

# Formation of Personalized Learning Path for Foreign Students Based on the MOODLE E-Learning Platform Using SCORM-Package

Anna Puliaieva<sup>1[0000-0003-0595-6709]</sup> and Lyudmila Kravtsova<sup>1[0000-0002-0152-635X]</sup> and Tatyana Zaytseva<sup>1[0000-0001-6780-719X]</sup>

<sup>1</sup>Kherson State Maritime Academy, 20, Ushakova St., Kherson, 73000 Ukraine  
leon85517@gmail.com, limonova@ukr.net, sunny@ksu.ks.ua

**Abstract.** In the paper questions about using Distance Learning Platform based on the SCORM standard for definition structure of teaching materials and creation personalized learning path for students are discussed. The authors made research of teaching way of the discipline Information Technologies for foreign students on the basis distance learning platform. A proposed strategy must take into consideration national, language, psychology and cognitive features of students, different their skill levels not only from information disciplines but also from other general science subjects.

A number of reasons conditions the relevance and practicability of the study. First, learning of foreign students in the maritime academy requires the creation of according conditions for them, which help better adapt to the learning process. Second, scientifically planned and methodically determined distance learning can help to students to be not cut off educating when they have practice training in remote areas.

Efficient use of education distance form depends on a built learning management system (LMS) and information technologies by which it had been realized.

Application of SCORM-package improves cognitive orientation, its accessibility, variability, creative education aspects and contributes to forming a public usable web-based learning environment. SCORM-packages have been developed taking into account a standard, so can be used for e-learning system based on different platforms.

Without taking into account that involved training course of marine professional was oriented to foreign students, the research results can be applied for students' teaching in other areas, because usage of SCORM standard allows to develop learning course independently of a software platform and some topics are general for the forming of information culture of trainees.

**Keywords:** Learning Management System, SCORM-packages, Distance Learning Platform, Information technologies.

## **1 The general problem statement and its actuality**

The term “e-learning” means any education with information technologies. Electronic learning has greatly impacted to education in general, making it available to anyone interested student, who wants to obtain deeper knowledge in various areas. Educational institutions at all levels use learning management systems as an essential part of the organization today. This enables students all needed materials of each course, which is part of the training program for a relevant field. Certainly, methodological content must be quality and satisfy of the educational program.

But there are some specializations for which e-learning usage is not only desirable but indispensable element for learners preparing. These included qualifications related to work at sea, when student can't attend classes because long time is not just abroad, but far away in the sea or ocean. However, career of the marine specialist, destiny or even lives of the crew and ship sometimes depend on sailor's knowledge, skills and attitudes, physical and moral training. To date, the primary problem of maritime education institutions is quality training of marine professionals, which can do complex problems and take right management decisions. So, the graduates' competitiveness in the international labour market depends on as far as full teaching institution applies modern technologies in education using all possible resources which defines actuality proposed material.

## **2 Analysis of recent research and publications, which launched the solution to this problem**

In recent years, e-learning has received much attention including in publications – tutorials, articles, workshops. Besides, there is about applying of increased abilities of distance learning platform and their apps. The e-learning resources such as SCORM standard are particularly popular that allows the application of distributed processing technologies (cloud educational service) besides to the direct function exchanging of training materials and management of the learning process. Both works of domestic and foreign authors have focused on this topic.

The paper by H. Husieva [1] has a detailed description of Learning Management System in the SCORM format. This is where author discusses the full cycle of establishing a training unit based on interaction SCORM-package and LMS in the structural form (apps for administration, documentation, path tracking and other online activities). Authors Yu. Telnov and O. Rohozyn [2] have devoted their work to preferences of educational objects that were created in SCORM standard and have built own develop based on SCORM. Their conducted experiment has shown the effectiveness of using develop when courses are created and, most importantly, improving the quality of teaching students.

