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Environment for the development of the digital competence of future specialists in the field of education

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Abstract: *In the conditions of continuously increasing requirements to the qualification of specialists in the field of pedagogy concerning the application of the competence-based approach in education as well as its expected results in terms of the formation of key competences, the digital competence of teachers and pedagogical students acquires special significance in relation to their professional realization in the sphere of education. The necessity to improve teachers' digital competence as part of their professional profile poses the demand that the scope and content of the concept be explored so that a conceptual base is formed for the technological development of that competence in the conditions of higher pedagogical education and in the practice of teaching as well. The paper is thus dedicated to the conceptual vision of the digital competence of future specialists in the field of pedagogy and to the opportunities for its expedient development. On the grounds of an empirical study of digital competences at the onset of university education, the research also explores the favourable environment that is conducive to it development.*

Keywords: *specialists in the field of pedagogy, digital competence, educational environment, self-evaluation of basic digital competence of future specialists in the field of pedagogy.*

The requirements concerning the quality of education are gaining increasingly greater significance and topicality as it determines not only the quality of life, but also the paths for scientific, economic, and cultural development in the information society, which are in turn instrumental in overcoming long-lasting controversies of social, ethnic, religious, etc. character. An alternative solution to this problem is to be found in the new competence-based educational paradigm specifically manifested in continuous, life-long education open for everyone and viewed as a fundamental factor in social and cultural integration and an important "economic potential" for the transformation of the EU into "the most competitive and dynamic knowledge based economy in the world". As a result, the improvement of the qualification and education of specialists in the field of pedagogy is among the most vital issues of modernity. Its solution is

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associated with the competence-oriented goal setting process in education and in the design of the study content as well as with the optimization of methods and technologies for organizing the latter through systematic control of actual educational results.

In other words, the focus of education nowadays is associated not so much with the acquisition of knowledge, skills and habits but with the mastering of the competences necessary for one's personal development and social realization. This requires a shift from the existing technocratic paradigm in education to a humanistic, personality-oriented and constructivist one which aims at forming personal and socially significant qualities such as independence, self-regulation and self-reflection, personal responsibility and other key competences.

The distinction between "competence" and "competency" in the course of development of a competence approach allows identifying "competence" as a personality quality (trait), a system of subjective characteristics and "competency" as a normative, objective feature. Combining them in a conceptual-event pair allows for an adequate mode of scientific use and a fully-developed design of technological options for their formation and enhancement.

While the problem of education quality and the qualification of specialists in the field of education is acquiring greater importance, its solution is being closely associated with the application of information and communication technologies (hereafter ICT), and work in a digital environment. Regulation № 12/01.09.2016 on the statute and professional development of teachers, headmasters, and other specialists in the field of education determines the state educational standards in the system of pre-school and school education posing a plethora of requirements for each education-related specialist on their professional profile and requisite competences considered as a system of knowledge, skills, and attitudes.

Digital Competence - contexts of understanding[1]

Studies of digital competence, defined as a key competence in the early 21st century, are aimed primarily at creating theoretical models, frameworks of the competences and research tools for assessing competences [1, 2, 3, 4]. A systematic research aiming at clarification of the digital competence and digital literacy demonstrates that there is a range of definitions used in theory and practice. They vary depending on if the concepts are defined by policy, research or both and if they focus on technical skills or social practices. They vary depending on if the concepts are defined by policy, research or both and if they focus on technical skills or social practices. The following directions for further research stand out in higher education: (1) more research based on critical perspectives to avoid commonsensical use of the concepts, (2) take the development of definitions of these concepts seriously (3) avoid cross-referencing incompatibilities and finally (4) engage in critical investigations regarding the legitimacy of policy over research in the domain of higher education research. The analysis in different contexts of understanding and clarification of digital competence differentiates two levels and approaches of definition. While the first one focuses more on proficiency in using ICT for professional purposes and implications for students' learning, the second one uses more general definitions of *digital competence* by listing numerous cognitive abilities, including the ability to solve moral problems, to develop or even exploit in order to achieve digital competence [5].

