

Tamara Maliarchuk,

Phd Candidate

Ivan Franko Zhytomyr State University

ORCID ID 0000-0002-1499-0960

Yuriy Danyk,

Doctor of Engineering Sciences, Professor,

Chief of Institute of Information Technologies

Ivan Chernyakhovsky National Defense University of Ukraine

ORCID ID 0000-0001-6990-865

SELF-DIRECTED LEARNING COMPETENCY AND LEARNER-CENTERED APPROACH IN E-LEARNING

***Abstract.** The paper examines E-learning ability and readiness of specific learners (e.g. servicemen). The newly designed innovative evaluation model and system of learners' ability and readiness for self-directed learning using e-learning technologies and learner-centered approach.*

***Key words:** self-directed learning competency, e-learning, m-learning (mobile learning), distance learning, learner-centered approach.*

Introduction. Distance learning officially appeared in the middle of 19 century. In 1840 Isaak Pitman suggested learning via post service (text mailing) for students of England. The correspondence courses, as it was called, gained new content and development at the end of 20 century. Officially the term "distance learning" was recognized in 1982, when International Council for Correspondence Education changed its name to International Council for Open and Distance Education due to innovative contribution of information communication technologies [5,16, 27]. It gave birth to electronic learning or e-learning, a new form of distance learning. New technologies made it more accessible. It positively affected the attitude to distance learning the possibility to increase its role in specialists' training in comparison with traditional learning, including the possibility of full transition to distance learning in some specific subjects.

The challenges of e-learning mass implementation and use require practical and theoretical research.

It is necessary to implement and develop e-learning forms and methods to education system due to

Rapid development of information society;

Fast outdated of specialists' knowledge and growth of information data, volumes, which should be analyzed by the students limited in time and influenced by constant changes;

Lifelong (continuous) learning concept, caused by e-learning implementation by modern society;

Limited possibilities of lifelong learning in learning or education centers.

Therefore, distance learning (e-learning) centers have been created and continue to be created in most higher educational institutions of the leading countries of the world.

Their creation and development are accompanied by powerful theoretical and applied researches, psychological and pedagogical experiments etc.

Analysis of Relevant Research. General theory of e-learning was developed in the works of J. Andersen, O. Andreev, St. Willem, S. Archangel, Y. Babansky, S. Batisheva, R. Bela, V. Bykova, J. Blomsstucka, C. Vedemeera, L. Vygotsky, V. Volkova, P. Halperina, S. Goncharenko, R. Deling, O. Kirsanova, D. Kigan, G. Kozlakova, J. Kumi, K. Korsak, G. Kostyuk, C. Kupisevich, V. Kukharenko, O. Matiushkina, M. M. Makhmutova, M. Moiseyev, M. Moore, I. Ogorodnikov, O. Okolelova, V. Oliinyk, O. Pekhoti, E. Polot, V. Rybalka, L. Romanyshina, V. Sagardy, P. Sikorsky, N. Syrotenko, P. V. Soldatkin, Stefanenko, N. Talizina, I. Kharlamov, A. Khutorskogo, B. Shunevich, T. Edvarda, and others [5, 9].

Pedagogical systems and lifelong (continuous learning) learning were researched by Y. Babansky, V. Bepalko, N. Nichkalo, V. Oliinyk and others. The organizational and pedagogical bases of distance education were studied by V. Oliinyk, V. Zhulkevskaya, N. Zhevakina, N. Korsunskaya, M. Tanas, P. Talanchuk, A. Tretyak, T. Koichev, V. Sheiko and others.

Pedagogical, psychological issues and design of e-learning courses were analyzed by V. Kukharenko, T. Oliinyk, V. Rybalka, N. Syrotenko, A. Petrenko, M. Besedin, E. Blinov, K. Vlasenko, V. Gurand others. The individualization of the learning process using learner-centered approach was reflected by B. Ananiev, G. Ball, L. Vygotsky [2], M. Danilov and others. One of the most highlights is the problem of the dialogue interaction of learners, who are studying with computer according to M. Smulson. Specific aspects of e-learning content and organization are represented in creative researches of M. Besedina, E. Blinova, K. Vlasenko, V. Gur, N. Datsun, M. Us.

Researches of Ukrainian and foreign scientists highlight the importance of analysis of existing and design of new e-learning models. General e-learning model consists of design of specific e-learning course for specific group of learners, access to course materials, organization of communication process between the participants of e-learning course, taking control tests by the learner and the final testing after finishing e-learning course.

The integral model of the distance education system is presented in the works of R. Deling. He considers distance education as a multidimensional system of learning and communication processes through an artificial signal source. It outlines eight dimensions of this system: a student; society (including legislation, government, family, etc.); organization (institution of distance learning), which helps the student in mastering the knowledge; learning goal; the content of what needs to be learned; the result of training; distance; signal source [25, 186].

According to M. Zgurovsky, a technically covering project of on-line learning consists of a block of learning management (learning management system (LMS)), an information block (information resource management (IRM)), a control block (testing and evaluation mechanism), a communicative block (interactive teaching system), and service system [39].

A. Khutorsky highlights five types (models) of e-learning based on educational interactions between learners, teachers and educational information objects for example web materials [3,4].

Six major e-learning models are offered by E. Polat:

- education by type of external studies;
- university education;
- training based on the cooperation of several educational institutions;
- training in specialized educational institutions;
- autonomous learning systems;
- informal, integrated learning based on multimedia applications.

She also drew attention to the fundamental importance of distinguishing the terms of self-directed learning, part-time studying and distance learning. Lack of differentiation between these terms reduces the organization of distance learning process to transfer of lectures, books and other didactic materials into electronic version and familiarization of learners with the content in correspondence.

There is a number of peculiarities, which require researches. They limit effective use of distance learning opportunities. First and foremost, since creation till nowadays distance learning service is used mainly by motivated in all aspects learners and psychologically resilient learners to absence of teacher during learning process. Learners without motivation, skills, capabilities, abilities and readiness to use distance learning did not use it or could refuse to benefit from other traditional education options.

Moreover, before the introduction and distribution of the electronic form of distance education, distance learning did not require specific technical and other knowledge, special equipment and skills to use it. Distance learning efficiency was not affected by ergonomic aspects of electronic gadgets and learners' attitude to them.