Analysis of possible use of DLS content in the SCORM format is executed in the papers of L. Zamikhovsky and V. Yakubovsky [3], O. Baibuz and N. Kharchenko [4]. On the other hand, many scientific works focused on the optimal choice of training resource, which allows to create personalized learning path of a learner taking account

his education attainment and personal preference. For instance, P. Brusilovsky [5] much attention has devoted to create an appropriate learning path of students. The same view is shared by K. Limonhelli [6] and T. Lendiuk [7], who are active supporters of creating a personalized learning path for each student in order to achieve target knowledge level. Greek scientists P. Karampiperis, D. Sampson [8] consider the definition of learning resource sequence as learning path. International scientific community, for example, P. Libbrecht [9], E. Bowling [10], has long been involved about the problem of reusing e-learning, hence there are some international standards in this direction that describe can be found and in the papers M. Hlybovets [11].

The works of N. Valko, N. Osipova, N. Kushnir [12] are devoted to the characteristics of STEM technologies and the description of the pedagogical experience of using interactive teaching methods in higher education.

### **3 Solving basic problems**

Most of the educational institutes are used course management system Moodle (Modular Object-Oriented Dynamic Learning Environment). Each teacher decides for self in what format own course will be created, how teaching materials structured for students' interest and involving them to general process of mutual understanding, which arouses desire to learn and self-learn. The user's attitude to the chosen educational system largely depends on educational institution's attitude to current technologies, its provision of modern technologies, means of communication and general strategy of introducing distance forms of providing knowledge in educational process. Additionally, the strategy itself depends on specifics of educational institution and the student body. But far not all users to the full possess features of work with resources and objects Moodle – LMS's with open source codes. Obviously, this system provides what's necessary for distance learning. It contains blocks for direct course creation, in addition, with applying of interactive elements, providing feedback, communication both between students and teacher, and between students themselves, testing the learners' level of mastering.

But capabilities of distance learning system can be greatly enhanced by downloading course elements, which are SCORM-compliant and can be displayed in a web browser.

The purpose of this article is an analysis of developing process of structure and content distance teaching material and formation personalized learning path in an environment of DLS using SCORM package. This approach should take into account psychological, personal and cognitive characteristics of learners.

SCORM standard has proved successful in foreign institutions and is actively used in the learning portals of Ukrainian educational establishes. It defines structure of learning materials and interface, so all learning objects can be used in different e-learning systems. Besides, SCORM standard is provided management of educational process and applying of selected parts of learning material without significant change its structure.

LMS Moodle several years is one of the educational process elements of Kherson State Maritime Academy (KSMA) not only as a modern training tool of theoretical and practical materials, but also checking learners' quality of education. In fact, it is a very

convenient learning platform, but not enough when it comes to foreign student education.

International relations in education are great importance for Ukraine higher education institutions. Firstly, it is exchange of experience, scientific and pedagogical ideas and views on the modern educational space. Secondly, it is a real opportunity not only to see how are learning in other countries, but also to involve students in this process. However, some Ukraine institutions in can compete with similar overseas universities. The citizens of different nations from Asia, Africa and Europe (Bangladesh, Cameroon, Lebanon, Ghana, Egypt, etc.) had desire to be trained in KSMA after carefully studied training level and educational environment there. In fact, its material and technical base meets the highest standards and contains such training complexes, which other maritime educational institutions would envy.

A multinational group of foreign students, each of whom communicates in English with an appropriate dialect, requires a special approach. This is about adaptive learning approach that takes into account both the mentality of each student of such groups and their different levels of prior training, and, most importantly, the training specific at a maritime institution that trains marine professionals for international campaigns. Thus, teachers should not only have professional competencies and sufficient communication skills in English for teaching but also correctly organize work of English-speaking group.

Let's show what problems teachers have faced, who conduct classes in foreign student groups and what methods of decision these problems they offer.

We'll do it on the example of discipline "Information Technologies" our department in KSMA and modern training methods based on the technical possibilities of the institution, teacher's experience and creative teaching approach.

