevralia 2020 g. - Ekaterinburg : RGPPU, 2020. - S. 470-477.

R. Krumswick defined the digital competence of teachers as follows: “Digital competence is a teacher's skill ... to use ICT in a professional context with good pedagogical and didactic views and knowledge of its implications for students and digital education strategies”. In addition, R. Krumswick defined the digital competence of teachers as different from the competence of other users of technology as “... the intersection between cognition, meta-knowledge, motor skills, learning strategies, self-efficacy and pedagogical and didactic aspects” and offered the model of digital competence of teachers.

In R. Kramsvik’s model the digital competence of teachers consists of four main components. These include basic (but not required) practical skills, didactic competence in action, assessing the impact of teaching strategies and a broader understanding of ethics, critical assessment of resources and personal development in a digital society: 1) Teachers’ access to “basic ICT skills” Technology should be largely transparent. 2) “Didactic ICT Competence” refers to the ability to use ICT across disciplines to achieve competency-based goals. 3) The Learning Strategy component predicts the meta-perspective of the first two components and takes into account the pedagogical consequences of changing attitudes towards education. 4) The digital education component provides a meta-perspective for the first three components and focuses on how student participation and personal development affect the digitalization of society, ethical views on the role of technology in human development, and the ability to critically assess information sources. [9, 10].

The Model of Educational Content of Education (TPACK), proposed by Mishra and Koehler in 2006, defines the digital competence of a teacher as the intersection of three main forms of knowledge: technological, pedagogical and informational. This structure suggests that the digital competencies of teachers can vary depending on the subject taught [11].

Since 2014, the European Commission Working Group on Digital and Online Learning (COO, 2014-2015) and the Working Group on Digital Skills and Competencies (CDC, 2016-2018) have been working on a program aimed at digital innovation in education in the European Union supported activities and helped to develop the following tools: The European Framework and related tools for the support and development of citizens (DigComp 2.1), teachers (DigCompEdu) and educational organizations (DigCompOrg); templates for the development and integration of digital educational content, including open educational resources for publicly available open online courses (MOOS); models for educational institutions to create a high-quality, open and innovative digital learning environment. The European Model for Digital Competencies for Education (DigCompEdu) identifies several areas in which educational staff can help develop digital competencies [12]. DigCompEdu's goal is to demonstrate and describe the digital competencies inherent in teaching staff. It includes 22 competencies, divided into six areas: 1) use of digital technologies in a professional pedagogical environment; 2) aimed at developing professional skills in searching, creating and sharing digital educational resources; 3) develop teachers’ skills in using digital tools in teaching and learning; 4) this is related to the acquisition of digital tools for assessing learning outcomes; 5) it aims to use digital tools to enhance student learning opportunities; 6) defines the content of the teacher's activities to support the development of digital competencies of students.

DigCompEdu allocates 6 different, gradually increasing levels of competence, corresponding to the levels of language competence of the European Computing System (CEFR): A1 Newcomer; A2 Explorer; B1 Integrator; B2 Expert; C1 Leader; C2 Pioneer.

The DigCompEdu model is compatible with the TPACK concept formulated by Mishra and Koehler. However, the TPACK model does not explain how the link between technological, pedagogical and content education is established, while DigCompEdu focuses on identifying pedagogical and professional areas for integrating technology into teaching and professional practice.

The most complete model of digital competencies is presented by S. Carretero, R. Vuorikari, Y. Punie. The authors provide a digital competency framework for citizens with eight skill levels and use cases. Among the purely technical skills of working with digital devices that they formulate, one can single out those that are an integral part of the pedagogical competence of teachers. Thus, the first group of competencies required for a teacher to successfully complete educational activities that may include competencies related to information literacy (digital fluency): the ability to find, analyze, interpret and critically evaluate information and content in a digital environment. The second group includes communication and collaboration skills in a digital environment: the ability to interact using digital technologies, their use in a digital environment and knowledge of the rules and norms of behavior in the process of communication, the adaptation of communication strategies to a specific audience, cultural characteristics. The third group of competencies is determined by the ability to create and process digital content in various formats, change and improve the quality of information and content. The fourth group of digital competencies includes the protection of personal data, devices and digital content, skills and abilities to ensure the safety of the physical and psychological health of users. The fifth group includes competencies associated with identifying and solving technical problems that arise when working with digital devices [14].

Within the framework of the ICT (Information and Communication Technology) Competencies of Teachers recommended by UNESCO, the competences consist of three modules: ICT use – to prepare students to use digital technologies for social development; mastery of knowledge – the formation of students' abilities for the socio-economic development of their country using digital technologies; educational production – teaching students the ability to update their knowledge and participate in innovative processes.

