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## THEORETICAL AND METHODOLOGICAL BASIS OF THE USE OF DIGITAL TECHNOLOGIES IN THE FORMATION OF ENVIRONMENTAL COMPETENCE OF APPLICANTS FOR EDUCATION

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*The article contains the results of scientific research on the theoretical and methodological foundations of the use of digital technologies in the formation of environmental competence of applicants for education. The purpose of the study is to conduct an analysis of theoretical and methodological foundations of the use of digital technologies in the formation of environmental competence of applicants for education in order to create methodological recommendations for teachers to carry out distance and blended learning. Peculiarities of the use of digital technologies in the formation of environmental competence of applicants for education are analyzed (intensification of learning due to the use of attractive and rapidly changing forms of information presentation, promotion of learning individualization; interrelation of portions of information and tests; strict logical sequence, structural and logical schemes; doing tests and solving tasks; having several attempts, learning the material anew or reperforming tasks). Characteristics of online platforms for use in the process of forming environmental competence of applicants for education according to their features, advantages and disadvantages, including Google Apps Education Edition, Google Classroom, Google Meets, Teams, Moodle, Zoom, Classtools, LearningApps, Edmodo, etc., were studied. A method of using mobile applications with ecological content in the formation of environmental competence of applicants for education has been developed through the determination of ways of their integration into educational and cognitive activities, locations (autonomous work in the educational building or remotely); frequency of their application (a prepared educational course, a project with usage of mobile technologies or a one-time integration into an educational session in the process of exploring a certain topic); creation and use of existing mobile applications; use of personal mobile devices or devices of educational institutions*

**Keywords:** applicants for education, digital technologies, scientific-methodical tools, online platforms, mobile applications

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### 1. Introduction

Intensive development of science and technology in the XXI century involves receiving, storing and processing a large amount of information. Peculiarities of carrying out the educational process, initially in conditions of the pandemic, now - of military actions in Ukraine, made corrections and actualized a distant form of educational and cognitive activity. The current computerized society sets requirements for the ability to use information resources of computer technologies to organize the educational process – computer communication literacy: using e-mail and e-mail box; searching the Internet for information necessary in educational activities; representations of educational and methodological materials on the Internet; registration in communities, forums, ability to use Web 2.0, etc.

According to the State Standards, educational institutions face the task to prepare students for life in the modern, informationally highly developed, dynamic

society. One of the ways to solve the above-mentioned task is introduction of computer technologies that open opportunities when working with various information in educational process. In pedagogical scientific terminology, the terms "information technologies" and "digital technologies" are used alongside the concept of "computer technologies". Digital technologies are identified with electronic tools, devices and resources that process, generate or store data. Well-known examples of digital technologies are social networks, games, multimedia and mobile phones.

### 2. Literary review

The analysis of psychological and pedagogical literature on the topic of the research testified to its extensive study, practical assimilation and application, and wide interpretation.

Thus, the analysis of electronic social networks as tools of modern educational environment was carried out

in [1], recommendations on the optimal choice of methods of organizing Internet resources were implemented in [2]. Features of the use of mobile applications in modern education, in particular due to the establishment of their advantages and disadvantages, are presented in [3, 4], use of mobile applications for conducting educational research during the study of subjects of natural and mathematical cycle is detailed in [5]. Experience of emergency distance learning in university teaching and learning during the COVID-19 pandemic is represented in [6, 7], the process of adaptation of teachers and applicants for education to the specified processes through the implementation of distance and blended learning is characterized in [8, 9]. Features of mobile learning technologies are presented in [10]. Information technologies in the formation of environmental awareness of future specialists are revealed in [11, 12]. The formation of professional competences of future teachers by means of computer methods using a research approach is proven in [13, 14]. Scientifically based theoretical and practical information, methodological tools for the formation of environmental competence, consciousness and an ecologically responsible attitude towards the environment among applicants for education is presented in [15]. The importance of using Learning Apps service to create interactive didactic exercises for Biology lessons was proven in [16, 17]. Research on the use of BYOD in the classroom during the educational process is presented in [18]. An ecological paradigm in the polyparadigmatic educational space is disclosed in [19]. Content, forms and methods of the formation of environmental competence of applicants for education on the basis of axiology were analyzed in [20]. Peculiarities of the formation of environmental competence of students in the context of preventing environmental pollution during the war are disclosed in [21]. Possibilities of teaching in difficult circumstances, practice of organization and implementation of educational and cognitive activities during military conflicts are disclosed in [22].

