ЕКОЛОГІЧНА ОСВІТА

UDC 378.091.3:502/504]:621.395.721.5
DOI https://doi.org/10.32846/2306-9716/2022.eco.5-44.44

MOBILE LEARNING IMPLEMENTATION IN THE PROCESS OF ECOLOGISTS TRAINING

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The topical while training specialists is to use information and communications technology (ICT), which promotes both personal and professional development. Now smartphones, tablets, and other gadgets are not just a means of communication but also an active means of learning, which contributed to the emergence of mobile learning (M-Learning). The article deals with the specifics of M-Learning implementation in the process of specialists field training in the sphere of environmental protection. The result of a survey of 172 full-time students (the 1st – 4th years) using closed-ended and open-ended questions revealed problems that students had during their studies. They are technical – gadgets with a small amount of memory, a lack of Internet speed or its absence; personal – problems with self-organization and self-discipline, lack of direct communication with the teacher and other students, fatigue, a low level of motivation, or its lack; procedural – excessive complexity of tasks and their scope and lack of methodological guidelines for tasks. The research also revealed the M-Learning advantages – its convenience, accessibility, the ability to plan one's own time. The use of M-Learning helps promote the formation of self-discipline, responsibility, and a sense of duty. Methods of mobile devices implementation in classroom work (to download electronic textbooks, to search for information and mobile applications) and in distance learning (for video conferences during lectures and practical classes, to download tasks for the individual work in Moodle and Google Classroom to find the necessary information, to download electronic textbooks, to demonstrate tasks and necessary materials by using Microsoft PowerPoint, for educational video clips, virtual experiments and modeling) are identified. The levels of student satisfaction with the results of M-Learning were identified by using the scale method (the method of «polar judgments»). The study of how the information technology implementation is effective for the formation of students' professional competence in the field of environmental protection is regarded to be perspective. *Key words:* educational process; electronic learning; means of Information and Communication Technology; mobile learning (M-Learning); professional training.

Застосування мобільного навчання в процесі підготовки фахівців з екології. Бондаренко Л.І., Волошина Н.О., Лазебна О.М., Білянська М.М.

Актуальним під час підготовки фахівців є застосування інформаційно-комунікаційних технологій, що сприяють як особистісному, так і професійному розвитку. Смартфони, планшети та інші гаджети на даний момент є не тільки засобом зв'язку, а й активно застосовуються як засоби навчання, що сприяло появі мобільного навчання. У статті висвітлено особливості використання мобільного навчання в процесі підготовки фахівців з екології. У результаті опитування 172 майбутніх екологів денної форми навчання з використанням запитань закритого і відкритого типу виявлено проблеми, що виникають у них під час навчання – технічні (невеликий обсяг пам'яті гаджетів, недостатня швидкість інтернету або його відсутність), особистісні (проблеми з самоорганізацією та самодисципліною, відсутність безпосередньої комунікації з викладачем та з іншими студентами, швидка втомлюваність, низька мотивація або її відсутність), процесуальні (надмірна складність завдань та їх обсяг, брак методичних вказівок до виконання завдань). У процесі дослідження з'ясовано переваги мобільного навчання – зручність, доступність, можливість самостійно планувати свій час. Встановлено, що використання мобільного навчання сприяє формуванню самодисципліни, відповідальності, почуття обов'язку. Виокремлено способи застосування мобільних пристроїв під час аудиторної роботи (для завантаження електронних підручників, пошуку інформації та як мобільні додатки); у процесі дистанційної форми навчання (для відеозв'язку під час лекцій і семінарських занять, для завантаження завдань для самостійної роботи у Moodle, Google Classroom, з метою пошуку необхідної інформації, для скачування електронних підручників, для демонстрування завдань і матеріалів за допомогою Microsoft *PowerPoint*, для навчальних відеокліпів, віртуальних експериментів та моделювання). З допомогою шкальної методики (метод «полярних суджень») з'ясовано рівні задоволення студентів результатами мобільного навчання. Перспективним є дослідження ефективності застосування інформаційних технологій для формування професійної компетентності фахівця в галузі охорони довкілля. *Ключові слова:* професійне навчання; освітній процес; засоби інформаційно-комунікаційних технологій; електронне навчання; мобільне навчання.

The problem statement. The current stage of social and economic development demands specialists who are socially active, able to adapt to specialization change, and quickly and mobile navigate and master innovations.

