

FORMATION OF DIGITAL COMPETENCIES IN THE PROCESS OF CHANGING EDUCATIONAL PARADIGM FROM E-LEARNING TO SMART-LEARNING AT PEDAGOGICAL UNIVERSITY

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Abstract: *The article analyzes the transformation of the educational paradigm of higher education from e-learning to SMART-learning and describes theoretical and practical aspects of the digital competencies formation of future teachers in the context of creating new knowledge in the SMART-University environment. The organizational and pedagogical conditions, principles and pedagogical methods of forming digital competencies are determined. A three-dimensional model for the formation of digital competencies in the context of creating new knowledge became the methodological basis for the pilot course “Information and communication technologies in education and science” for undergraduates of the pedagogical university. An experimental study was conducted in order to implement this model into the educational process of Ternopil National Pedagogical University. The results of the study showed that the role of pedagogical university is changing from providing knowledge to creating the conditions for students’ independent acquisition of new knowledge and forming appropriate digital competencies in the context of creating new knowledge.*

Keywords: e-learning, SMART-learning, model of digital competency formation, creation of new knowledge, research.

INTRODUCTION

Development of competencies is an important task of any modern educational system. The realities of the present impose the need for competencies formation. Modern education should prepare a person who is able to use the gained knowledge for a competitive activity in various spheres of public life. Therefore, the issue of organizing the learning process from the point of view of the competency-based approach is relevant.

Educational process must form a modern system of universal competencies. Objectives of education, which foresee the commitment of teachers to the competency-based approach concerning the organization of the educational process, lead to a change in the requirements for existing educational technologies.

Achievement of the set goals is possible provided scientifically organized and theoretically grounded development of the competencies of future teachers in the process of changing the educational paradigm from e-learning to SMART-learning. Professional requirements for a teacher are updated, and in particular, emphasis is placed on the level of professional competency rather than on professional knowledge.

The tasks of competency development are examined in many scientific studies conducted both abroad and in Ukraine. The problem of identifying and describing competencies and the process of their formation was solved by many scientists: B. Oskarsson, S. Sho, R. Selman, A. Shelton, V. Baidenko, A. Bondarevska, I. Yakymanska, Ie. Novykov, V. Kalnei, E. Zeer, D. Jung, I. McClellan, P. Gillet, G. LeBoterf, V. Oros and others. In particular, such scholars as (Zhaldak 2009; Morze, Kocharian 2014; Smyrnova-Trybulska 2007) disclosed the content of competencies during the application of information and communication technologies. According to modern researchers of this issue (Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J. 2000; Guasch, T., Alvarez, I. & Espasa, A., 2010), these competencies include the orientation in the information space, receiving information and operating it in accordance with own needs and requirements of the modern high-tech information society.

COMPETENCY-BASED APPROACH IN EDUCATION

Competency-based approach involves mastering knowledge and skills of future teachers in complex. This leads to the definition of a new system of teaching methods. Selection and design of these methods are based on the structure of the respective competencies and functions that they perform in the learning process.

A variety of approaches to the definition of the term “competency” causes problems in its comprehension and understanding the competency-based approach content. The issue of forming the digital competencies of future teachers remains unresolved in conditions of functioning of SMART-University.

The purpose of the article is to determine the theoretical and practical aspects of forming the digital competencies of future teachers in the context of creating new knowledge in the SMART University environment, defining organizational and pedagogical conditions, principles and pedagogical methods of forming digital competencies in the process of changing the educational paradigm from e-learning to SMART-learning.

The competency-based approach in education implies prior orientation towards the aims. They are educational vectors of learning ability, self-determination, self-actualization, personality development and socialization. The main units for evaluating the quality of education results are competencies (Zeer 2000).

In the literature (Morze, Kocharian 2014; Ovcharuk 2013; Smyrnova-Trybulska 2016; Jung 2005) this concept is considered ambiguous, due to the complexity of the structure of professional activity in various fields and differences in the theoretical approaches of researchers.

Based on the works (Approving the national qualifications framework, <http://zakon2.rada.gov.ua/laws/show/1341-2011-п>; A common European frame work for ICT Professional sinall industrysec tor, <http://www.ecompetences.eu>) a competency is considered here to be a set or an array of theoretical and practical knowledge, skills and values that can be readily called upon and put into action in a situation and context that is different from prior situations. Although training may provide initial necessary elements, such competency is considered to develop with varied experience, and with the ability and confidence of the individual to adapt.