It is only several aspects, which are at the starting point of their research. They require solution of complex and interconnected problems for providing further effective development of e-learning as a form of distance learning.

Furthermore, there are specific spheres and occupations, where distance education is ineffective, professionally and economically inadvisable, or generally unacceptable.

Unfortunately, the research of these problems requires more attention. Meanwhile, its relevance is increasing with the distribution of distance learning and reaching an increasing number of users.

Specific categories of learners need improvement of e-learning forms and methods with adaptation to the nature of their work and their subjective peculiarities.

Purpose. The research is aimed at the analysis of existing evaluation models of learner readiness to receive education through the use of e-learning, including mobile learning (m-learning). The practical result of the research is a newly designed Servicemen Self-Directed Learning Competency Model, Learner Ability

and Readiness Evaluation System for use of e-learning and m-learning technologies.

Research Methods. The authors' research is based on

- The integrated use of system analysis methods, analysis of recent publications and practical experience of leading specialists in the field of distance education,

- Application of the principles of distance learning theories,

- Activation of cognitive activity,

- Individualization of education,

- Organization of self-directed learning,

- Continuous learning,

- The analysis of the information and communication technologies use in education,

- The theory of modeling and the practice of developing e-learning models,

- Empirical methods (conversation, observation, questionnaires, computer testing, expert assessment for distance learning readiness in specific educational institutions),

- Analysis of the results of the conducted pedagogical experiments for the purpose of experimental verification of the hypothesis and the results of the research.

Methodology. The hypothesis of the research is based on the assumption that distance learning of specific categories of learners will be effective under the following conditions:

- The harmonious combination of their abilities, capabilities and readiness for e-learning and m-learning,

- The development of their self-directed learning competency (the term is given by American scientists [15,33]) (or self-educational competency as it is named by post-soviet scientists [14, 17, 19, 20, 21])

- Professional training for the practical use of technologies and use of hard and soft means in the conditions of their modern dynamic development;

- Teachers, tutors, instructors mastering knowledge and skills in developing the content e-courses and their teaching and methodological support, adapted to the conditions of self-directed learning using modern information and communication technologies;

- Use of teaching methods aimed at enhancing the learners' cognitive activity,

- Developing learners' creative abilities on the basis of a learner-centered adaptive approach,

- Developing skills to find, analyze and use new information for task solution of specific occupations.

To achieve this goal, the following tasks were solved:

1. A new improved e-learning model was developed on the analysis basis of the main achievements of Ukrainian and foreign science in the research sphere. Unlike the known models, it considers psychological and physiological peculiarities of learners, their ability to e-learning and m-learning, their capabilities

and level of readiness for receiving education with the help of e-learning, considering the peculiarities of m-learning use as a form of e-learning.

2. The research represented the analysis of scientific literature and practical experience in testing tutors, future e-learners with the help of e-learning system on their readiness to learning and the level of development of their self-directed learning competency. The development tendencies of self-directed learning competency were specified for effective use in obtaining electronic education.

3. Pedagogical conditions and organizational aspects of complex e-learning readiness testing were designed and theoretically grounded for specific groups of learners.

4. Effective online control of e-learning process was offered for specific groups of learners.

5. The main aspects and peculiarities of learner-centered approach in e-learning for specific groups of learners were analyzed.

The solution of tasks mentioned above required concrete definition of such form of distance education as e-learning. Particular characteristics of m-learning as a special form of e-learning were identified.

Nowadays the term distance learning in Ukraine is associated or sometimes considered synonymic with such terms as m-learning, e-learning or online learning. Law of Ukraine defines electronic and on-line learning as distance learning [6-8]. At the heart of the relationship between e-learning, distance learning and mobile learning there are specific aspects of pedagogy, technology, social and psychological factors. But despite the interconnection of terms, they cannot be used synonymously.

Computer-assisted learning is defined by the term e-learning. *E-learning* is the use of information and communication technology in the network and in the learning process. The term e-learning, unlike other concepts, covers all aspects of the learning activities in subjects for online and offline learners during synchronous or asynchronous learning process through a network or computer technology and other electronic devices [40].

Distance learning is an educational approach based on interaction at a distance between a student and a teacher, between students; it enables the teacher to respond timely to the student's actions.

Making posts, giving comments or distribute didactic materials in web-environment cannot be considered distance education. Teachers should be in constant interaction, communicate with students and receive feedbacks from them [16, 27].

Mobile learning, in comparison to distance learning, is not limited to localization and differs in its accessibility at any time and place.

Despite the differences in the definition of these terms, most scholars consider their effectiveness in interconnection [34], which is based on the flexibility of choice [35]. According to personal and professional needs and capabilities (technical, financial) a teacher and a learner choose a learning model with the help

of electronic technologies (computer technologies) (e.g. case technologies of distance learning, correspondence training, radio and TV training model, network learning model, m-learning (mobile personal portable gadget model (MPPG)), mixed) that is effective at the specific time.

Foreign scholars and researchers call this type of learning flexible, Ukrainian scientists adhere to the term distance learning [5, 35, 40]. Results of the researches conducted by scientists from different countries showed that the effectiveness of learning process in the electronic environment depends on a number of psychological and physiological peculiarities of a person (perception of electronic format, previous experience of using electronic technologies, type of memory and attention, attitude to technologies for the development of self-directed competency) [28-30].

The necessity to determine the level of readiness for distance learning is proved by foreign researchers and scientists. But the authors are ignorant of researches concerning human ability to both distance and e-learning and their forms. The ability aspect was defined and included by the authors to the suggested m-learning organization model for specific groups of learners.

The *M-Learning Organization and Use Model* for specific group of learners consists of

- A model of the basic technical (software and hardware) complex,
- The model of the basic subject-content complex,
- The basic models of mobile learners (m-learners), which includes a system of requirements for m-learners and teachers, instructors, tutors,
- Methods of assessing their readiness for mobile learning (assessment of compliance with the basic requirements and their development level of self-directed learning competency),
- Determining the options for their preparation to ensure the necessary level of readiness.