The means of information and communications technology (ICT), namely electronic learning (E-Learning), mobile learning (M-Learning), and distance learning, are widely used in the educational process. Their imple-

mentation is particularly topical in the context of the Covid-19 pandemic because educational institutions have to switch to online learning. In organizing the educational process, school teachers, teachers of higher education institutions use various technical devices – mobile phones, smartphones, personal computers, webcams, netbooks, tablets, e-books, and so on. Distance learning technology is used for lifelong learning. E-learning is a process of competence formation carried out using electronic means (a computer) and environments with full or partial use of the Internet [1].

Analysis of recent studies and publications. There are several views on M-Learning: as a kind of distance and e-learning at the same time [1]; as a component of E-learning or its continuation [2]; as identical to M-Learning [3]. M-Learning is interpreted as an approach to learning in which mobile electronic devices create a mobile educational environment where students can use them as a means of access to educational materials contained on the Internet, anywhere and anytime [1]. According to UNESCO, M-Learning involves the use of mobile tools that can be used individually or in combination with other information and communication technologies to organize the educational process without being tied to place and time [4].

Gadgets have significant potential to enable students to be creative, thus preparing them for changes in the global economy and helping them adapt to modern technology, providing flexibility and the ability to learn anytime, anywhere at a comfortable place [5, 6]. Factors influencing students' interest in using M-learning are consideration of relative advantage of mobile communication, complexity (or, conversely, simplicity), social impact, job satisfaction, and self-learning [7]. M-Learning does not replace traditional classroom work but can serve as a supplement. We accept the M. Sarrab, L. Elgamel, H. Aldabbas [8] view that teachers have the opportunity to work with the whole group and individually with particular students. Also, we share the opinion of M. Sharples, J. Taylor, G. Vavoula [9] that M-Learning can be regarded as a challenge to formal school education, a way to transfer knowledge and skills needed in later life.

T. Brown, L. Mbati [10] refuted misconceptions about M-Learning as learning, which happens only with the help of mobile phones (M-Learning is all about the mobile device or M-Learning is learning while mobile), or in the process of mobile communication (during physical movement), or available through mobile communications (M-Learning is merely e-Learning accessed through mobile). Besides, it is a common and fair assumption from many first-world researchers that M-Learning is not really possible in rural settings where low bandwidth restricts the use of bandwidth-intensive resources such as video streaming, multimedia, and operating rich. Researchers also mention that M-Learning is only applicable to distance learning and not to face-to-face classroom activities and it means accessing and completing all course material and coursework on a mobile device. M. Bilianska, A. Kolodyazhna, Y. Shuhailo, L. Bohoslavets [11] have generalized the studying of the Ukrainian language as a foreign one with the help of online platforms Moodle, Google, Classrom, and with the help of smartphones using messengers Viber and Telegram.

Researchers have defined and generalized the advantages and disadvantages of M-Learning implementation. For example, D. Parsons [12] correctly pointed out the use of additional affordances of the mobile device, for example, location awareness and both synchronous and asynchronous collaborative communication.

Contextual and situational learning, the use of simulators and cognitive games, augmented reality, and the launch of interactive 3D models are possible with the help of mobile devices. Students have the opportunity to share information (text, images, audio, and video) and personal publications. They can independently choose a topic for research, search for the necessary information and analyze it, share it and create their own publications, presenting the results of their searches through visualization. Students can access the network and use the necessary training materials both online and offline by downloading them; share and store information, expand communication through text messaging [10, 13, 15].

Attention should be also paid to the results of the research of M-learning from the teachers' point of view. Teachers' willingness to use mobile learning depends on several factors, including the teacher's personality (abilities to select digital teaching/learning devices and use their technical capacities for educational purposes; the knowledge to appropriately use them in the lessons, the availability of organizational skills), teacher's attitude to this process and perception of its effectiveness, and their abilities to manage the education process itself [13].

Given the contemporary realities, distance learning is prevailing in the educational process. In National Pedagogical Dragomanov University the educational process of future ecologists' training takes place with the help of the information platform Moodle. The system allows applying the techniques of presenting theoretical material in the form of presentations and educational videos, which significantly expands the possibilities to understand the lecture content. Regarding the lessons of practical mastering material, it is necessary to think over the methodical tools that will enable to process the material as much as possible and to acquire the ability to use the learned material.