In the Concept of a New Ukrainian School (New Ukrainian School: Fundamentals of the Standard, <http://nus.org.ua/wp-content/uploads/2016/12/nova-schkola1pantone-363-EC-1.pdf>) competency is considered as a combination of knowledge, skills, ways of thinking, views, values, personal qualities that determine the ability of a person to successfully conduct activities in new unpredictable conditions.

Thus, a competency-based approach in learning is characterized by complex acquisition of knowledge and skills and orientation of learning process on the final practical result. Competency-based approach is a bridge that combines an educational institution with the real world and its requirements.

A competent graduate and a future teacher is a person who possesses the competencies necessary for a successful life. A competent graduate is able to reveal, develop, maintain and constructively actualize life opportunities in the complex present conditions. These characteristics should be formed during the learning process and include knowledge, skills, attitudes, experience and behavioral patterns of personality (Zablotska 2008).

Let us consider the digital competencies of future teachers in the context of changing the educational paradigm from e-learning to SMART-learning at a pedagogical university. The notion of digital competencies presumes the ability of the teacher to use information and communication technology to carry out information activities in their professional work. These competencies namely mean to be able to:

- carry out information activities on the collection, processing, transmission and preservation of informational educational resources;
- evaluate and actualize the possibilities of educational electronic publications and open informational educational resources;
- organize information interaction between the participants of the educational process on the basis of ICT;
- create and use psychological and pedagogical diagnostic methods for controlling and assessing the level of students' knowledge;
- carry out educational activities using ICT tools in aspects that reflect the specifics of a particular school subject.

In our opinion, one of the important components in the structure of digital competencies is the competency to organize the educational process in the electronic environment. Scientists (Qualification characteristics of the teacher of distance learning as one of the aspects of the quality of the whole distance learning system, <http://www.elw.ru/reviews/detail/1047/>; Kommers, Smyrnova-Trybulska, Morze, Noskova, Yakovleva, Pavlova, Drlik, Malach, Delgado, Pinto, Issa, Issa 2014; Smyrnova-Trybulska 2016) distinguish the following groups of competencies of the teacher of e-learning:

- professional;
- informational and pedagogical (for the development of an electronic course), communicative, communication competencies and competency of personal self-improvement (for the implementation of the electronic course).

For a teacher to develop an e-course, it is necessary to form informational and pedagogical competencies that consist of:

- competency of methodological design of a professional e-learning product;
- competency of the development, creation, implementation and application of educational and methodological complex in the educational process;
- competency of control of joint (group, co-operative) professional activity, teamwork, cooperation in the process of organizing e-learning;
- competency to possess methods of creating various kinds of pedagogical control materials, designing a system for assessing the quality of control materials, selecting software and control techniques.

In order to implement an e-course a teacher ought to form the communicative competencies and self-improvement competencies:

- in the field of pedagogical technologies of electronic and distance learning skills in practice (conducting virtual discussions, webinars, round tables, project activities, etc.);
- in the field of educational and organizational activity, acquisition of software and technology in education, and knowledge of e-learning systems;
- in the field of independent, cognitive activity, based on mastering of the methods of acquiring knowledge from different sources of information.

Digital competencies, including the field of e-learning, should be complemented by new competencies due to inevitable changes in the field of education. Educational institutions, universities and schools begin to lose their importance to students, as they are no longer the only places where a student can apply for knowledge. Now knowledge can be obtained with the help of social networks, various educational services and corporate sector.

We believe that providing an ongoing process for obtaining new knowledge is possible only with electronic technologies, as well as technologies for creating new knowledge. Today, they are not only a resource for the successful functioning of the educational process, but also the guarantor of the transformation of universities into innovative scientific, educational and cultural centers, which implement the principle of “lifelong learning” (Balyk, Shmyger, Oleksiuk 2017).