Generally, a model for the training, organization and use of m-learning should include pre-testing of future m-learners to determine their degree of readiness for such a form of studying. It is necessary to conduct assessment of their self-directed competency and define what training should be undertaken to ensure an appropriate level of readiness. It depends on whether a candidate for learning is unprepared, partially ready, prepared for all aspects (high, medium, low level of readiness respectively). Further, changes in m-learner readiness degree, development level of self-directed learning competency and effectiveness of m-learners' training are evaluated at times during m-learning process.

Ability for Electronic Learning and Mobile Learning. The Merriam-Webster Dictionary defines ability as " natural aptitude or acquired proficiency." Learning ability considers cognitive abilities of a person, namely memory, perceptions of information and creative thinking, which are essential components of any learning process.

The Academic Explanatory Dictionary of the Ukrainian language defines ability as a set of natural aptitudes [10]. Ability, in turn, is not limited to the knowledge and skills that a person owns, but optimize their implementation in life.

Implementation and development of self-directed learning competency requires previous detection of person ability to distance learning, mainly e-learning and m-learning. Due to specific characteristics of distance learning one can assume that a person who has the ability to the traditional form of learning may lack the ability to distance learning.

The intellectual abilities of the person, especially its perception of the new, independence, self-control are determined by common tests of a person on the ability to learn before employment, before the enlistment or enrollment to educational institutions, using tests for the identification of intellectual abilities (e.g. Intelligence Structure Test 2000R (Amthauer et al., 2001), Raven's Progressive Matrices Test, Eysenck's intelligence test (Eysenck, H. J. (1979). The structure and measurement of intelligence. New York: Springer-Verlag). Farley, F. (2000). Hans J. Eysenck (1916-1997). American Psychologist, 55, 674-675., etc.), personal qualities (Sixteen Personality Factor Questionnaire (16PF), etc.), models of possible working situations, interviews determine the intellectual abilities of the person. But the authors are ignorant of testing person ability to distance learning, e-learning and m-learning. Detection of person ability or disability to use forms of distance learning gives an opportunity to improve development of self-directed competency of a person. If a person has an ability to use a form of distance learning, it is crucial to determine readiness level of a future learner to development of self-directed learning competency using computer technologies. In a case of necessity, a learner should be supported with training to use any form of distance learning. Due to individual set of skills and aptitudes of every person the use of learner-centered approach in design and choice of e-learning course is beneficial. It will involve cognitive and personal characteristics with digital implementation of learner-centered approach.

Development of Self-Directed Learning Competency for Increasing E-Learning and M-Learning Efficiency. Analysis of scientific and pedagogical literature [1, 19, 20] determines the development of self-directed learning competency as the growth of academic level in the process of continuous education. It is aimed at achieving socially significant educational goals, satisfaction of cognitive interests, general cultural and professional inquiries, and enhancement of professional qualifications. Self-directed learning process is usually based on the model of systematic learning forms, but is regulated personally by a learner.

The issue of readiness for a particular activity in relation to self-directed learning competency is interconnected with preparation aspect. Preparation is the basis for ensuring readiness and, accordingly, the availability of tools for quantitative and qualitative assessment of the state and level of preparation. In the Dahl dictionary (1998) the term "preparation" is interpreted as a state of pre-execution of something, and "to prepare something" [12]. According to S. Ozhegov

and N. Shvedova (1986) it means to teach, give the necessary knowledge for something. In this case, "preparation" is a process, and "readiness" - the result of this process [13]. Researches, such as M. Danilko, N.Matskevich, V.Slastenin, define "readiness" as a result, a state, a consequence of a person's professional training in one or another type of activity.

Moreover, self-directed learning readiness should be assessed and considered at the same context. Self-directed learning readiness can be formed through the purposeful development of a person.

In the pedagogical dictionary "readiness" to cognitive activity (to continue education) is treated as a set of two qualities: the desire to expand the range of knowledge and the development of skills for systematic learning activities [9]. In psychological and pedagogical literature there are personal and functionally psychological interpretation of readiness concept. In terms of a personal approach, readiness is a set of human qualities that are adequate to the needs of a particular activity. Readiness at the functionally psychological level is considered as a mental state, which occupies an intermediate state between mental processes and personal characteristics. It forms a functional level, against which necessary processes develop to ensure the effectiveness of a certain type (educational, cognitive, professional, etc.) activities. But m-learning readiness peculiarity is not only its psychological component, but also technical and psycho technical components. M-learning readiness is not limited by the detection of the learner's knowledge level and technical skills in using mobile gadgets. It also evaluates the degree of learner's perception and comprehension of didactic material, which depend on ergonomic characteristics of these gadgets and the ability to submit and present learning content using characteristics of these gadgets. The authors found a correlation between the effectiveness of e-learning or m-learning and the development of self-directed learning competency: the higher the development level of self-directed competency, the more effective the e-learning or m-learning process and vice versa.

Foreign scientists and researchers define readiness for development of self-directed learning competency as an internal state of psychological readiness. Psychological readiness is researched mainly in self-directed learning of adults on the basis of digitalization of the learning process [25,33]. The research of development of self-directed learning competency using computer technologies requires analysis e-learning readiness models or m-learning readiness models and readiness components for development of servicemen self-directed learning competency.

The structural components of the development of self-directed learning competency have been reflected in the researches of R. Perkatyi, Y. Pryshupa, O. Fedorenko, L. Belousova, O. Shelok and others [14,17, 19-21].

According to the results of researches of mentioned scientists and researches carried out by the authors, there are four correlated structural components in the development of self-directed learning competency of specific groups of learners

(e.g. military personnel): motivation, organization, information processing, reflexive control.

The *Motivation Component* involves the desire of the serviceman for self-improvement, the internal need for systematic updating and enrichment of professional knowledge, the presence of motives for the development of self-directed learning competency. This component serves as a stimulus to continuous self-improvement and self-development, which is the basis for continuous self-directed learning activities.

The *Organization Component* is responsible for the rational planning and organization of cognitive activity (time management, the choice of forms, methods and techniques of self-directed learning). Organization component is the basis for a clear construction of the self-directed learning competency development of servicemen.

Information Processing Component involves self-guiding movement from cognitive goal to result by means of independent cognitive activity, functionality of knowledge, skills and abilities, their self-improvement; information search (search and selection of the necessary information), the ability and willingness to work with information and information technologies for the development of self-directed learning competency.