The research goal. The aim of the study is to identify the level of students (future ecologists) satisfaction with M-Learning, to detect problems arising while M-Learning in classes and during distance learning, to develop both ways to solve them and implementation perspectives.

Research methodology. The research was conducted during the 2020/2021 academic year with the help of such methods and techniques as questionnaires, comparison, ranging, systematization, and generalization. The aim of the questionnaire was to collect data and examine

the advantages and disadvantages of ICT, M-Learning in particular, during training future ecologists in terms of distance learning. The comparison provided an opportunity for outlining various scientific views on the problem under consideration. Ranging was used for studying the significance of factors related to the organization of mobile learning. The aim of systematization and generalization was to draw conclusions. Applicants of the first (bachelor's) level of higher education, the specialty «Ecology», of Ukrainian higher education institutions took part in the research.

The pedagogical research involved 178 full-time students of the 1st – 4th year of study, aged 17-22. Students study both at public expense and at the expense of individuals. The selection of respondents was made by random sampling from four institutions of higher education in Ukraine with average, sufficient, and high levels of academic achievements based on the results of the final semester certification. 172 responses were received. The method of cluster sampling from the general number of higher education applicants in the specialty «Ecology» was used. The optimality and representativeness of the sample was ensured by the percentage of respondents with a confidence interval equal to 85%, and a confidence interval – 5%. The general number is 1228 respondents, the sample size is 178 respondents, the response rate is 96%, and the confidence interval is 1.96.

Students of the National Pedagogical Dragomanov University (32 people), National University «Chernihiv Collegium» named after T. G. Shevchenko (23 people), Zhytomyr Polytechnic State University (75 people), and Yuriy Fedkovych Chernivtsi National University (42 people) took part in the survey. The survey was placed on the Google platform.

To determine the level of students satisfaction with the results of M-Learning during the organization of distance learning, V. M. Zav'yalova's [15] scale method «Microclimate assessment of a student group» (method of «polar judgments») adapted to the research objectives was used. The questionnaire consisted of 15 essentially opposite judgments. The judgments on the left in the table reveal satisfaction with M-Learning, on the right – radically opposite and characterize dissatisfaction. The students' task was to choose one of the polar judgments (left or right) that characterizes their positive attitude to M-Learning. It was also equally important to indicate one of the five numerical values, which corresponds to the level of the characteristic manifestation applying signs «+» (for positive statements) and «-» (for negative ones), where 3 is a high level, 2 is a medium level, 1 is a low level, and 0 means «hasn't decided». Students were asked to express their satisfaction with certain statements as follows: 3 – I completely agree; 2 – I agree (more yes than no) 1 – I partially agree; 0 – it is difficult to answer; -1 – I partially disagree; -2 – I do not agree; -3 – I completely disagree.

The results and discussion. To determine the level of students' satisfaction with the results of M-Learning during the organization of distance learning certain indicators of all responses with positive and negative results taken from each question were summed up. Then the difference between them was found. Based on individual responses or profiles received from each student, an average profile was created.

According to the chosen research methodology and the obtained calculation results, the following levels of students' satisfaction with M-Learning results during the distance learning organization have been determined:

50 and more points – high level – M

–Learning is of high quality, convenient, and fully meets students' needs;

40-49 – medium-high level – M-Learning more satisfies than dissatisfies students' needs;

21-39 – medium level – M-Learning partially causes some difficulties and students' dissatisfaction (it dissatisfies more than satisfies);

11-20 – medium-low level – M-Learning causes difficulties for most students;

0-10 – low level – M-Learning does not meet the needs of students at all and it is inconvenient.

Based on the conducted research with the implementation of the technique «polar judgments», the students' attitude to the use of M-Learning as one of the tools for the realization of distance learning has been clarified (Table 1).

Based on the obtained data, the M-Learning profile was created, with the help of which the level of each component under study and thus the number of respondents in each of them were determined. The results of the study showed the following levels of students' sat-

Table 1

The results of students survey on their attitude to M-Learning (based on the method «polar judgments»)

Assessment	Sequence number of the characteristics															Sum	Average value
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
+3	110	113	68	74	57	61	68	65	55	42	34	77	82	57	64	1027	69
+2	31	34	48	42	57	44	48	59	46	51	39	46	34	40	59	678	45
+1	16	8	24	22	28	26	28	25	25	36	34	15	22	28	19	356	24
0	10	6	12	12	14	13	12	11	20	14	20	18	13	25	13	213	14
-3	2	3	5	10	9	11	7	5	8	13	10	9	6	6	8	112	7
-2	2	3	9	3	4	9	5	4	9	8	19	2	4	8	6	95	6
-1	1	5	6	9	3	8	4	3	9	8	16	5	11	8	3	99	7

isfaction with M-Learning during the organization of distance learning: low – 20 people, medium-low – 14, medium – 24, medium-high – 45, high – 69 respondents.