A single information space is created on the basis of modern ICT. A new task for a high school is to integrate students into this space, thus giving them the opportunity to access the relevant knowledge and technologies that will be in demand in their future profession. In turn, educational technologies that allow teachers to teach not only in the classroom but also outside the classroom are actively used. Therefore, e-learning is giving place to SMART-learning that allows you to adapt the educational process to the needs of the student. (European Investment Bank (2012) JESSICA for Smart and Sustainable Cities//Horizontal Study Smart Technology based Education and Training// SMART DIGITAL FUTURES. Netherland: Amsterdam: IOS Press BV 2014).

SMART-learning is a concept that involves comprehensive modernization of all educational processes and resources, as well as the methods and technologies used in these processes. It should be noted that the scientists (Oros 2015, Tikhomirov, http://conf.it-edu.ru/sites/default/files/sbornik_2015_vypusk_1.pdf) consider the following basic principles of SMART-learning:

1. Usage of the topical information for solving educational tasks as part of the educational program.
2. Organization of independent cognitive, research and project activity of students.
3. Implementation of the educational process in the distributed learning environment.
4. Interaction of students with a professional community.
5. Individualization of training.
6. Variety of educational activities, providing broad opportunities for students to study curricula and courses according to their financial situation, social conditions and health.

FORMATION OF DIGITAL COMPETENCIES IN THE CONTEXT OF CREATION OF NEW KNOWLEDGE

Process of changing the educational paradigm from the traditional model of learning to e-learning and further to SMART-learning is also taking place in Ukrainian education. It should be noted that the evolution of education in Volodymyr Hnatiuk Ternopil National Pedagogical University made the way from traditional learning to SMART-learning:

- traditional learning and computer-based learning;
- “e-learning” (electronic / distance learning), which operates on the basis of modern information and communication and pedagogical technologies;
- “blended learning”, which involves a combination of different methods of classroom and out-of-class learning;
- coaching, informal teaching;
- SMART-learning.

Let us dwell on the main principles of the creation of SMART-University at TNPU. Infrastructure of SMART-learning is based on the use of the university LMS server, cloud technologies, university digital repository and the Wiki-portal (Figure 1).

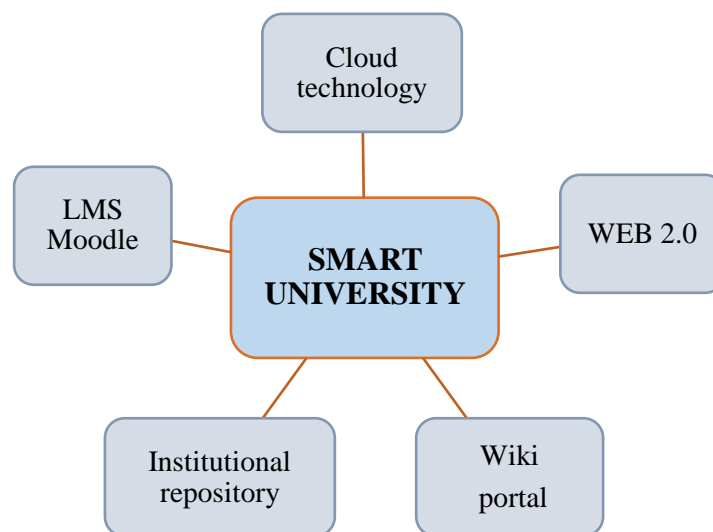


Figure 1. SMART-University Environment in Volodymyr Hnatiuk Ternopil National Pedagogical University

Source: Own work

It is worth noting that the development of social partnership and cooperation was the basis of the SMART philosophy formation in Ternopil National Pedagogical University (Figure 2).

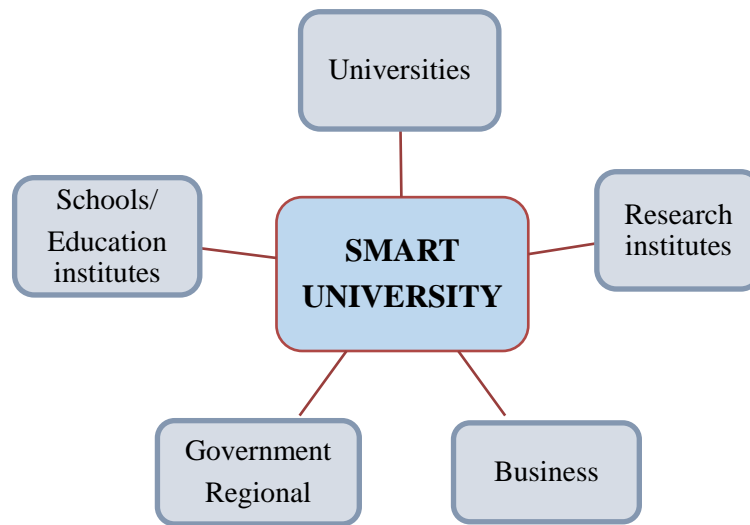


Figure 2. Social Partnership and Cooperation in Volodymyr Hnatiuk Ternopil National Pedagogical University