The concept digital competence, its definition, formation and development as well as the levels of that competence and its evaluation are related with a variety of contexts of understanding. T. Hristova (2017) argues that in its most general, digital competence can be viewed from five separate perspectives: (1) Cultural competence covering the conception of digital cultures, "being born digital" and being able to function in a digital environment; (2) Knowledge and information on competence elicitation and competence evaluation, which comprises the skills for critical use of digital content; (3) Active digital competence constituting the capacity for production, authentication, normalization and updating of digital content; (4) Fair and law-abiding digital citizenship which includes the honest use of digital content, such as the legal manner of copyrighted texts and for presenting one's own content for use by others (through

[1]Elements of this conceptual vision have been presented in Tsankov, N. Digital Competence of Physical Education Teachers and Sports Coaches as Pedagogical Specialists. *Activities in Physical Education and Sport*, **2017**, *Vol. 7, No. 2,* 162-164.

CC-licenses); (5) Competence for the use of the proper instruments depending on users' goals (mobile platforms and devices, etc.) and capacity for understanding their potential and limits [6].

The research, conceptualization and operationalization of basic concepts such as computer literacy, digital literacy, media competence and others, lead to the defining of digital competence as a "set of knowledge, skills, attitudes (including abilities, strategies, values and awareness) which are essential when using ICT and digital media to perform tasks, solve problems, communicate, manage information, cooperate, create and share content, build knowledge effectively, efficiently, appropriately, critically, creatively, independently, show flexibility and ethics, work consciously, enjoy one's free time, participate, train, communicate, consume and expend the individual's rights and opportunities" [4].

Digital competence does not only refer to knowing how to surf the Web but can be described as a range of knowledge and skills, integrated within a specific context of functioning. The European Framework for Digital Competency of Citizens (DIGCOMP), outlines five areas that define the term "digitally literate4: *information processing, communication, content creation, safety and problem solving*. The European Union has been putting efforts in the creation of various online tools for assessment and determination of the level of digital competence [7].

As for digital competencies as essential components of digital competence of the pedagogical specialists, the studies in the field have repeatedly pointed to a lack of available career development opportunities, especially in the context of lifelong learning when it comes to the use of information and communication technologies for educational purposes, as well as the lack of opportunities for entering a network for professional collaboration that could lead to the implementation of new practices with higher pedagogical effectiveness.

Digital competence of pedagogical specialists

Digital competence, defined as one of the eight key competences for lifelong learning includes "the confident and critical use of information society technologies for work, leisure and communication" [8]. Digital competence implies connectivity with the skills to use digital technologies that allow teaching professionals to work with modern information and communication technology, computers, software applications and databases, helping them to realize their ideas and objectives in the context of their work. It is important for pedagogical specialists to have the ability to search, collect and process information and approach it critically and systematically as well as the skills to use the design tools for media information and the capacity to access, search and use Internet-based services, especially in the context of their future activities and opportunities for continuous professional qualification.

There is a certain degree of controversy, however, concerning the content and the structure of pedagogical specialists' digital competence which interfere with its successful formation and development during their university education. In the theory and practice of education these controversies are commonly related to: (1) misconceptions and inability to differentiate between systematic education of specialists in different fields (primarily those in technical and engineering specialties) in the field of information technologies, the training of teachers in computer science and information technologies, and the training of teachers in other disciplines as users of such technologies; (2) the inadequate employment of the competence-based approach in the design of the aims of education and its expected results as well as the impossibility to identify the fundamental elements of any competence; (3) the lack of a clear view of the conceptual frame of teachers' digital competence and the possibilities for its successful inclusion in their professional profile; (4) the lack of a conceptual model for the design of special didactic techniques for the formation of the digital competence of pedagogical specialists within their training as educators.