From 2016 onwards, that's four years in a row, the Academy accepts foreign students, who wish to be marine education. Not only in each academic year but even in each group, students are different from each other by nationality, level of English, which causes some teaching difficulty in such groups. We would like to stress separately two main points. First, it is a dialect and some slang expressions that foreign students use when communicating both with each other and with the teacher. Very often it makes difficult for understanding and translate the students' speech during class. Second, it's a training level. With the example of discipline Information Technology that is taught the first year at the academy, we are dealing with a polar different computeracy level in foreign student groups. Therefore, in our opinion based on own experience, the issue of adaptive learning in such groups is most relevant, so, requires the introduction of modern forms and methods of teaching. The teacher's task is to plan classes in such a way as to make work in a group effective, interesting for students, as much as possible, taking into account all their features, capabilities and experience.

A personalized approach in education was implemented by our department with DLS of KSMA built on the Moodle platform. Resources and activities of Moodle allowed to create training courses such that each student could choose his or her own learning path, get complete information on this or other department's discipline, perform and send practical works to the teacher for checking and be tested for assessing the level of material mastering.

During the first two academic years, distance learning courses were developed that have used interactive elements of Moodle. Availability of multimedia equipment in classrooms, student's ability to work on PC, his (or her) access to the course's electronic resources significantly improved the learning quality. But a thorough analysis of the Moodle platform operating principles allowed to add modules that were created in the SCORM format in training courses. This standard provides compatibility of course components, presents training material in separate blocks, greatly enhances the possibility of learning personalization and student's independence in the learning.

Taking into account teaching experience in foreign student groups, it can be noted that the creation of SCORM-packages and their use in classes of the discipline Information Technologies is very effective in the learning. First of all, the teacher forms the structure of the future package, which should cover all information elements, training, consulting, the performance of planned practical works, checking knowledge, etc.

In the academic year 2018/19, the usage of SCORM-package for foreign student group was first proposed. The student is able "to travel" independently on educational material through the properly designed course structure thus increasing cognitive motivation and knowledge levelling. The survey results showed that work with such resource is much more convenient for student.

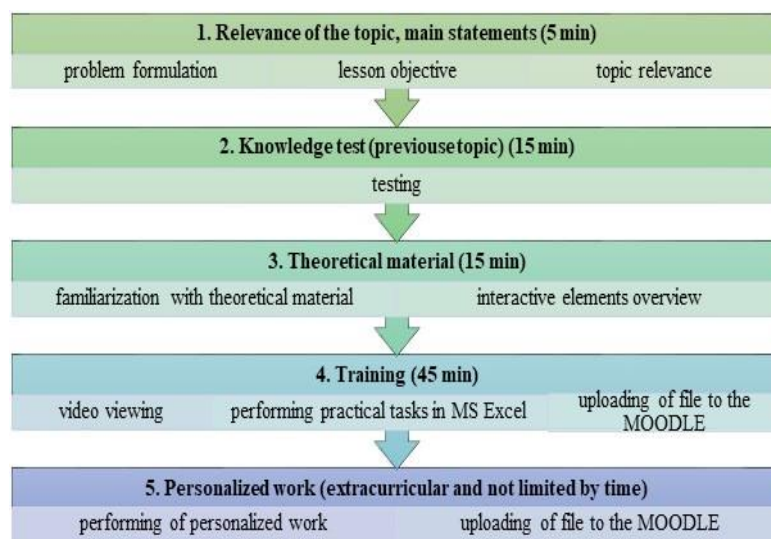
Experience of the above-mentioned academic year has helped to expand possibilities SCORM-standard guided by basic principles of package designing, namely:

- Quantization principle that is a distribution of material into modules, which have minimum amount but closed in content.
- Completeness principle (each module has following components: theoretical core, questions on theory, examples, tasks and exercises to solve independently, questions on the module, test, context help (Help), comments).
- Visibility principle: the availability of a visualization that makes possible to understand and memory of new concepts, assertion and methods.
- Branching principle: each module should be hyperlinked to other modules so that user has choice of switching to another module. It ensures to the student be able choose the personalized learning path.
- Principle of regulatory and adaptability: student manages module's blocks independently by selecting the level of complexity, study sequence, applied orientation that depends on the learning purpose.
- Principle of computer support: the learner can get computer support for performing standard actions at any moment of the topic processing to focus on the main material; it should be noted that student must be proficient in the computation techniques of a sufficient level of complexity.
- Collection principle: that is, all module's elements are made in formats, which provide to collect it's into electronic complexes, to expand and supplement in new blocks.