Source: Own work

Previously, programs of professional training of future teachers at TNPU were focused more on comprehension of learning material, and now the attention is paid on self-consistent acquirement of new knowledge and on the ability to use it in solving life issues (Table 1).

Table 1. Changes in educational process in Volodymyr Hnatiuk Ternopil National Pedagogical University

	Pedagogics of e-learning	Pedagogics of SMART-learning
Teacher	Providing content and information	Accompanying students in creating new knowledge, developing practice-oriented projects
Student	“Consumption” of content and information	Creating new knowledge, practice-oriented projects

Source: Own work

Our express survey on the formation of competency in creating new knowledge showed that students and teachers rarely publish their own ideas and materials online (9% - students, 26% - teachers). They reported their weak competence in this area.

A model for the development of digital competencies in the context of creating new knowledge was developed. It comprises three components: technical, informational, and social. Formation of digital competencies took place within the course “Information and communication technologies in education and science” for undergraduates of all specialties of the pedagogical university. The course was built on the basis of this model. During the training of future teachers, the focus was on the competency to create new knowledge and to solve practical and research tasks, aimed at integrating the experience gained earlier and mastering the new one in the process of joint activities with teachers or under their guidance.

The process of forming the digital competencies of undergraduates took place under the following organizational and pedagogical conditions (Figure 3):

1. Ensuring the integration of knowledge in the process of creating and implementing practice-oriented projects.
2. Application of forms and methods of training focused on the professional development of the personality of the future teacher, acquiring practical experience and pedagogy of constructing knowledge. Developing such skills of the 21st century as complex problem solving, critical thinking, creativity, human management, coordination with others, emotional intelligence cognitive flexibility, ability to assess the situation and make decisions, and ability to negotiate.
3. Organization of an effective informational SMART-environment.

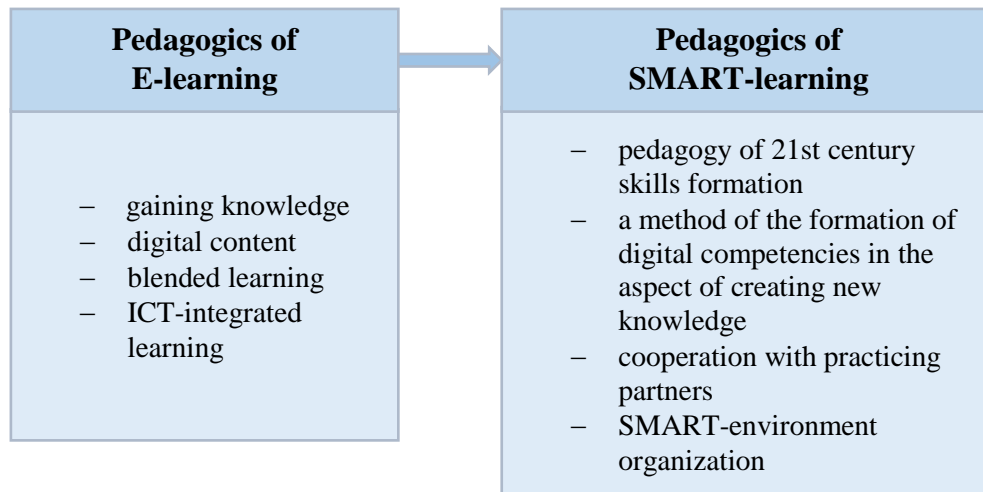


Figure 3. Conditions for the formation of digital competencies in the pedagogical SMART University

Source: Own work

Basic principles of digital competencies formation at our university:

- interdisciplinarity of knowledge and project approach;
- realization of creative and innovative approaches;
- support for professional and social development;
- integration: university – local community – business.