Each of these modules covers six aspects of work: understanding the role of digital competencies in education, curriculum and assessment, teaching practice, ICT hardware and software, organization and management of the educational process, professional development [15].

M. Tsvetkova and V.M. Kiryukhin noted that the digital competence of teachers is based on general digital literacy and includes the general competences of digital pedagogy: the use of e-learning in teaching practice; the use of training platforms for mobile learning; using e-books and open educational platforms to prepare for lessons; work with digital materials and training platform; use of online courses to improve qualifications in their subject [16].

We were able to analyze the well-known modern structures of digital competence of school teachers. In their professional activities, teachers should use the following concepts of digital pedagogy in their work: open educational resources, massive open online courses, electronic textbooks, educational platforms, electronic libraries, cloud educational systems and Internet services, digital video communication, global media, automated management systems of educational organizations, electronic portfolios of students and personal electronic offices.

In accordance with these competencies, we have identified three main digital competencies that affect the success of teaching activities:

1. Use of ICT platforms.
2. Ability to work in an open educational space (keeping electronic journals, class groups in social networks, conducting classes using distance learning technologies and ICT platforms).

Using digital materials in preparation for lessons (working with libraries of e-books) [17].

Conclusions

In our opinion, “digital competence is the ability of a user to freely and safely use the potential of digital devices to search, create, critically evaluate, process, distribute and transmit information for personal/professional purposes”. As a result of the analysis of the conclusions of the above-mentioned researchers and models of the formation of pedagogical digital competence, the pedagogical "digital competence" of a teacher is information and communication technologies (digital information resources, network technologies, educational platforms, cloud technologies, etc.) in educational, methodological, research activities, and the ability to effectively and safely use information.

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Мұғалімдердің цифрлық құзыреттілігін қалыптастырудың мәні мен модельдері

Мақала білім беру жүйесінің өзекті мәселелеріне арналған. Цифрландыру процесінде оқыту құрылымы мен оқу процесін ұйымдастыруда түбегейлі өзгеріс бар. Осыған байланысты білім алушыларға цифрлық технологияларды пайдалана отырып, білім беру контентін жасау және ұсыну әдістерін жаңарту өзекті проблемалардың бірі болып табылады. Қолжетімді және оңтайлы оқу материалдарын, тиімді оқытуға арналған мазмұнды және оқушылардың білімін тиімді жеткізуге

арналған құралдарды жасау үшін қаражат қажет. Цифрлық технологиялар студентке оқу мазмұнын, әртүрлі білім беру мазмұнын оңай және тез, ыңғайлы жеткізуге мүмкіндік береді. Бұл білім беру саласындағы мамандардан педагогикалық цифрлық құзыреттілікті талап етеді. Цифрлық құзыреттілік, педагогикалық цифрлық құзыреттілік ұғымдарының мәнін анықтауда зерттеушілердің тұжырымдары ұсынылған. Педагогтердің цифрлық құзыреттілігін қалыптастырудың негізгі модельдері келтірілген, отандық әдістемелік сайттардың мазмұнын жетілдіру қажеттілігі негізделген.

Кілт сөздер: құзыреттілік, цифрлық құзыреттілік, цифрлық педагогикалық құзыреттілік, модель, SAMR, TPACK, DigCompEdu, DigEuLit.

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Сущность и модели формирования цифровой компетентности учителей

Статья посвящена актуальным проблемам системы образования. В процессе цифровизации происходит кардинальное изменение структуры обучения и организации образовательного процесса. В этой связи одной из актуальных проблем являются обновление методов создания и предоставление обучающемуся учебного контента с использованием цифровых технологий. Необходимы средства создания доступных и оптимальных учебных материалов, содержание для эффективного обучения и средства эффективной передачи знаний обучающихся. Цифровые технологии позволяют легко и быстро, удобно передавать обучающемуся содержание обучения, разнообразный учебный контент. В свою очередь, они требуют цифровой педагогической компетентности от работников сферы образования. Изложены выводы ученых-исследователей в определении сущности понятий «цифровая компетентность» и «педагогическая цифровая компетентность». Приведены основные модели формирования цифровой компетентности педагогов, обоснована необходимость совершенствования содержания отечественных методических сайтов.

Ключевые слова: компетентность, цифровая компетентность, цифровая педагогическая компетентность, модель, SAMR, TPACK, DigCompEdu, DigEuLit.

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