These principles have formed the basis of the course Information Technologies for foreign students. For example, structure one of the interactive course's modules Information Technologies was designed based on SCORM methodology in the application iSpring Suite 9.0 on the topic "Tabulation of the function and graphing in MS EXCEL".

Note that this topic is very important for any student of technical higher education, because it not only reveals topic, but also generally covers such elements as an understanding of analytical dependence (formulas), knowledge of Excel's built-in functions, ability to perform calculations in accordance with a mathematical model.

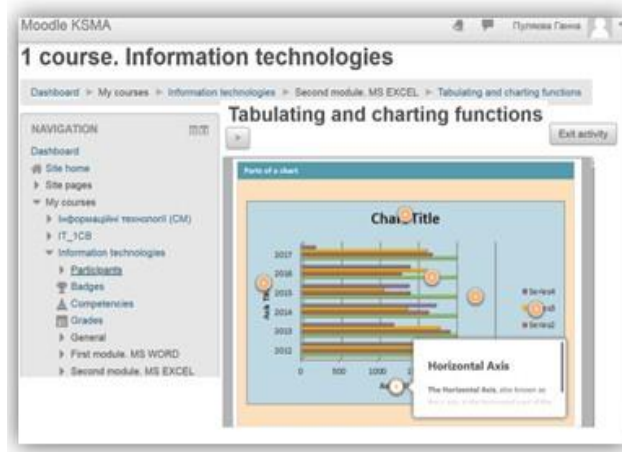
Teacher offers a standard lesson structure for this course to systematize student's work and choosing own learning path (see Fig. 1). But the student can control time independently that spent at any stage, and most importantly, can review any step, for example, theoretical material or explanations for practical tasks, without leaving the SCORM-package. Additionally, the student can learn the topic even if he or she was absent from class for certain reasons at any convenient time.



**Fig. 1.** Lesson structure with SCORM-package

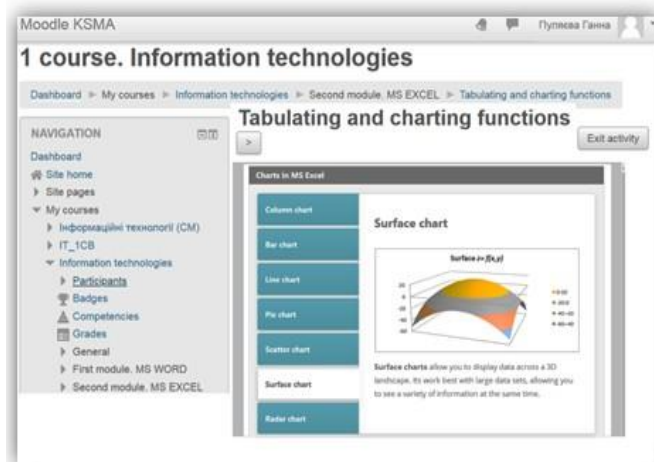
The next stage is a fill content of the created structure. The student's training level and interest to topic mastering dependence exactly on content quality. Therefore, teacher expands the learning material with interactive elements such as Video, Labeled Graphic, Media Catalog and others.

So, the package element *Labeled Graphic* was used when teaching the topic "Tabulation of functions and charting in MS EXCEL" (see Fig. 2). This element contributes to enhancing foreign students' understanding of the properties of excel chart components. Each label is responsible for a certain chart element. The student can see description of element clicking on the label. If necessary, he or she can refer to a theoretical description of the material or to the example of tasks execution, or while performing a personal task without leaving the package.



**Fig. 2.** Interactive element Labeled Graphic

One more interesting element of the package is "Tabs" that use when topic "Tabulation of functions and charting in MS EXCEL" teaching to familiarize with the basic kinds of charts. The student sees view corresponding type of the chart and its description pressing on the tab (see Fig. 3).



**Fig. 3.** Interactive element Tabs

Levels of relevant competencies formation in control and experimental groups have been analysed to confirm the hypothesis that modern training courses should provide an opportunity to build personalized learning path and e-learning courses that developed according to the SCORM standard is an effective tool for this.