Thus, 80 % of the respondents indicated their satisfaction with M-Learning implementation (medium, medium-high and high levels in total). We also analyzed the results of a students' survey, which included both closed-ended and open-ended questions to find how to use mobile devices during classroom work and distance learning and problems that arise during their implementation (Table 2).

According to the survey, most students use laptops and desktops while preparing for classes, the rest of them use smartphones and tablets. However, during distance learning, priorities have changed somewhat – smartphones and tablets have priority over laptops (19%) and desktops (18%). During classroom activities, the use of mobile devices is somewhat limited – for downloading electronic textbooks (48%), information search (37%) and as mobile applications (15%). They are used for video communication on Zoom, Google Meets, Skype during lectures and seminars, to download tasks for independent work in Moodle, Google Classroom, to find the necessary information, to download electronic textbooks, to show tasks and necessary materials using Microsoft PowerPoint, for classes with the help of

Table 2

Results of students' survey on possibility to implement mobile devices

Question (Variable)	Options (Answer)
Devices (gadgets) that students use during self-preparation for classes	– Desktop computers (53%), Laptops (27%), Smartphones (12%), Tablets (8%)
Devices (gadgets) used during distance learning	– Smartphones (39%), Tablets (24%), Laptops (19%), Desktop computers (18%)
Ways to use mobile devices during classroom work	– to download electronic textbooks (48%); to search for the necessary information (37%), as mobile applications during classes (37%)
Ways to use mobile devices during distance learning	– for video communication on Zoom, Google Meets, Skype during lectures and seminars – to download tasks for independent work in Moodle, Google Classroom – to find the necessary information – to download electronic textbooks – to demonstrate tasks and necessary materials using Microsoft PowerPoint – for classes with the help of smartphones using (via) Viber, Telegram. – for educational video clips, – virtual experiments and simulations – as applications during classes – as platforms and social networks blogs – as geographical maps
Factors motivating to work with mobile devices	– the opportunity to work regardless of a place and time (56%) – desire to keep up with others (21%) – desire to master new skills (17%) – implementation of game elements (4%) – I can't answer (2%)
The satisfaction degree of meeting requirements for communication between students and a teacher as well as students with each other	– satisfy completely (18%) – more yes than no (36%) – more no than yes (31%) – do not satisfy completely (12%) – I can't answer (3%)
Challenges while working with mobile devices	– problems with self-organization and self-discipline – lack of Internet access in the dormitory and apartment – device specifications (low memory, insufficient Internet speed) – lack of hardware (computer, tablet, phone, webcam, etc.) – a lack of direct communication with the teacher and each other – a lack of motivation for M-Learning – Rapid fatigue – excessive complexity of tasks and their scope – a lack of guidelines for tasks completion – no difficulties

smartphones using (via) Viber, Telegram, as applications during classes, for educational video clips, virtual experiments and modeling, as platforms and social networks blogs, and as geographical maps (mostly students named several answer options, so the % was not determined).

Regarding the challenges, the first place is taken by technical difficulties: technical characteristics of devices (small memory capacity, insufficient Internet speed) (16%), a lack of Internet access in the dormitory and apartment (3%), a lack of technical means (computer, tablet, phone, webcam, etc.) (2%). Then we have personal challenges: 14% of the respondents have problems with self-organization and self-discipline, 13% of the respondents see difficulties in the lack of direct communication with the teacher and other students; 10% of them indicated a lack of motivation for M-Learning, and 6% outlined rapid fatigue. The third group is procedural difficulties: 9% of the respondents noted the excessive complexity of tasks and their scope, 2% – a lack of guidelines for tasks completion. 25% of the students had no difficulties at all.

According to the results of the study, 80 % of future ecologists expressed a positive attitude to the use of M-Learning as one of the tools for the implementation of distance learning (medium, medium-high and high levels in total). It is obvious that the majority not only positively perceived this form of work but also was ready to continue working in a given mode. The problem of self-discipline and self-organization is of concern to 14% of the respondents. On the other hand, the growth of personality, the formation of value characteristics, and professionalism encourage the development of a person's self-independence. The incentive to acquire self-discipline as one's own achievement while studying in educational institutions should be considered as a positive feature.