To solve the issues raised by these theoretical and practical controversies, student education in pedagogical majors needs to be oriented towards the development of competences and specific skills as defined by their professional profile presented in Regulation № 12 от 01.09.2016 г. for the statute and professional development of teachers, headmasters, and other specialists in the field of education. It emphasizes education-related specialists': (1) knowledge of ICT and the mechanisms for their integration and application in the educational process; (2) familiarity with techniques for the formation of communicative skills in children and students and for the development of critical, constructive thinking and effective search, elicitation, and selection of information from various sources based on an evaluation of its usability; (3) knowledge and employment of innovative methods for teaching and student evaluation;

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(4) skills for the application of ICT in the course of the education process, for demonstrating support and increasing student motivation for the formation of their own digital competence; (5) knowledge and implementation of the requirements for safe conditions of education, work and environment, including those for work in internet environment; (6) knowledge of techniques for effective presentation and for developing students' presentation skills.

Since the goal of the present section is to delineate the concept of digital competence in relation to education specialists, differentiating it from digital competence in general, it may be worth noting that objects and phenomena occur before the terms employed for their denotation come to be established. A preliminary conceptual frame of the properties of any competence, which offer an opportunity for its future contextual and situational interpretation, is predicated on the necessity to construe its invariant characteristics. Different conceptions of the content and boundaries of digital competence, defining it through its "cognitive, relational, and social" character, are popular in the scientific discourse [9]. Taking into consideration its multi-dimensional structure, the difficulties of the conceptual identification of digital competence is frequently related to: (1) the inadequate knowledge of the computer competencies and the competencies for operating different digital sources of information as a basis of digital competence; (2) the impossibility to evaluate it in its totality, especially in long-term perspective; (3) its dependence on other competencies, some of which of meta-cognitive character, which facilitate and predicate its development; (4) its dynamics as a process and phenomenon as well as its social determination. These problematic issues make it difficult to identify the basic competencies of the teacher integrated in his/her digital competence. Considering the integrative nature of the latter, it is often viewed as constituted of a technological, a cognitive, and an ethic component conjoined in a contextualized fashion [9].

These parameters form an adequate basis for the delineation and determination of the major characteristics of the conceptual frame of the digital competence of the pedagogical specialist, which include:

- integration of skills and competencies for using up-to-date information and communication technologies and a variety of digital media;
- abilities for critical evaluation of the content of the electronic information and knowledge of the advantages and disadvantages of digital media;
- efficient application of digital information processing and storage devices and abilities for adequate communication in different types of environment;
- skillful employment of information technologies and digital devices in a diversity of activities performed by the pedagogical specialist combined with an ability to project the respective skills onto a variety of levels: methodological, administrative, qualification-oriented;
- educational design based on the creative integration of digital media in the context of the subject to be studied which can provide for a learner-centred approach to students' performance and will also enhance the opportunities for the development of skills of cooperation, sharing, openness of expression, reflection, problem management, trust, and responsibility while promoting the sense of security and privacy;
- design of interdisciplinary educational routs facilitating students' abilities to employ information technologies and digital devices for information processing and storing in their studies at different stages of education in view of their needs defined by their personality, age, and social attributes.

In the context of subject differentiation in education, the aspects of the digital competence of the pedagogical specialist are further defined, broadened, and enhanced to the effect of acquiring a variegated character, which is manifested in the variant that make its application and content suited for specific educational purposes. The contextual prerequisites for the manifestation of its variants however are not in conflict with the invariant characteristics of the conceptual framework suggested in the current paper. This contributes to the dynamic nature of the digital competence of the pedagogical specialist, which makes it necessary to re-define it in the context of continuous learning.

Design of the empirical study and analysis of the results

The empirical study was conducted with a **contingent** of 85 students enrolled to be trained in the professional field 1.2. Pedagogy (Preschool and Primary School Pedagogy, Special Pedagogy). **The goal**

of the study is to establish the level of digital competence of the future pedagogical specialists based on their self-assessment and to identify the possibilities to design an educational environment which to purposefully develop in the context of their future professional realization. The Online **Self-Assessment Map** is based on the Digital Competence Self-Assessment Matrix and the Digital Skills Assessment Tool is part of the Europass: A Curriculum Vitaecreated in accordance with the European Framework for Digital Competence of the Citizen, also known as DIGCOMP, which outlines five areas: information processing, communication, content development, safety/security and problem solving. The five basic digital competences are assessed at three levels of manifestation/mastering: basic, self-sufficient, and proficient, including basic knowledge, skills and relationships in the five areas.