Based on our own experience in developing digital competencies in the context of creating new knowledge, we identified the pedagogical peculiarities of the use of ICT tools during the learning process, which included the use of search, problem and active teaching methods, research organization, group work and work in pairs.

We note that for the development of digital competencies in the context of creating new knowledge, it is worth using ICT tools such as knowledge maps, wikis, blogs, Google Apps, 3D books, electronic boards, etc.

Under the conditions of ICT tools use, active teaching methods were chosen as the most suitable for the development of digital competencies in the context of creating new knowledge. Among them are such methods as brainstorming, design thinking, case method, project method, etc. During the development of educational tasks, emphasis was placed on the creation of social practice-oriented projects by undergraduates (Shmyger, Balyk 2016). This approach means the transition from a traditional model of education to the acquisition of a predetermined set of knowledge for SMART-learning, with its emphasis on knowledge and innovation.

Approbation of the model we created took place in 2015/2017 in the process of teaching the course “Information and communication technologies in education and science” and the courses for teachers training (2016).

After completing these courses, we conducted a survey on the development of students’ digital competencies in the context of creating new knowledge. 264 undergraduate students and 23 teachers of Volodymyr Hnatiuk Ternopil National Pedagogical University took part in this survey. The questionnaire contained 25 questions; in particular, seven questions concerned acquisition of the technical component of the competency

for creating new knowledge, nine questions concerned acquisition of the information component and nine questions concerned acquisition of the social component. Let us consider and analyze some of the results of the questionnaires of teachers and students about their acquisition of the three components of digital competencies in the context of creating new knowledge.

The technical component of digital competencies in the context of creating new knowledge includes the practical skills of working with:

- local university network, server of university electronic courses;
- university learning network;
- personal learning network;
- mobile technologies;
- ICT tools for creating new knowledge.

We present the results of the questionnaire concerning the acquisition of ICT tools for creating new knowledge (Table 2).

Table 2.

ICT tools for creating new knowledge (technical component)

	Teacher	Student
LMS Moodle	68%	75%
Platform for the institutional repository	31%	25%
Platforms for video conferencing	39%	52%
Cloud services	57%	62%
Mobile services	42%	73%

Source: Own work

The information component of digital competencies in the context of creating new knowledge includes the practical skills of working with:

- information search;
- structuring and organizing information;
- critical evaluation of information;
- creation of information;
- distribution of information;
- obtaining new knowledge by analyzing and synthesizing various data (conclusions, predictions).

We present the results of the questionnaire concerning the acquisition of ICT tools for creating new knowledge (Table 3).

Table 3.

ICT tools for creating new knowledge (information component)

	Teacher	Student
Productivity software	85%	72%
Google Apps services	77%	62%
Microsoft Office 365	34%	21%
Web 2.0 services	81%	63%
Custom-made software	43%	44%

Source: Own work

The social component of digital competencies in the context of creating new knowledge includes the practical skills of working with:

- collective thinking strategies online;

- different ways of interacting with others on the Internet;
- safety of interaction with others on the Internet;
- ethics of interaction with others on the Internet.

We present the results of the questionnaire concerning the acquisition of ICT tools for creating new knowledge (Table 4).

Table 4.
ICT tools for creating new knowledge (social component)

	Teacher	Student
Electronic mail	78%	46%
Message board	14%	48%
MOOC (Massive open online courses)	3%	12%
Social network	71%	94%
Quick messaging tools	81%	92%

Source: Own work

The study showed (Figure 4) that among three components (technical, social, informational) of digital competencies model in the context of creating new knowledge teachers are ahead of students only regarding the information competency.