The *Reflexive Control Component* is responsible for the ability to self-examine and self-assess self-directed learning. It also includes self-control and self-regulation in the process of self-directed learning competency development (self-reporting on the effectiveness of work, developing or finding new tasks for elimination of mistakes and improving knowledge acquisition). The Reflexive Control Component performs a cognitive and productive functions in self-directed learning competency development.

Regarding technical and psycho technical components of self-directed learning competency, the analysis of Ukrainian and foreign researches [14,17, 19-21, 25, 33] discloses the technological component of readiness. Technological component of readiness consists of the level of skills in using m-learning applications and computer programs, the Internet, web resources. The absence of technological component makes impossible the development of self-directed learning competency in conditions of society digitalization. It is explained by mass use of digital, infocommunication and computer technologies in professional, personal, educational and other spheres of self-directed learning development.

In order to achieve the required efficiency and quality of testing, the complexity of the tasks should be reasonable rational for a reliable identification of the degree of comprehensive readiness of those who are tested for m-learning. The use of the test should avoid a certain special qualification of the user. It is necessary to provide quantitatively differentiated character of the evaluation. The results of the test should be stable to the effect of random factors.

Ergonomic Aspects, Technological and Context Peculiarities of E-Learning and M-Learning. Most foreign scientists in the definition of m-learning focus on the technical component, regarding the ergonomics and size of the mobile

device. The design of the content component of the m-learning course involves specification of the mobile device [28]. But the technical component effects psychological characteristics of the user: the perception of the e-learning and m-learning material, the attitude to e-learning and m-learning, motivation. Therefore, the effectiveness of e-learning and m-learning, and, with it, the development of self-directed learning competency, require a preliminary determination of the level of readiness. If it is necessary, the preparation for the development of self-directed competency by means of electronic (especially mobile) learning technologies should be provided.

The authors analyzed 17 e-readiness and m-readiness scales to design a content component of the m-readiness test scale for specific group of learners. Tools of 7 scales were used for indication of students' readiness level to e-learning and m-learning. Tools of 11 scales were used for indication of teachers' readiness level in applying e-learning technologies in learning process.

Table.1. *Tools Analysis of E-Learning and M-learning Readiness Models*

Models	Tools
<i>E-Learning Readiness</i>	
Fischer's Self-Directed Learning Readiness Scale	<ol style="list-style-type: none"> 1. Self-management 2. Desire for learning 3. Self-control
A.Rasouli, Z.Rahbania, M.Attaran	<ol style="list-style-type: none"> 1. Communication and participatory skills 2. Metacognitive skills 3. Access level and skill to work with computer and the internet 4. Cognitive skills 5. Self-direction
L.Barnard-Brak, W.Y.Lan, V.O.Paton	<ol style="list-style-type: none"> 1. Environmental Structuring 2. Goal Setting 3. Time Management 4. Help Seeking 5. Task Strategies 6. Self-evaluation
Akaslan and Law	<ol style="list-style-type: none"> 1. Availability of technology 2. Use of technology 3. Self confidence 4. Acceptance 5. Training
Lynch and Dembo	<ol style="list-style-type: none"> 1. Goal setting 2. Environment structure 3. Time management 4. Help search 5. Self-control 6. Metacognitive skills
Hussin, Manap, Amir, Krish	<ol style="list-style-type: none"> 1. Demographic information 2. Skills and experience 3. Psychological readiness 4. Financial readiness
<i>M-Learning Readiness</i>	

Bakry`s STOPE	<ol style="list-style-type: none"> 1. Strategy 2. Technology 3. Environment 4. Organization 5. People 6. Development
Fetaji and MajilindaFetaji`s	<ol style="list-style-type: none"> 1. Education and cultural background 2. Computing skills 3. Learning preferences 4. The quality of e-learning content 5. Viable learning environment and its e-learning logistics 6. Motivation 7. Attitude toward technology
Chapnick`s Model	<ol style="list-style-type: none"> 1. Psychological readiness 2. Sociological readiness 3. Environmental readiness 4. Human resources 5. Financial readiness 6. Technological skill (aptitude) 7. Equipment 8. Content readiness
Li-An Ho`s	<ol style="list-style-type: none"> 1. E-learning system quality 2. Technology readiness 3. Learning behavior 4. Learning outcome
Haney`s	<ol style="list-style-type: none"> 1. Human resources 2. Learning management system 3. Learners 4. Content 5. Information technology 6. Finance 7. Vendor
Chai Lee et Al`s	<ol style="list-style-type: none"> 1. Organizational factors 2. General factors 3. Cognitive factors
Rodger`s Diffusion	<ol style="list-style-type: none"> 1. Relative advantage 2. Compatibility 3. Image 4. Visibility 5. Ease of use
Engholm`s	<ol style="list-style-type: none"> 1. Organization`s culture 2. Individual learner 3. Technology 4. Content 5. Organizational and industry factors
Borotis and Poulymenakou	<ol style="list-style-type: none"> 1. Business 2. Technology 3. Content 4. Training process 5. Culture 6. Human resources 7. Financial component

Aydin and Tasci	<ol style="list-style-type: none"> 1. Technology 2. Innovation 3. People 4. Self-development
Psycharis	<ol style="list-style-type: none"> 1. Resources <ul style="list-style-type: none"> - Technological readiness - Human resources - Economic readiness 2. Education <ul style="list-style-type: none"> - Readiness of content - Educational readiness 3. Environment <ul style="list-style-type: none"> - Entrepreneurial readiness - Leadership readiness - Readiness of culture (of organization and staff)

As a result of the analysis of the toolkit of e-learning and m-learning readiness models, the authors indicated correlation between the tools of the readiness models (mentioned above), the components of the internal structure of self-directed learning competency and the components of the development of self-directed learning competency of military personnel.

During the research the authors indicated tools, which were approved and successfully used in several scales. The tools included metacognitive skills, cognitive skills and psychological characteristics (Table 1.). Correlation of these tools and their effect on the m-learning readiness level, e-learning efficiency were researched by foreign scientists (the names of the readiness models in the Table 1. correspond to the names of their creators). One of the research results indicates that students with prior experience in using web resources continuously have better perceptions of on-line tasks and mixed forms of distance learning courses and believe in achieving better learning outcomes. In contrary, students with little or no experience in using computer and other information technologies has worse attitude to e-learning process and low efficiency learning results. Awareness of the experience of online student learning in advance provides an opportunity to increase the level of readiness for e-learning, which maximizes the results of e-learning.