The analysis of literary sources shows that significant attention is paid to the problems of changing and updating educational paradigms on the basis of sustainable development, determining the role of digital technologies in the conditions of the COVID-19 pandemic and the current war conditions in Ukraine using distance and blended learning. However, the problem of using online platforms and various online resources for learning in the process of forming environmental competence of schoolchildren is not sufficiently revealed.

### **3. The purpose and objectives of the study**

The purpose of the study is to analyze theoretical and methodological foundations of the use of digital technologies in the formation of environmental competence of applicants for education in order to create methodological recommendations for teachers for implementation of distance and blended learning.

To achieve the goal, such tasks were set:

1) to analyze peculiarities of the use of digital technologies in the formation of environmental competence of applicants for education;

2) to investigate characteristics of online platforms for usage by teachers in the process of forming the environmental competence of applicants for education;

3) to develop a methodology for usage by teachers of mobile applications with ecological content in the formation of environmental competence of applicants for education.

### **4. Research method**

The following methods were used to conduct the research: analysis and generalization of pedagogical and methodical sources in order to identify the range of issues that require scientific and methodological support; methods of comparative analysis, interpretation and generalization of facts; comparative-analytical for the analysis of the formation of applicants' for education environmental competence for the use of digital technologies; system analysis for the development of methods for the formation of schoolchildren's environmental competence with the help of digital technologies.

### **5. Results**

#### **5.1. Analysis of the use of digital technologies in the formation of environmental competence of applicants for education**

As a result of the analysis of the use of digital technologies in the educational process, it was found out, that from a psychological and pedagogical point of view, learning with the help of computer technologies is distinguished by the following features:

1. The work of applicants for education with computer technologies ensures activation of learning due to the use of attractive and rapidly changing forms of information presentation, contributes to individualization of learning (everyone works in a mode convenient for him/her).

2. The educational material is built from consecutive, somehow interconnected frames. By frame we mean a fragment of educational material consisting of separate, independent, but interconnected portions of information and tests that contribute to the effective assimilation of knowledge and skills.

3. The educational material is divided into parts in a strict logical sequence and is a form of structural and logical schemes.

4. After studying a certain portion of the educational material, students are offered to answer control test tasks and solve the tasks.

5. A student begins the next portion only after completing the task of the previous part. Subjects of an educational activity with insufficient preparation are offered to make several attempts, study the material anew or perform the task again.

6. Control questions and tests should be created to teach to distinguish main properties, to establish relationships between processes, etc.

7. The effectiveness of training increases due to the fact that the learner takes on each subsequent portion of the material only after mastering the previous one.

Among the wide variety of the use of computer technologies in education, the Internet has great prospects. It is an excellent source of additional information,

thanks to which education is characterized by accessibility, interactivity, active interaction of teachers with students, educational materials in electronic form, individual approach, etc.

Summarizing the above mentioned capabilities of a computer and computer technologies as a whole, we formulated the following functional capabilities of computer technologies in the educational process of natural science subjects that are relevant in our context:

- providing a combination of visual and auditory perception of information, image scaling and study of processes and phenomena in dynamics;

- control of the individual pace of educational activity: a user has an opportunity to independently choose a moment of transition to the next position, portion of educational information, set speed of tasks submission, time of their solution. At the same time, a computer can serve as a certain regulator to inform a user that his/her work pace is either too slow or unreasonably fast;

- possibility of independent transition from a higher level of educational material complexity to a lower one and vice versa. A user chooses and determines the degree of difficulty of the task. There is an ability to try your hand at different levels of difficulty and to take into account gaps in learning the material. A teacher should not focus on the average level, because it objectively does not exist;

- ensuring the possibility of dividing a content of an electronic textbook, a manual into separate blocks of information, which makes studying the course more flexible, more efficient, deeper, more diverse, more

meaningful, and also significantly simplifies a search for necessary materials;

- ensuring flexibility of learning – a user chooses duration and sequence of learning materials by him/herself, fully adapting the entire learning process to his/her capabilities and needs. So a user can work in a convenient mode, without experiencing any discomfort, without focusing on anyone;