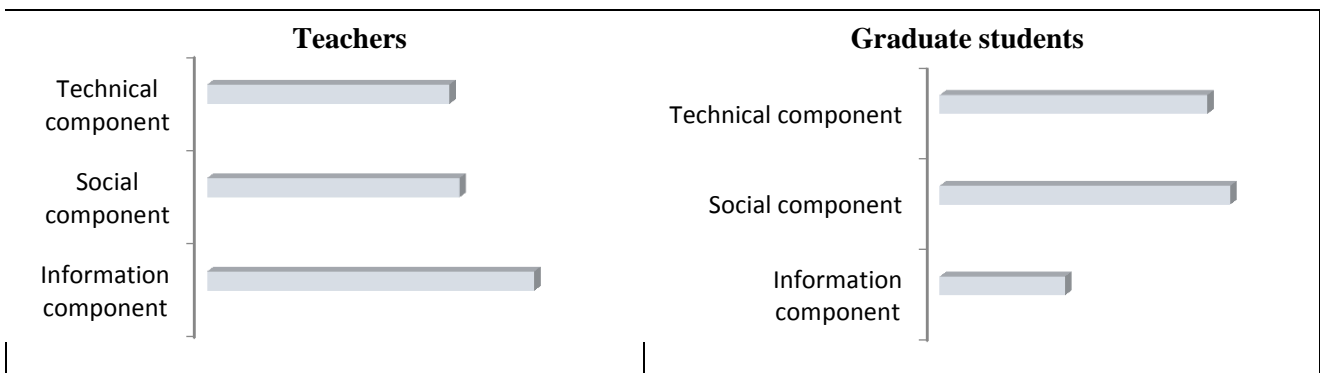


Figure 4. Levels of digital competencies acquisition by teachers and undergraduates of TNPU (based on digital competency model)

Source: Own work

Largely, such a result is due to a change in the activities of a university teacher in the context of modern educational changes and pedagogy of constructionism. In particular, a teacher organizes a process, and students construct new knowledge, seek their own understanding, and form their own judgments, conclusions, views, defining a personal position in the knowledge of scientific theories, objective phenomena and processes.

Students demonstrated a higher, than teachers did, level of competencies with technical and social components. Technology is integrated in their life; they have free and unrestricted access to information and interpret it in their own way. They make their own contribution to the construction of new knowledge in the process of interaction with others. Educational communications and social networks contribute to their maximum social and cognitive interaction.

The obtained results have shown that today the educational model “the student as a passive recipient of knowledge from a teacher” requires the transition to a model “students’ independent acquisition of new knowledge”. Currently, the role of a pedagogical university is changing from the provider of knowledge to the creation of conditions for students to independently acquire new knowledge and form digital competencies in the context of creating new knowledge.

CONCLUSION

The study and analysis of research and publications on the development of digital competencies of future specialists, including teachers, gives grounds for concluding that the transformation of the educational paradigm of higher education is taking place. E-learning is giving place to SMART-learning, which makes possible the adaptation the educational process to the needs of the student. E-learning focuses mainly on technology. SMART-learning involves the comprehensive modernization of all educational processes and resources, as well as the methods and technologies used in these processes.

A three-dimensional model for the formation of digital competencies in the context of creating new knowledge became the methodological basis of the pilot course “Information and communication technologies in education and science” for the undergraduates of the pedagogical university.

The process of formation of digital competencies of undergraduates took place under the following organizational and pedagogical conditions: ensuring the integration of knowledge in the process of implementation of practice-oriented projects, application of forms and methods of training focused on professional development of personality and 21st century skills formation and organization of effective information SMART-environment of the university.

The results of the pedagogical research conducted among undergraduates and teachers of Volodymyr Hnatiuk TNPU regarding the development of digital competencies in the context of creating new knowledge have shown that the university educational model where “student is a passive recipient of knowledge from a teacher” requires the transition to a model of “students’ independent acquisition of new knowledge”.

Nowadays, the development of a knowledge society is becoming more and more relevant. This society will give advantages to the knowledge work. Therefore, in the long view, for training of future teachers for master's degree, it is planned to design and create e-courses using modern means of personal knowledge management in order to form the epistemological level of digital competencies.