During the analysis of scientific and pedagogical literature, the authors found interconnection of mentioned psychological characteristics of users (perception of electronic version of didactic material, prior experience in using web-resources, attitude to distance learning) and specification of electronic gadget. But not only ergonomics of mobile screen has an effect on psychological and physiological characteristics of a person. The authors indicated the interconnection of psychological and physiological characteristics of a learner`s technical devices that were used with content presentation in learning process and withits efficiency due to electronic gadgets.

For example, there is a significant difference in the way a smartphone, tablet, laptop, and desktop computer are used. The smartphone has seven hand movements. It is used, as a rule, when a person moves or when stands. The most

tiring parts of body are the thumbs, wrists, forearms, eyes, neck in use. The tablet is used more for reading, while sitting or standing. The distance between the eyes and the screen, in comparison with the phone, is bigger. The time of fatigue increasing is greater. On the contrary, the notebook is more tiring for vision, due to the wrong or lack of screen capture for the right angle [23, 24, 26, 32]. The screen ergonomics requires the detection of a gadget type (e.g. test question, designed by the authors: "For accessing the Internet I use": a) a stationary computer; b) a tablet; c) a smartphone; d) other). The speed of tiring influences the effectiveness of self-directed learning and the motivation to develop self-directed learning competency by means of electronic and mobile technologies.

Scientists also found that physiological and psychological characteristics are also involved in developing the content of the e-learning or m-learning course. They affect positive or negative **attitude** to the distance learning process [23]. Physiological and psychological characteristics also are included in the development of software. It serves for the convenience and minimization of factors of irritation, fatigue, negative attitude to the electronic learning process. Physiological characteristics usually include the angle of view on the screen, the posture of the user and the combination of hand movements. Psychological characteristics deal with the colors used in the content, the size and quality of the image. Ergonomics also affects the quality of **information perception** [32]. Text information is better perceived in print than in electronic version. This is due to document navigation problems, scrolling, sliding, and slowing down. It interferes with the perception and reading of a document through the spatial instability of the information presentation. In the future, there appears a problem of the mental representation of information by the user, its use and perception. Therefore, it is necessary to indicate a dominant channel of information perception. The authors adapted "Diagnostics of the dominant perceptual modality" by S. Yefremtsev (an example of a test question, designed by the authors: "I better perceive information": a) by ear; b) when I see; c) when I read; g) when I see and hear). Establishing a dominant channel of information perception enables the right choice of information presentation (text, schematics, audio, video, images) when developing the curriculum. This is especially important for implementation of learner-centered approach.

Due to correlation of mentioned tools, the authors designed a separate tool for Self-Directed Learning Competency Development Readiness Scale by means of e-learning and m-learning technologies, psycho-technological component. The psycho-technological component includes ergonomics of the mobile device, prior experience in using mobile and electronic devices, cognitive and metacognitive skills.

Thus, the author identified five components of the model of Self-Directed Learning Competency Development Readiness Scale by means of e-learning and m-learning technologies: **organization, motivation, reflexive control, information processing and psycho-technological.**

On the basis of these five components the authors designed testing system, which included 36 main questions and filter questions for receiving objective results. The questions have open and closed forms of answers. Every component of the model includes the necessary number of skills for development of self-directed learning competency by means of e-learning and m-learning. The necessary skills were specified by the authors during the analysis of the researches of e-learning and m-learning readiness models. The authors identified three readiness levels of learners to development of self-directed learning competency by means of e-learning and m-learning according to earlier specified necessary skills and components of self-directed learning competency: low, middle and high.

Table 2. *Self-Directed Learning Competency Development Readiness Scale by Means of E-Learning and M-Learning Technologies*

COMPONENTS OF SELF-DIRECTED LEARNING COMPETENCY DEVELOPMENT				
Motivation	Organization	Information Processing	Reflexive Control	Psycho-Technological
Necessary Skills for E-Learning and M-Learning				
Goal setting for development of self-directed learning competency	Organization of the learning environment	Help seeking	Self-management	Cognitive and metacognitive skills
Comprehension of personal needs	Time management	Cooperation with people	Self-control	Prior experience in using electronic and mobile technologies
Self-direction for constant changes, self-development	Organize personal learning techniques	Tolerant attitude to contradictive opinions	Self-evaluation	Perception of the ergonomics of a mobile gadget
Resist and solve problems and difficulties		Ability to use information flows: to select, analyze, store and use information.		Technical skills of using electronic gadgets and computer programs

Table 3. *Readiness Levels to Self-Directed Learning Competency Development by E-Learning and M-Learning Technologies*

Components of Self-Directed Learning Competency Development	Readiness Levels to Self-Directed Learning Competency Development by E-Learning and M-Learning Technologies		
	High	Middle	Low
Motivation	Clearly formulates and sets goals for e-learning and m-learning; Determines the basic needs for the development of the self-directed learning competency; Aspires to study new	Not always forms the goals of personal e-learning or m-learning process; Aspires to study new technologies, approaches, programs in the educational process,	Does not understand the goals of personal e-learning or m-learning process; Does not see the effectiveness of e-learning or m-learning tools for