- possibility of re-studying the content of the educational material, since an electronic textbook, a manual allows you to listen to the lecture course of natural sciences subjects at a convenient time, if necessary, repeatedly returning to necessary places;

- performing the function of a means, by which it is possible to "personally" communicate with a user and motivate his/her activity in a certain way (praise, evaluation, remark on erroneous actions, etc.);

- ability to control and self-control constantly and objectively. At the same time, a user gets grades, assigned by a computer, immediately after completing tasks, reviews his/her answers and analyzes errors. Such self-control of knowledge contributes to the cultivation of a sense of responsibility, develops memory, attentiveness.

Nowadays, there is a large number of online platforms and various online resources for learning. It is quite easy for a teacher to get lost in the multitude of platforms when he/she does not know the characteristics, advantages and disadvantages of one or another platform. We will describe types and capabilities of the most common of them and summarize the identified studies in Table 1.

Table 1

A number of useful online platforms for formation environmental competence

<i>Online platform</i>	<i>Essence of online platforms</i>
Google Classroom <a href="https://classroom.google.com/">https://classroom.google.com/</a>	The platform that most teachers like due to the Ukrainian language, simple interface and ability to set grades directly on the platform, with a possibility of confidential settings to ensure stability of learners' mental state, tracking the progress and evaluation of a learner.
Google Meets <a href="https://meet.google.com/">https://meet.google.com/</a>	The platform for video conferences can be opened from a mobile phone or other gadget, without having an application, directly in the browser by putting a link in the search field. The only thing you need is the Gmail app, which helps you to easily authenticate without signing up.
Teams <a href="https://www.microsoft.com/sk-sk/microsoft-teams/log-in">https://www.microsoft.com/sk-sk/microsoft-teams/log-in</a>	A platform for chats, online meetings and collaboration, integrated with Microsoft Office software. It has very similar capabilities to the Google classroom platform.
Moodle <a href="https://moodle.org/?lang=uk">https://moodle.org/?lang=uk</a>	A platform with a fairly easy interface, but without video communication, however, Moodle allows teachers to insert a link to a conference in Zoom, Skype, Google Meet, etc., if necessary.
Zoom <a href="https://zoom.us/">https://zoom.us/</a>	A cloud platform for video and audio conferences and webinars. Simple clear interface. There is a screen demonstration, a live chat of participants, possibility of mass turning off participants' microphones, so that extraneous sounds do not interfere.
LearningApps <a href="https://learningapps.org/">https://learningapps.org/</a>	An online service that allows you to create a great variety of interactive exercises. LEARNING APPS constructor is intended for development and storage of didactic multimedia interactive tasks.
Edmodo <a href="https://new.edmodo.com/">https://new.edmodo.com/</a>	Tools and resources for managing classrooms and students' distance learning, an English-language platform with ability to add personal files to the portal. Registration is free and fast.

## 5. 2. Methodology of using mobile applications with ecological content in the formation of environmental competence of applicants for education

**Mobile learning** (M-Learning) is identified by scientists as a modern direction, related to the development of distance education systems due to the use of mobile phones, smartphones, personal computers (PPC), e-books. It is integrated with measures necessary for the realization of educational goals: effective management of systems of educational institutions, improvement of coordination of efforts of educational institutions and customers' of educational services families. Mobile devices are usually understood to include PDAs, smartphones, tablets and mobile phones, but this list can be expanded

to include any self-contained compact device that accompanies people in their daily lives.

Nowadays, smartphones or tablets based on the Android operating system are most often used as the most appropriate mobile devices. With the help of gadgets, it is possible to use resources of the "Internet" network and various free applications, downloaded from the PlayMarket service. The specified service is saturated with many applications as indispensable assistants in the process of mastering biology, chemistry, physics, mathematics, ecology, which are relevant during the formation of applicants' for education environmental competence, and is distinguished by free download. We will analyze some of them and summarize the mentioned studies in Table 2.