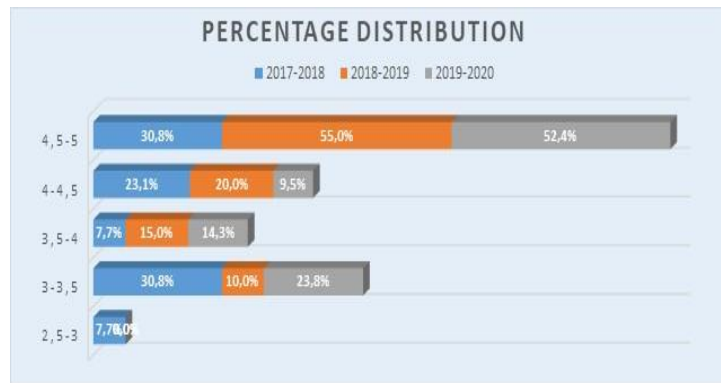
The students' training results on discipline Information Technology in the academic years 2017/18 and 2018/19 have been taken by measures of a control group, the experimental group was formed in the academic years 2019/20.

The application of most statistical methods is based on the idea of using a random set of students, who took part in the study, from all persons on whom the conclusions can be spread, but in our case - all 100% of foreign first-year students were involved owing to the real learning process when we conducted experiment.

The level of formed subject competencies of foreign students has become an object of research and analysis.

A quantitative type of data variation was used to obtain objective data: discrete variation - students' total scores on topics were assessed, continuous variation - students' average points of current scores on each separate topic [13].

Percentage distribution of control and experimental groups' learners with different educational levels shows in the following chart (see Fig. 4).



**Fig. 4.** Percentage distribution of control and experimental groups' learners

The variation series and histograms (see Fig. 5, Fig.6) of experimental and control groups by the average and total scores were constructed (Table 1).

**Table 1.** The variation series of experimental and control groups

Scores (W)	50	60	64	74	83	90	100	$\Sigma$
Number of control group students ( $f_{contr}$ )	1	5	7	4	2	2	4	25
Number of experimental group students ( $f_{exp}$ )	0	4	4	5	3	3	6	25

Measures of variation were calculated to extensive and full characterization of variation facilities. One of them is a weighted average:



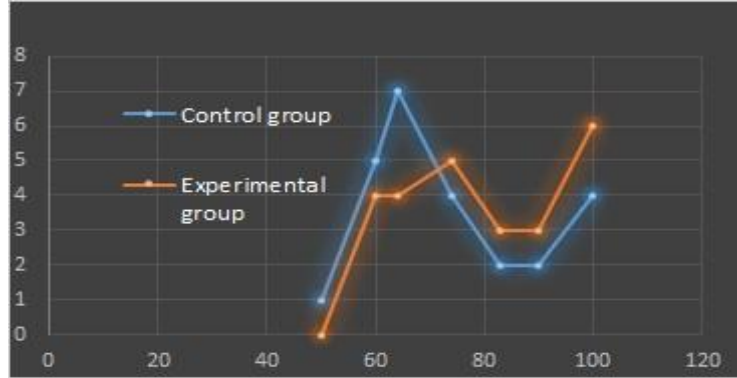


Fig. 5. Variation curves

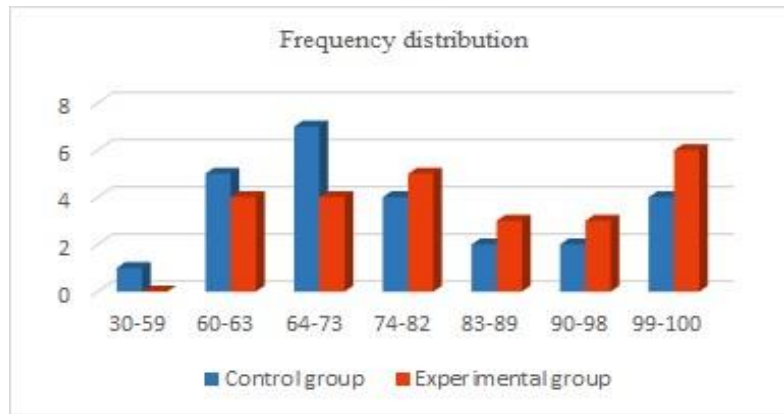


Fig. 6. Frequency distribution

$$M = \sum \frac{f_i \cdot W_i}{n}, \quad (1)$$

where n is number of all variants.