	<p>technologies, approaches, programs for the development of the self-directed learning competency;</p> <p>Always perform the tasks, despite the possible difficulties during the e-learning process</p>	<p>but because of difficulties quickly loses interest;</p> <p>Determines the basic needs for the development of the self-directed learning competency</p>	<p>the development of self-directed learning competency</p>
Organization	<p>Organize time and place for self-learning;</p> <p>Set up for learning;</p> <p>Organize personal e-learning process;</p> <p>Has or creates personal teaching methods or techniques</p>	<p>Does not systematically give time for e-learning or m-learning;</p> <p>Has problems in choosing a place learning without external distractions;</p> <p>Not always chooses appropriate teaching methods and techniques for personal e-learning or m-learning process.</p>	<p>Has a low level of organizational skills, needs a manager to organize personal e-learning or m-learning</p>
Information Processing	<p>In case of difficulties, a learner always calls for help with friends, colleagues or acquaintances or searches for answers on the Internet;</p> <p>Regards the opposite point of view in case of disputable issues;</p> <p>Ability to work in a team (in web groups);</p> <p>Skills to search, analyze information in electronic space</p>	<p>Uses Internet browsers;</p> <p>Missing team collaboration experience in the web environment;</p> <p>Has difficulty in analyzing information in the web environment;</p> <p>Regards the opposite point of view in case of disputable issues</p>	<p>Has low level of electronic literacy: does not know how to use Internet browsers; lack of experience in electronic communication and team collaboration in the web environment</p>
	<p>Is able to control personal e-learning process;</p> <p>Creates a systematic learning plan and customizes the "Reminder" function on</p>	<p>Entrusts the control of personal e-process to an electronic training program;</p> <p>Unsystematically adheres to e-learning</p>	<p>Lack of experience in controlling personal self-directed learning process: the learner has no experience in creating his own</p>

Reflexive Control	<p>the electronic gadget;</p> <p>Adhere to the requirements and rules of the e-learning or m-learning course;</p> <p>Conducts own analysis of achievements and mistakes of personal development by means of e-learning or m-learning</p>	<p>plan of the e-learning or m-learning course;</p> <p>From time to time ignores the rules and requirements of the e-learning or m-learning course;</p> <p>Trusts the analysis of personal achievements and errors for e-learning programs or does not carry out this analysis.</p>	<p>work plan, analyzing his achievements and mistakes.</p>
Psycho-Technological	<p>Has a positive perception of electronic gadgets as a means for self-directed learning;</p> <p>Has no problems with the perception and assimilation of information from the electronic display;</p> <p>Has a positive prior experience with the use of electronic gadgets in education</p> <p>No problem with the use of electronic gadgets</p>	<p>Has a positive experience in using a particular kind of electronic gadget in everyday life;</p> <p>Perception of information depends on the type of electronic gadget, the size of its display;</p> <p>Has some difficulties in navigating individual types of electronic gadgets</p>	<p>Has difficulty in perceiving information from an electronic display;</p> <p>There is no or negative previous experience with the use of electronic gadgets for educational purposes;</p> <p>Has difficulties in navigating and using electronic gadgets</p>

After defining in the process of testing and analysis of its results the level of readiness for the development of self-directed learning competency by means of e-learning, it is necessary for the learner to be prepared to e-learning and m-learning. It will increase the effectiveness of learning, and at the same time, will positively influence the development of self-directed learning competency.

Using Learner-Centered Approach in E-Learning and M-Learning. The basis for individualization of a learning process is the use of a learner-centered approach. In well-known systems of secondary and higher education, the learner-centered approach was used to identify the individual abilities of students and for students' further division into groups, classes according to their level of success. At first there was an individualization process, and then the differentiation of learning. Differentiation could also include division according to interests. Thus, extra classes were created. Differentiation of education is a concrete form of

organization of the learning process. It creates the most suitable conditions for the implementation of the individualization in teaching. Differentiation is a form of learning; individualization is the principle of learning [11]. The authors researched cases of partial use of the learner-centered approach in e-learning courses on the study of foreign languages and humanitarian disciplines for NATO troops. Individualization of the learning process included the level of knowledge, the speed of perception of information and the correctness of the tasks. The differentiation shared students at the levels according to their knowledge [36-38, 41-42]. However, an assessment of the ability and readiness for self-directed learning by means of e-learning and m-learning was not conducted.

As subjects of e-learning are those who study (students, pupils, learners), and those who provide the learning process (pedagogical workers, methodologists, developers of e-learning and m-learning courses), it is necessary to conduct assessment of the ability and readiness for e-learning and m-learning of teachers, developers of e-learning and m-learning courses and students. It will increase the level of development and efficiency of self-directed learning by means of e-learning and m-learning technologies.

Conclusion. In the article the authors evaluated the existing models of the readiness to use e-learning and distance learning technologies. They presented models for the readiness of the specific groups of learners (e.g. military personnel) to carry out self-directed learning activities by means of computer technology.

On the basis of the analysis of the main achievements of national and foreign science in the field of research, an advanced model of e-learning and m-learning has been developed. It, unlike the known models, involves the psychophysiological characteristics of e-learners, their ability to such training, their level of personal skills and readiness for training by means of e-learning and m-learning technologies, considering the peculiarities of the use of m-learning.

The improved testing of tutors, teachers and learners to their e-learning and m-learning readiness and development level of self-directed learning competency was offered. Due to innovative tests the authors also defined the ways of development of self-directed learning competency to the necessary level for effective use of e-learning and m-learning in gaining education. The pedagogical conditions and organizational aspects of complex testing of specific groups of learners for e-learning and m-learning readiness were designed and theoretically proved.

For the first time, it was designed and proved the assessment system of readiness and ability to e-learning and m-learning. The innovative system of self-directed learning competency development by means of e-learning and m-learning gives an opportunity to increase the efficiency of e-learning process by detection the ability for e-learning and their e-learning readiness level. Learners with low e-learning readiness level were recommended to prepare for e-learning and m-learning. It will increase the efficiency and improve the development of self-directed learning competency of those, who desire to conduct e-learning and m-learning.