Table 2

A number of mobile applications with ecological content

<i>Applications and links</i>	<i>Essence of useful functions of applications and links</i>
Plickers <a href="https://play.google.com/store/apps/details?id=com.plickers.client.android&amp;hl=uk&amp;gl=US">https://play.google.com/store/apps/details?id=com.plickers.client.android&amp;hl=uk&amp;gl=US</a>	A convenient application for a quick assessment of applicants' for education knowledge right at the training session. You can conduct a survey of the whole class/group in half a minute. All you need are printed sheets for each learner in the classroom and your phone or tablet (learners do not need one).
Anatomy 4D. <a href="https://www.4danatomy.com/">https://www.4danatomy.com/</a>	The free app and simple printable image transfer applicants for education and anyone who wants to learn about the internal structure of a human body into an interactive 4D world of human anatomy. It uses augmented reality and takes viewers on a journey inside the human body and heart, revealing spatial interaction of our organ systems, skeleton, muscles and body.
Bio Inc – Biomedical Plague <a href="http://playbioinc.com/">http://playbioinc.com/</a>	A biomedical strategy simulator, in which the patient's fate is determined, deadly diseases develop. The application will acquaint learners with various diseases and ways of their transmission, and will show more than 100 realistic biomedical conditions.
Bacteria interactive learning VR 3D <a href="https://www.apkonline.net/uk/bacteria-interactive-educational-vr-3d/com.rendernet.bacteria">https://www.apkonline.net/uk/bacteria-interactive-educational-vr-3d/com.rendernet.bacteria</a>	The mobile application shows all known forms of bacteria, 3D images are successfully visualized and interactive, and contain captions. Almost all of them include built-in animations and voiceovers, which is very convenient when using a mobile application. The mobile application contains interesting games, entertaining animated quizzes and other visual elements.
Zoopolis <a href="https://play.google.com/store/apps/details?id=com.azurinteractive.animalsevolution&amp;hl=uk&amp;gl=US">https://play.google.com/store/apps/details?id=com.azurinteractive.animalsevolution&amp;hl=uk&amp;gl=US</a>	An interesting and bright mobile application. When students play this mobile application, they can feel like real explorers of the Earth's oceanic, marine, forest, and river fauna. In addition to animals, there are many islands, oceans, coasts, flat islands, forest islands, Antarctica, savanna, jungles, mountains, rivers, deserts, island farms and cities to explore.
Evolution Idle <a href="https://play.google.com/store/apps/details?id=com.littlebitgames.idleevolution&amp;hl=uk&amp;gl=US">https://play.google.com/store/apps/details?id=com.littlebitgames.idleevolution&amp;hl=uk&amp;gl=US</a>	You can not only observe, but also participate in creation and development of territories and living creatures. Different eras will appear before an applicant for education: the Stone Age, the Iron Age, Our Time and the Future. This game can also be used at the lessons of science subjects, in particular biology, on the topic "Evolution", etc.

### Advantages and disadvantages of mobile devices

The use of tablet computers and smartphones in the educational process has recently intensified significantly. The interest and need to use these devices under the conditions of online education as a means of providing customers of educational services and subject teachers with necessary educational and cognitive materials is being updated. Among the opportunities to support learning are processing of e-books or online content from the Internet, listening to music and watching videos, etc. However, there are a number of problems that can arise when using mobile learning in the classroom.

So, along with the visible advantages of mobile learning, we should highlight a number of problems and difficulties, namely:

– technical problems: small screen size and keys on mobile devices; problems with Internet access; operation of mobile devices only from batteries; regulated amount of memory available on mobile devices; problems of information security; lack of uniform standards in connection with mobile platforms, etc.;

– social and educational problems: not all students are financially able to purchase a suitable mobile device; assessment of learning outcomes, online content security; rapid development of mobile technologies; lack of development of pedagogical theory for mobile learning; presence of conceptual differences between electronic and mobile learning; security of personal information, etc.

Therefore, the appealing to the interpretation of the term "mobile application" makes it possible to under-

stand it as such software for organizing and carrying out work through smartphones, tablets and other mobile devices that are installed on devices or downloaded to them in online stores selling mobile applications (App Store, Google Play, Windows Phone Store, etc.).