The average value of variation will be closer to values that occur more frequently. Therefore, closer to this value, first of all, we should hope to obtain most values in future observations.

We have obtained result for the control group:  $M_{contr}=3.86$ .

This value is equal:  $M_{exp}=4.18$  for the experimental group.

This number is a specific centre of frequency dispersion observed values of an investigated quantity.

The average value does not fully characterize a series, because different in nature variation series may have the same average value. Therefore, essential distribution characteristics are also frequency dispersion characteristics, in particular the standard deviation ( $\sigma$ ) of the observed values of the investigated quantity from arithmetic mean and dispersion ( $D$  or  $\sigma^2$ ) a measure of variation. These values indicate the deviation of

a random variable from the distribution center and related to each other (dispersion is equal to standard deviation arisen to square) [14].

In our experiment, we have obtained the following dispersion values:

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (X_i - M)^2}{n-1}} \quad (2)$$

$$\sigma^2_{\text{contr}}=0.067$$

$$\sigma^2_{\text{exp}}=0.056$$

Let hypothesis  $H_0$  argues that level formation of foreign students' subject competencies when using SCORM packages on the distance learning platform does not exceed efficiency of the traditional teaching method discipline Information Technology. We shall accept an opposite assertion as hypothesis  $H_1$  to hypothesis  $H_0$ .

In other words, we will check the hypothesis that estimates' samples of the control and experimental groups belong to the same general population using the Kolmogorov-Smirnov test (K-S test) [15].

Let us calculate the value of K-S test to hypothesis testing

$$T_{\text{exp}} = \frac{1}{n} \max(\sum f_2 - \sum f_1) = 0.2, \quad (3)$$

where  $\sum f_i$  is the frequency accumulation in relevant samples.

$$T_{\text{contr}} = \alpha \cdot \sqrt{\frac{n_1 + n_2}{n_1 \cdot n_2}} = 0,014, \quad (4)$$

where significance level  $\alpha = 0.05$ .

Since,  $T_{\text{exp}} > T_{\text{contr}}$  so the alternative hypothesis  $H_1$  was accepted over the null hypothesis  $H_0$  in accordance with decision-making rule for the two-tailed test of Kolmogorov-Smirnov.

On the basis of statistical data, the conclusion was made: with probability 0.95 it can be considered as data of two samples belong to different general populations, i.e. experimental and traditional teaching methods of discipline Information Technologies provide different distributions of the learners' scores.

The results indicated to state the positive impact of SCORM-package implementation on training quality of future sailors and continue strategy formation, which would increase level of students' competence upon completion of the course.

#### 4 Conclusions and directions for further research

Even though that specific training course for marine specialists oriented to foreign students is considered there, some topics are common for disciplines related to information

technologies in other areas of training. Applying of SCORM standard provides an opportunity to develop a distance learning course, which independent of the software platform on which the training will take place.

The problem of reusing electronic learning resources and their transferability from one virtual learning environment to another is always relevant for educational technologies.

In the future, we plan to develop a course based on the Learning Tools Interoperability (LTI) standard, which allows users of one environment to access resources of another. It makes possible to integrate them in United Distributed Learning Environment, which is created and shared [16]. For example, educational institutions may use publicly available e-learning resources that have been developed by other scholars, a uniform learning environment can be built on the institution, combining different platforms.

These focus on professionally directed disciplines such as Theory of Ship Structure, Navigation and Location, Ship Management and others in the field of training of maritime professionals. But the quality of specialist training is determined in all areas, including the skills of modern innovative technology. Additionally, the proposed teaching method to the disciplines of our department ITCSN is easy to introduce to other departments. Therefore, we consider the conducted study is timely, useful and practically applicable.