REFERENCES

1. Bukhlova, N. (2003). Organizacija osvitnoyi diyalnosti [Organization of Learning Activities]. Kiev, VG Osnova, 63p. (in Ukrainian).
2. Vygotsky, L. S. (1999). Pedagogichna Psychologia [Pedagogical Psychology]. Moscow: Pedagogika-Press, 533 p. (in Ukrainian).
3. Khutorskaya, A.V. (2001). Suchansna dydaktyka [Contemporary didactics: a textbook for high schools]. St. Petersburg Peter, 544 p.(in Ukrainian).
4. Khutorskaya, A.V. (1988). Yevresticheskoyeobucheniye[Heuristic teaching. Theory, methodology, practice] Moscow: International Pedagogical Academy, 266 pp.(in Russian).
5. Andreev, AA, Soldatkin, V.I. (1999). Distancionnoye obucheniye: sushnost, tehnologii, organizaciya [Distance Learning: Essence, Technology, Organization]. Moscow, Izdatelstvo MESI, 196 p.(in Russian).
6. The Law of Ukraine "On Higher Education". Verkhovna Rada Ukrainy. 2002, №20. Art. 134
7. The Law of Ukraine "On Education" (as amended). Voice of Ukraine. 1996 April 25.
8. Ministry of Education and Science of Ukraine (2), Order "On Approval of the Regulation on Distance Learning" of 04/25/2013 No. 466
9. Goncharenko, S. (1997). Ukrayinskyi pedagogichniy slovnyk [Ukrainian Pedagogical Dictionary]. K., Lybid, 376 p. (in Ukrainian).
10. Slovnyk ukrayinskoyi movy [Dictionary of the Ukrainian language]: in 11 volumes. - Volume 3, (1972). P. 532. <http://sum.in.ua/s/zdatnistj> Dictionary of the Ukrainian Language Academic Explanatory Dictionary (1970-1980) (in Ukrainian).
11. Encyclopedia osvity [Encyclopedia of Education] Acad. ped Sciences of Ukraine; heads Ed. VG Flint. K., Yurincom Inter, (2008). 1040 p. (p.332) (in Ukrainian).
12. Dahl Dictionary in the Internet. The basis of the site is the first original publication of the dictionary Dahl. (In Russian) Retrieved 14 March (2018). <http://slovardalya.ru/>
13. Ozhegov, S.I., Shvedova, N.Yu. (2003). Explanatory Dictionary of the Russian Language, Publishing House "Az", 1992, OCR Konnik MV, Verification, Correction and Formatting S. S. Trushkin. (in Russian) Retrieved 14 March 2018: http://www.lib.ru/DIC/OZHEGOW/ozhegow_s_q.txt
14. Pryshupa, Y.Y. (2016). Formuvannya samoosvitnyoyi kompetentnosti inzhineriv budivelnikiv v procesi profesiynoyi pidgotovky["Formation of self-educational competence of future engineers-builders in the process of professional training"]: diss. for obtaining a scientific degree of candidate ... pedagogy: 13.00.04. National Aviation University, Kyiv. (in Ukrainian).
15. Guglielmino, L.M. (1997). "Development of the Self-Directed Learning Readiness Scale "Unpublished doctoral dissertation, University of Georgia", *Scientific Articles*.
16. Keegan, D. (1996). Foundations of distance education. London and New York, Routledge. 3rd revised edition, 224 p.(in English).
17. Bilousova, L.I. (2009). Technologiya formuvannya u maybutnih pedagogiv kompetentnosti samoosviti z vikoristannyam potentsialu informatsiyno-navchalnogo seredovischa [The technology of forming future educators of competence of self-education using the potential of the informational and educational environment]. Information technologies in education: Sob.Nauk.Prasts / Gol.red.Spiavakovsky O.V. Kherson, KDU Publishing House, Issue III. 11-20 (in Ukrainian).
18. Ognisty, A., Ognista, K., Malyar, E. (2012). Defeniciya gotovnist v konteksti maybutnoyi professiynoyi diyalnosti vchyteliv predmetnykiv u napriami fizychnogo vyhovania ["Defenition" Readiness "in the context of the future professional activity of subject teachers in physical education"], Physical education, sports and culture, health in modern society: collection of scientific works №3 (19), p. 91-95 (in Ukrainian).
19. Perkaty, R.M. (2014). Samoosvitnya kompetentnist maybutnih oficeriv vnutrishnih viysk yak predmet naukovykh doslidgen [Self-directed learning competency of future officers of

internal affairs as a subject of scientific research]. Pedagogical sciences №4 (73), p.273-286 (in Ukrainian).

20. Fedorenko, O.G, Sutnist, I (2014). struktura samoosvitnoyi kompetentnosti maybutnih vchyteliv informatyky [Essence and Structure of Self-Educating Competence of the Future Teacher of Technologies], Herald of KDAK. Issue 43. (In Ukrainian).

21. Scholok, O.B. (2007). Kompetentnist samoosviti yak pedagogicheskaya problem [Competence of self-education as a pedagogical problem] / OlesyaBorisovnaScholok // Materily of the International Scientific and Practical Conference (Lugansk, 3-5 Zhovtnya 2007 p.). - Lugansk: Alma Mater, - Part 3. - p.167-175. (in Ukrainian).

22. Hsiu-FengShiha, Shu-Hui EileenChen, Shu-ChuChen, Shyh-ChyiWeyd. (2013). "The Relationship among Tertiary Level EFL Students' Personality, Online Learning Motivation and Online Learning Satisfaction", *Procedia - Social and Behavioral Sciences Journal*, Volume 103, 26 November Pages 1152-1160. (in English).

23. Berking, P., Haag, J., (2015). ADL Initiative, A Reference Model for Designing Mobile Learning and Performance Support, Interservice/Industry Training, Simulation, and Education Conference (L/ITSEC), Paper No. 15225, pp. 12 (p.9). (in English).

24. Dennerlein Jack T. The State of Ergonomics for Mobile Computing Technology, DOI: 10.3233/WOR – 152159, IOS Press, "Work" No 52, 2015, pp. 269-277. (in English).

25. Delling, R.M. (1966). "Versuch der Grundlegungzueiner systematischen Theorie des Fernunterrichts", in L.Sroka (ed.). Fernunterricht Hamburg: Hamburger Fernlehrinstitut, s.186. (in English).

26. Guglielmino, L.M. (1996). "An Examination of Self-Directed Learning Readiness and Selected Demographic Variables of Top Female Executives". In H.B.Long and Associates (eds.), *Current Developments in Self-Directed Learning*. Norman: Public Managers, University of Oklahoma, (in English).

27. Goldoni, J., Bobic, J., Saric, M. (1992). Psychological and Ergonomic Aspects of Work with Video Display Terminals, *Arch higradaloksikol*, Vol. 43 No 3, pp.219-226. (in English).

28. Keegan, D. (1988). Theories of distance education: Introduction/ D. Sewart, D. Keegan, B. Holmbergeds. // *Distance education: International perspectives*. – New York: Routledge, p. 63–67. (in English).