Another 21% of the respondents think about challenges in using M-Learning due to technical problems. Now this problem is temporary, and it is addressing and should not affect the M-Learning tool in the future. Regarding the lack of direct communication with the teacher and students with each other (13% of the respondents), it is obvious that such an indicator represents socialization as an important characteristic of human life. This is also confirmed by the results of the study by S. Sadiq, and Dr. S. Batool [6]. It is necessary to vary and use the forms of work that enable people to fill a niche. However, this requires a separate approach and research.

That is why a wide range of answers is appropriate and enables a person to consider possible options for personal determination in relation to the problem of distance work and M-Learning. This explains the division of questions into closed and open ones. The latter allows determining the reasons as well as partially explaining the respondent's choice of this or that answer.

Analysis of the data, based on the figures in Table 1, indicates the following: Question 1 is aimed at studying the need for the use of e-devices in the educational process: mobile devices (tablets, mobile phones, and laptops) are necessary for the ecologists training (2/3 of respondents). The same number of respondents is determined by the convenience of e-devices implementation as a means of obtaining information. The figure of respondents' answers to Question 2 indicates the information stated above.

It is logical to question the extent of the information obtained (question 4 concerns it) and whether it is enough to visualize the theoretical material with the help of e-devices? The answers of the respondents to question 5 indicate that the majority gives positive responses to the information asked. About 90 % of the respondents are satisfied with the presentation of materials by using M-Learning. These figures are topical in studying the problem of implementation M-Learning in the educational process.

Microsoft Office Access is a database management system, a part of the Microsoft Office suite. It has a wide range of functions, including related queries, sorting by various fields, links to external tables and databases. The advantages of this program are low cost, availability for use, a simple interface, the ability to constantly add and update, data input in any format (documents, other databases, text, tables, photos, links, dates, etc.), and the ability to conduct research. A mobile application for the practical mastering of the course «Environmental Monitoring» was developed based on the product described above [14, 15].

Center «New Europe» with the support of the Foundation named after Friedrich Ebert conducted research showing that 86% of Ukrainian youth aged 14-29 had constant access to the Internet and 4% are deprived of such an opportunity at all. Regarding the use of the Internet for educational purposes, this figure is 79 %, and 19% of respondents never use the Internet for study and work; 37 % of respondents use it often as a source of news and information, and 11 % – never use it. Young people use such social networks as Vkontakte, Instagram, Facebook, and Twitter most of all. Besides, such messengers as Viber, WhatsUp, and Telegram are also popular [16].

The further questions regarding the use of M-Learning in the professional training of ecologists were related to the possibilities of self-study, self-discipline, and work convenience, and so on. The figure of students' responses concerning the acquisition of new digital skills for successful work in the format of distance work deserves special attention. As Table 1 (question 11) shows such a significant number of respondents had to work and acquire certain skills and abilities. In fact, almost 60% of students had no problems with their work.

Question 13 indicates that a significant number of the respondents favorably embraced, mastered, and were ready to continue working in the format of distance learning. The highest indicators of the respondents'

number are related to positive aspects of the ability to choose independently the time for work and tasks completion, the ability to freely allocate their time and use it for personal needs.

Conclusions and prospects for further research. Mobile learning is characterized by the fact that it does not require a physical connection to the cable network, providing access to training materials anywhere and at any time via a mobile phone or another technical device provided there is a mobile connection. This promotes student learning mobility.

The results of the study, which engaged 172 applicants for higher education in the specialty «Ecology» from 4 institutions of higher education in Ukraine, showed the following levels of student satisfaction with M-Learning while organizing distance learning: low – 12%, medium-low – 8%, medium – 14%, medium-high – 26%, high – 40% of respondents. The positive aspect of the study is that M-Learning promotes self-discipline and responsibility.

The results of the survey on the ways and possibilities of using M-Learning allowed us to draw conclusions about its prospects not only in the process of distance learning but also during classroom work. It can be used to download e-textbooks, search for information to demonstrate tasks and materials by using Microsoft PowerPoint. In addition, it can help edit educational video clips, conduct virtual experiments, and do modeling. People can use it as mobile applications, in particular during training practice.

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