## References

1. Huseva, A.I., Kireev, V.S.: SCORM methodology for designing educational information resources. *Information Technologies in Education*. In: XIX International Conference and Exhibition, pp. 66–68 (2009).
2. Telnov, Yu.F., Rogozin, O.V.: Development of innovative educational technologies based on a model using SCORM specifications. *Open Education* 4, 37–46 (2009).
3. Zamikhovsky, L.M. Yakubovsky, V.P.: Analysis of the possibility of using SCORM-format as a standard for distance learning systems. *East European Journal of Advanced Technology* 5(2), 34-38 (2012).
4. Baibuz, O.G., Kharchenko, N.I.: Systems of distance learning management. Actual problems of automation and information technology, [http://nbuv.gov.ua/UJRN/apatit\\_2013\\_17\\_12](http://nbuv.gov.ua/UJRN/apatit_2013_17_12), last accessed 2020/01/26.
5. Brusilovsky, P.: Adaptive navigation support: from adaptive hypermedia to the adaptive web and beyond. *PsychNology Journal* 2(1), 7-23 (2004), [https://www.researchgate.net/journal/1720-7525\\_PsychNology\\_Journal](https://www.researchgate.net/journal/1720-7525_PsychNology_Journal), last accessed 2020/01/06.
6. Limongelli, C., Sciarrone, F., Vaste, G.: Personalized e-learning in Moodle: the Moodle\_LS System. *Journal of e-Learning and Knowledge Society* 7(1), 49-58 (2011), <https://scholar.google.com/citations?user=-yV4gUMAAAAJ&hl=en>, last access 2020/03/01.

7. Lendyuk, T.V.: Adaptive learning and fuzzy logic in the construction of individual learning trajectories. *Global and national problems of economy* 6, 959-964 (2015).
8. Karampiperis, P., Sampson, D.: Adaptive Learning Resources Sequencing in Educational Hypermedia Systems. *Educational Technology & Society* 8(4), 128-147 (2005).
9. Libbrecht, P.: A model of re-use of E-learning content. In: *Third European Conference on Advanced Learning Technologies*. pp. 222-233. Maastricht. Netherlands (2008), [https://link.springer.com/chapter/10.1007/978-3-540-87605-2\\_25](https://link.springer.com/chapter/10.1007/978-3-540-87605-2_25), last accessed 200/02/10.
10. Bowling, E.: The evolution of Lotus e-Learning Software, [http://www.ibm.com/developerworks/lotus/library/ls-elearning\\_evolution](http://www.ibm.com/developerworks/lotus/library/ls-elearning_evolution), last accessed 2019/11/16.
11. Hlybovets, M.M.: The role of standards in e-learning systems. *Computer technologies* 160, 107– 114 (2011).
12. Kushnir, N., Valko, N., Osipova, N., Bazanova, L.: Experience of Foundation STEM-School. In: Ermolayev, V. et al. (eds.) *Proc. 14-th Int. Conf. ICTERI 2018*. Kyiv. Ukraine. CEUR-WS.org/Vol-2104, 431-446 (2018)
13. Zaytseva, T., Kravtsova, L., Puliaieva, A.: Computer Modelling of Educational Process as the Way to Modern Learning Technologies. *CEUR Workshop CoSinE*, vol. 2393, pp. 849-863 (2019).
14. Hrabar, M.I., Krasnyanskaya, K.A.: The use of mathematical statistics in pedagogical research. *Pedagogy*, Moscow (1977).
15. Kalensky, A.A.: Checking the efficiency of training information technologies in the tactical disciplines processing. *Bulletin of the National University of Defense of Ukraine* 6(25), 60-65 (2011).
16. Shcherbina, O.A.: Learning Tools Interoperability is the new standard of integration for distance learning platforms. *Information technology and training tools*, vol. 47 (3), pp. 167-177 (2015), [http://nbuv.gov.ua/UJRN/ITZN\\_2015\\_47\\_3\\_16](http://nbuv.gov.ua/UJRN/ITZN_2015_47_3_16), last access 2020/01/18.