29. Traxler, J. (2009). Learning in a Mobile Age. *International Journal of Mobile and Blended Learning*, 1(1), 1-12. (in English).

30. Nikitenko, G. (2011). Analysis of Adult Students' Self-Directed Learning Readiness, Affective Learning Outcomes, Prior E-learning Experience, and Age in Hybrid and Online Courses. In T. Bastiaens& M. Ebner (Eds.), *Proceedings of ED-MEDIA 2011-World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 2503-2513). Lisbon, Portugal: Association for the Advancement of Computing in Education (AACE). Retrieved March 16, 2018 from <https://www.learntechlib.org/p/38212/>

31. Robert Alfred. (2014). "Okinda Assessing E-Learning Readiness at the Kenya Technical Teachers College", *Journal of Learning for Development*, Vol 1, No 3 <https://files.eric.ed.gov/fulltext/EJ1106130.pdf> (in English).

32. Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1973). Taxonomy of educational objectives, the Classification of educational goals. Handbook II: Affective domain. New York: David McKay Co., Inc. , Definitions and key words from <http://www.nwlink.com/~donclark/hrd/bloom.html> (in English).

33. Anne Mangan, Bente R. Walgermo. (2013). Kolbjorn Bronnick Reading Linear Texts on Paper Versus Computer Screen: Effects on Reading Comprehension, *International Journal of Educational Research*, Vol.58, pp.61-68, journal homepage: www.elsevier.com/locate/ijedures. (in English).

34. Guglielmino, L.M. (1997). "Contributions of the Self-Directed Learning Readiness Scale (SDLRS) and the Learning Preference Assessment (LPA) to the Definition and

Measurement of Self-Direction in Learning "Paper presented at the First World Conference on Self-Directed Learning, Montreal, Canada, September 1997a (in English).

35. Georgiyev, T., Georgiyeva, E., Smrikarov, A. (2004). M-Learning – A new stage of e-learning. Proceedings International Conference on Computer Systems and Technologies – CompSysTech` 2004, 1-5. Retrieved February 2014 from <http://ecet.ecs.ru.acad.bg/cst04/Docs/sIV/428.pdf> (in English).

36. Low, L., O'Connell, M., (2006). Learner-centric design of digital mobile learning. Online Learning and Teaching Conference - OLT Conference 2006. 26 September, Brisbane, Australia. Retrieved May 22, 2015 from https://olt.qut.edu.au/udf/OLT2006/gen/static/papers/Low_OLT2006_paper.pdf (in English).

37. Results of the International Conference "Advanced Distributed Learning" of the Partnership for Peace organization, Sofia (Bulgaria), (2014). (in English).

38. Results of the International Conference "Advanced Distributed Learning " of the Partnership for Peace, April 20-22, Bucharest (Romania), (2015). (in English).

39. BILC Symposium "Language Training in the Armed Forces", April 5-8, (2016), Kyiv (Ukraine). (in English).

40. Zgurovsky, M. Z. (2003). Development of the system of distance education in Ukraine. Higher Education Open and Distance Knowledge Base for Decision-Markers, Materials of the Meeting of the IITE Focal Points in the CIS and Baltic Countries, Kiev IITE. (in English).

41. Zemsky, R. and Massy, W. F. (2004) Thwarted Innovation: What Happened to elearning and Why, a Report from The Learning Alliance, University Pennsylvania. [Accessed 10th August 2004] Available on-line from: <http://www.irhe.upenn.edu/WeatherStation.html> (in English).

42. Web resource of the NATO Advanced Distributed Learning System: <https://jadl.act.nato.int/>.

43. Carol, I. National University of Romania (Romania), official website: http://unapro.academia.edu/Departments/Advanced_Distributed_Learning.

РЕЗЮМЕ

Тамара Малярчук,

аспірант,

Житомирського державного університету

імені І. Франка

Юрій Даник,

доктор технічних наук, професор,

Начальник Інституту інформаційних технологій

Національного університету оборони України імені Івана Черняховського

Особливості самоосвітньої компетентності та суб'єктно-орієнтованого підходу в електронній освіті

У статті представлені результати дослідження оцінки здатності і готовності специфічних категорій тих, хто навчається (наприклад, військовослужбовців) до використання технологій дистанційного навчання. Запропоновано моделі та система оцінки їх здатності і готовності до здійснення освітньої і самоосвітньої діяльності з використанням технологій дистанційного навчання та особливості суб'єктно-орієнтованого підходу в ньому.

Отримані теоретичні та практичні результати дослідження проблем та аспектів, які виникають та мають місце в процесі здійснення електронного дистанційного навчання та впровадження і використання технологій електронного мобільного дистанційного навчання базуються на глибокому всебічному аналізі та врахуванні наявного досвіду розвитку та підвищення ефективності процесу

дистанційного навчання напрацьованого провідними вітчизняними та іноземними фахівцями.

Метою дослідження є аналіз існуючих моделей оцінки готовності тих хто навчається до отримання освіти шляхом використання електронного дистанційного навчання, у тому числі мобільного електронного дистанційного навчання (*m-learning*).

Практичний результат дослідження - це створення нової моделі здійснення освітньої і самоосвітньої діяльності з використанням технологій електронного мобільного дистанційного навчання з оцінкою, формуванням та врахуванням самоосвітньої компетентності військовослужбовців, системою оцінювання здатності, здібностей та готовності до використання технологій електронного дистанційного навчання, у тому числі мобільного електронного дистанційного навчання (*m-learning*).

Дослідження авторів ґрунтується на застосуванні елементів теорій дистанційного навчання, активізації пізнавальної діяльності, індивідуалізації навчання, організації самостійного навчання, безперервного навчання, аналізу використання інформаційних та комунікаційних технологій в освіті, теорії моделювання та практики розробки моделей електронного навчання, емпіричних методів.

Інноваційна система розвитку самоосвітньої компетенції тих, хто навчається дає можливість підвищити ефективність процесу електронного дистанційного навчання, у тому числі мобільного електронного дистанційного навчання шляхом суб'єктно-орієнтованого формування у тих, хто навчається, готовності до таких видів навчання.

Ключові слова: самоосвітня компетентність, електронне навчання, мобільне навчання, дистанційне навчання, суб'єктно-орієнтований підхід.