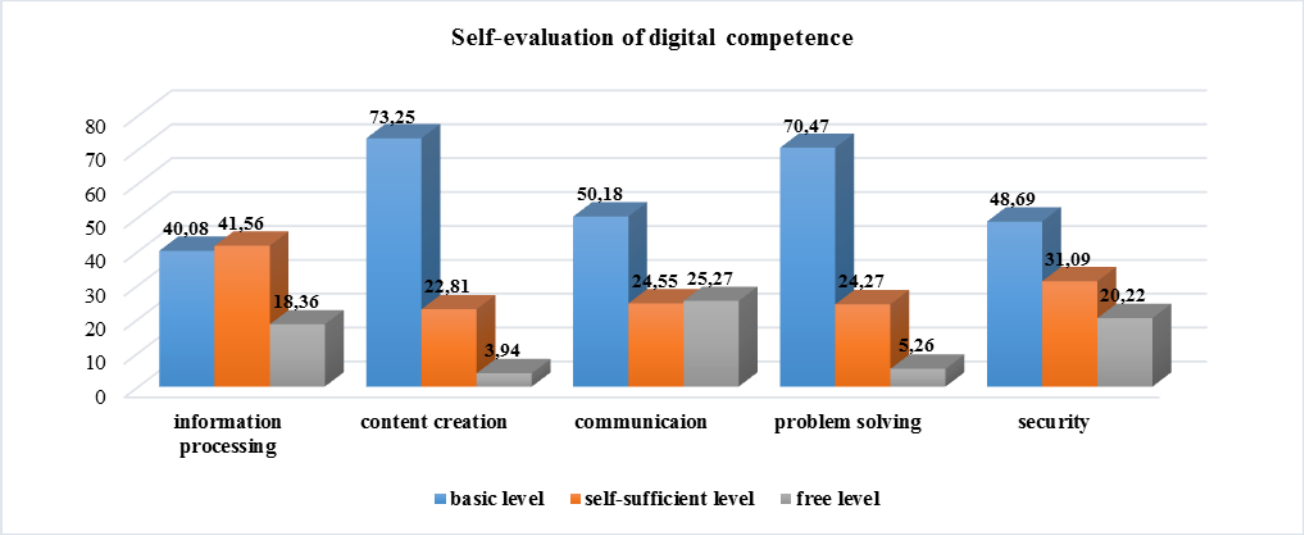

Figure 1. Self-evaluation of digital competence

From the analysis of the results summarized in Figure 1, it becomes clear that in the first area of competence (processing of information), 41,56% of the respondents self-assess their knowledge and skills to be on the self-sufficient level and 40,08% - on the basic level. A deeper analysis shows that 89,41% of students "can search for information online using a search engine" and 52,94% "can use different search engines to find information". 57,65% of self-assessors use search filters, 75,29% know that not all online information is reliable and 50,59% of students compare different sources to assess the reliability of the information they find; only 20,00% can evaluate the validity and reliability of information using a set of criteria. 41,18% of respondents classify and properly systematize the information they are looking for to facilitate its future use. All these elements of basic training are in favor of building up the searching and processing skills of students (future pedagogical specialists) given that the use of online learning resources should go through additional check from the teacher, bearing in mind that there are many imposed misconceptions about learning content. Only 18,36% of the students enrolled to be trained in the Pedagogical field self-assess their knowledge and skills in the field of information processing at a free level of knowledge. Serious are the students' difficulties in using web feeds (such as RSS - *Really Simple Syndication*) to get the information they are interested in. A mere 2,35% of them can use the subscription option to get information from the global Internet network collected in different sites through a set of web feeds. The percentage of pedagogy students who can use advanced search to find reliable information on the Internet is also very small – 7,06%, even with regard to the use of the simplest advanced search options: such as using quotes, underscore, etc. Only 27,06% can use cloudsto store information, which requires the search for ideas to improve the skills to apply cloud technologies in the context of pedagogical activities. Despite the comparatively high self-assessment of the students in terms of information processing, the observations show that when given practical task to search for information, to preserve it using different formats and to evaluate its reliability, only 13,5% of the students manage successfully within set timeframes.