REFERENCES

- A common European frame work for ICT Professional sinall industrysec tor, <http://www.ecompetences.eu>, (accessed 29 May 2017).
- Approving the national qualifications framework. Resolution of Cabinet of Ministers of Ukraine November, 23th (2011), <http://zakon2.rada.gov.ua/laws/show/1341-2011-п> [In Ukrainian]
- Balyk N., Oleksiuk V., Shmyger G., 2017: *Development of E-Learning Quality Assessment Model in Pedagogical University*. ICTERI 2017 ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. – 440-450 p. [In Ukrainian]
- European Investment Bank (2012) JESSICA for Smart and Sustainable Cities//Horizional Study Smart Technology based Education and Training// SMART DIGITAL FUTURES. Netherland: Amsterdam: IOS Press BV 2014
- Guasch, T., Alvarez, I., & Espasa, A., 2010: *University teacher competencies in a virtual teaching/learning environment: Analysis of a teacher training experience*. Teaching and Teacher Education, 26(2), 199-206.
- Jung, I., 2005: *ICT-pedagogy integration in teacher training: Application cases worldwide*. Educational Technology and Society, 8 (2), 94-101.
- Kommers P., Smyrnova-Trybulska E., Morze N., Noskova T., Yakovleva T., Pavlova T., Drlik M., Malach J., Delgado S.C., Pinto P., Issa T., Issa T. *Contrastive analysis and e-learning competences in Australia, Crech republic, the Netherdlands, Poland, Portugal, Russia, Slovakia, Spain and Ukraine within the Framework of the irnet international research networ project in E-learning and Intercultural Competences, Development in Different Countries edited by SMYRNOVA—TRYBULSKA E., . Katowice-Cieszyn: Universities Silesia in Katowice, 2014. ISBN 978-83-60071-76-2.*

- Morze, N.V., Kocharian A.B., 2014: *Model of standard for the ICT competence of university professors in view of improving the quality of education*. Information technologies and means of education, 2014, Vol. 43, Iss. 5, P. 27-39. [online] at http://www.nbnv.gov.ua/UJRN/ITZN_2014_43_5_5. (accessed 20 May 2016) [In Ukrainian]
- New Ukrainian School: the basics of the standard, <http://nus.org.ua/wp-content/uploads/2016/12/nova-schkola1pantone-363-EC-1.pdf>, (accessed 29 May 2017)
- Nikulicheva N. *Qualification characteristics of distance education teacher as one of the aspects of the quality of the whole distance learning system*, [online] at <http://www.elw.ru/reviews/detail/1047/> (accessed 12 June 2017) [In Russian]
- Oros, V., 2015: *The formation of professors' ICT-competence in the context of life-long learning*. New Pedagogical thought, 2015. №26, P. 204-206. [online] at http://www.nbu.gov.ua/UJRN/Npd_2015_2_50. (accessed 5 June 2016) [In Ukrainian]
- Ovcharuk, O.V., 2013: *Information-communication competence as a subject of discussion: international approaches*. Computer in family and in school, 2013. №7, P.3-6. [online] at http://nbuv.gov.ua/UJRN/komp_2013_7_2, (accessed 22 May 2017) [In Ukrainian]
- Shmyger G., Balyk N., 2016: *Formation of informational and social competencies of students for their professional training at the pedagogical university*, Scientific Review, 1(22), p.14-21. [In Ukrainian]
- Smyrnova-Trybulska, E.N., 2007: *Fundamentals of Generating Information Competences of Teachers in the field of Distance Learning*. Monograph, Kherson: Ailant, 2007, 704 p. [In Russian]
- Smyrnova-Trybulska, E.N., 2016: *E-learning and open education quality – some European and national standards and regulations*. Monograph «E-learning Methodology — Implementation and Evaluation», Katowice, Cieszyn: University of Silesia, 2016, Vol. 8 , 51-72 p.
- Tikhomirov V. *Smart education as the basic paradigm of information society development*, [online] at http://conf.it-edu.ru/sites/default/files/sbornik_2015_vypusk_1.pdf, (accessed 1 June 2017)
- Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J., 2000: *Teachers and ICT: current use and future needs*, British Journal of Educational Technology, 2000, 31 (4), p. 307-320.
- Zablotska O., 2008: *The competence approach as an educational innovation: comparative analysis*, Journal of Zhytomyr State University, 40 (Pedagogical Sciences), p.63-68.
- Zeer E. , 2000: *Psychology of Personally Oriented Vocational Education*, Ekaterinburg: Publishing House of the Ural State Professional Pedagogical University, 258 p
- Zhaldak M. I., 2009: *The model of social and professional competencies of teachers of computer science*, Naukovyj chasopys Nacional'noho pedahohichnoho universytetu imeni M. P. Drahomanova. Seriya 2: komp'yuterno-oriyentovani systemy navchannya, 2009, 7 (14), p. 3–10. [In Ukrainian].