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The second area of competence or "content development" competence, apart from being a basic for the modern man, is in direct connection with the context of activities of pedagogical specialists. In their self-assessment, 49,41% of students say they can create simple digital content (such as text, tables, images, audio files) in at least one format using digital tools, and 40,00% can edit content developed by others. Although 73,25% of the respondents considered their level of knowledge to be basic, only 32,00% of them in the course of solving a specific practical task related to content development were able to successfully fulfill it within a set timeframe. There is a significant discrepancy between self-assessment and practical implementation in task-solving. Only 18,82% of students claim to be able to create complex digital content in different formats (such as text, tables, images, audio files) and 21,18% of them say they can do basic formatting (for example, enter notes under line, charts, tables) related to content created by them or another user, as in a real situation, this share drops to 9,36%. Unsatisfactory is the share of those who self-assessed themselves as having basic knowledge in the field of programming - 5,88%, which in terms of introducing the subject Computer Modeling in the primary school curriculum, will require skills in the field of programming and the search for compensatory opportunities to acquire basic knowledge and skills in this area. Only 3,94% of students rate their level of content creation as proficient. Unsatisfactory share – 2,35% can create or modify complex, multimedia content in different formats, using different digital platforms, tools and environments, and only 1,18% of the students know how to design, create and modify a computer database tool. None of the students have indicated that they know how to apply licenses and copyrights, which requires special attention in the course of training in the licensing of electronic learning resources.

The highest relative share is of respondents who self-assess their level as proficient – 25,27% in the field of competence in "communication". 94,12% of the respondents indicate that they can communicate using a mobile phone, voice over IP (for example, Skype) e-mail or chat, etc. and use their basic functions (e.g. voice messages, SMS, send and receive e-mail, text messaging), 74,12% of them can share files and content using simple tools, and 63,25% are aware of the availability of social networks and online collaboration tools. Despite the high self-esteem in the field of communication, only 12,00% of respondents can use its educational opportunities, while 67,06% of them can use some online services (e.g. public services, e-banking, online shopping, etc.) 12,00% ofthe respondents actively participate in online spaces and use several online services. At the third level of proficiency, 67,06% of students are actively using a wide range of communication tools (email, chat, SMS, instant messaging, blogging, microblogging, social networks) for online communication, and 30,59% can use advanced messaging features (such as video conferencing, data sharing, app sharing). However, only 12,94% of respondents can create and manage content with collaborative tools (such as electronic calendars, project management systems, online checking, online spreadsheets), which are currently part of pedagogical work. All this is a reason to think about making full use of social communication opportunities as an opportunity to resolve educational goals, although quite often the self-assessment of students and their actual ability to solve specific practical tasks diverge.

The results for problem solving competence are of interest where the students' self-assessment draws attention to the prospects and areas for their future training. 49,41% of the respondents are aware that digital tools could help them solve problems, and 58,82% are aware of the need to improve their digital skills on a regular basis. However, only 7,06% regularly do this. Unsatisfactory is the relative share (4,71%) of respondents who can choose the most appropriate tool, device, application, software or service to solve (non-technical) problems, and only 3,53% of the students are aware of new technological developments; only 1,18% of them can solve almost all problems that arise with the use of digital technology. All this is unambiguously confirmed when setting real practical tasks from the field of application of the information and communication technologies into the activity of the pedagogical specialists, only 7,85% of the students can appropriately choose what tools to use in their solution, and over 95,00% of them have a serious difficulty if the problem chosen is an integral one, that is, requires different technological solutions. All this draws attention to the design of the educational environment in Information and Communication Technology training and work in digital environments so as to provide an opportunity to solve integrated problems from the practice of pedagogical specialists with an integrated technology application.

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Although there are some discrepancies in students' perceptions about privacy and its protection, especially in view of the adoption in 2016 of Regulation (EC) 2016/679 of the European Parliament and the Council of the European Union on the protection of individuals with regard to the processing of personal data and on the free movement of such data and the application of new rules known as the General Data Protection Regulation (or GDPR), 92,94% of the respondents know that they should not disclose personal information in the online space. However, only 4,71% of them are aware of their online identity and their digital footprint That is, there is some contradiction between students' knowledge and the search for ways to apply them in practice in a real online environment. Only 11,76% of them can identify phishing mail (malicious attempts to acquire information) and 3,53% of them can encrypt emails or files. 50,59% of future pedagogical specialists to avoid health problems (both physical and mental) use information and communication technologies wisely, and 55,29% of them are informed about the impact of digital technology on everyday life, online consumption, and the environment.

Conclusion

The digital competence of pedagogical specialists, as each competence, has its own internal logic expressed in a simultanuous functioning of the system of competencies in specific contexts and in practical terms.

This logic can be designed through the clarifying the basic components of digital competence, namely: cognition, motivation and values, technology, communication and reflexion. At their core, these components include the following parameters as foundation for digital competence: (1) in the plane of cognition – the possibility of processing information based on basic cognitive processes (analysis of incoming information, synthesis, formalization, comparison, generalization, development of options to use information and forecasting the consequences of the resolution on various problem situations, generating new information, organization and storage of information into long-term memory); (2) in the plane of motivation and values - creating conditions conducive to the formation of values and value orientations, increase motivation in a different respects; (3) on the technology plane – the capacity to work with different information and communication technical equipment for storage and processing of information, technology skills to work with to work with information databases and information flows; (4) on a communication plane - ability to encode and decode the information in different systems (natural or formal), to use technical means of communication in the process of transmitting of information using CTI; (5) on the reflexion plane - awareness of the capaity for self-regulation, self-government in behavioral respect, expansion of consciousness and self-realization [10].

In order to design an environment that enables us to form and develop information competence of future pedagogical specialist, it is necessary to know this system of competences, to be able to operationalize it to the relevant knowledge, skills and attitudes.

The methodological analysis of the competence approach in education direct us to the search for cognitive, activity-based, creative, personal and axiological component in the digital competence of the future pedagogical specialists. This is the reason fbehind the search for specific technological solutions and possibilities for formation and development of digital competence.

These technology solutions can be successfully found based on technological variants of a project-invariant for the formation and development of digital competence which takes into account the following key determinants:

- social needs for the development of the digital competence of pedagogical specialists;
- goal formation, complex projection and educational design of the formation and development of digital competence;
- a project developing the formation and enhancement of digital competence, containing: concept, content and procedure;
- development of model-invariant and approbation options for forming and developing digital competence of pedagogical specialists [11].

Thus, with a comprehensive and methodologically sound conceptual vision it is possible to fully form and develop digital competence in future pedagogical specialists through their university education.

Europe’s digital agenda is related to the initiative for overcoming the lack of information-and-communication skills viewed as one of the crucial obstacles faced in the process of mastering the potential

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of new technologies by way of enhancing digital literacy, stimulating the formation of long-lasting e-Skills, and introducing digital literacy policies. The present paper demonstrates that Information and Communication Technologies provide a variety of methods for the facilitation of the educational process by organizing it in a manner that takes into account the individual student needs. They also make it possible for students to build their digital competences necessary for a knowledge-based economy. For this transformation to be put to practice, however, it is necessary that future education specialists should have profound knowledge of how to work in a digital environment, which means that their digital competence should develop continually in pedagogical context. This postulates a demand for the design of an effective, adequate, and stimulating technologically oriented environment that takes into consideration students' needs and deliberately and systematically develops an educational process based on the solution of integrated tasks from actual pedagogical practice. This in turn implies a goal-oriented and expedient application of ICT guaranteeing, both didactically and from a methodical perspective, the professional improvement of the key digital competence.

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