#### **Norms regarding mobile educational applications**

The following requirements are defined for mobile educational programs:

- *compactness* (short duration of M-Learning components, their availability in an online environment, in which potential interruptions in communication are likely;

- *a high level of microergonomics* (ensuring high image/sound quality with a small screen size, small output file size (download speed);

- *ubiquity and availability* (access to mobile educational application anytime and anywhere; large range of mobile network providers and availability of mobile devices ensure widespread use of mobile learning services at a time convenient for a student;

- *personalization of teaching* (mobile devices belong to their owners, possibility of unhindered systematic use for the required time, availability of many setting functions. This makes it possible to provide wider potentials of mobile technologies for the purpose of personalization compared to offline technologies);

- *instant feedback and assessment of program learning outcomes* (acceleration thanks to mobile technologies of the process of assessment of program learning outcomes of applicants for education and faster tracking of the achieved successes by teachers; opportunity to learn anytime and anywhere).

Using mobile educational applications, a user is able to choose a type of educational task, time for its completion, individually dose the amount of information to be learned and performance of creative tasks.

The basis for ensuring the use of digital technologies is presence of a *set of conditions*, namely:

- readiness of teachers to use modern digital technologies in their professional teaching activities (online platforms and various online resources for learning: Google Apps Education Edition, Google Classroom, Google Meets, Teams, Moodle, Zoom, Classtools, LearningApps, Edmodo, etc.);

- ensuring constant improvement of knowledge, skills, formation of competencies for the use of services and other digital technologies in professional pedagogical activities in the context of one's own continuous education;

- systematic use of acquired skills in the process of educational and cognitive activity;

- continuous improvement of organization of one's own professional pedagogical activity using digital technologies;

- systematic improvement of the level of mastery of modern means of digital technologies and formation and necessary updating of one's own digital competence.

#### **Maintenance of situational training.**

Compared to the usual educational process in classrooms, mobile devices facilitate the movement of students in the environment close to real conditions to facilitate understanding of natural science subjects (biol-

ogy, chemistry, physics, mathematics, ecology) using various mobile applications. For example, mobile applications are city guides that tell about the most important architectural objects, their compositions, constructions and meanings; mobile applications with complete information about plants in their natural habitat to gain knowledge about them, etc.

Nowadays, there are a large number of mobile applications targeting different types of devices. Developers provide free access to programs, which is a very important factor in the fact that they can be used in the conditions of distance and face-to-face learning. The role of modern eco-relationships is difficult to exaggerate, as the useful functions they perform greatly facilitate the formation of useful eco-habits and ecological competence of their users.

Therefore, the use of mobile applications in the educational process of educational institutions requires determination of ways of their integration into educational and cognitive activities and depends on the location (autonomous work in the educational buildings or remotely); frequency of their application (a prepared educational course, a project using mobile technologies or a one-time integration into an educational session in the process of studying a certain topic); creation and use of existing mobile applications; use of personal mobile devices or devices of educational institutions.

The detailed analysis of the use of modern digital technologies in the formation of environmental competence of applicants for education makes it possible to determine the advantages and disadvantages of the process.

#### ***The main advantages of using mobile learning technology, in particular modern mobile applications, are:***

- 1) technology innovation;
- 2) use of portable devices for conducting the educational process;
- 3) ability to use technology as an additional means of learning;
- 4) ability to download necessary theoretical material for solving educational tasks at a time convenient for an applicant for education using mobile applications;
- 5) assistance in adaptation to learning in information space;
- 6) possibility of quick access to creation of ecological models, construction of graphs, tables, calculation of the formula, counting;
- 7) simultaneous interaction by one and a group of customers of educational services.

#### ***The disadvantages of implementing mobile learning technology are:***

- 1) shortage of high-quality fully functional Ukrainian-language educational content for mobile devices and means of its development;
- 2) inadequate "technical" preparation of teachers in creating mobile applications;
- 3) small display formats and battery capacity sizes of mobile devices, which is not always convenient for educational and cognitive tasks;
- 4) limited battery life, which must be taken into account during a long period of performance of an educational and cognitive task;

5) incompatibility of some mobile devices with other mobile applications;

6) additional expenses for installing specialized applications with enhanced capabilities for performing educational and cognitive tasks.

So, modern digitization of the educational process is an actual and overdue phenomenon. The analysis carried out above enables a conclusion about the expediency and necessity of using online resources by teachers during the formation of environmental competence of applicants for education.

## 6. Conclusions

1. Peculiarities of the use of digital technologies in the formation of applicants' for education environmental competence are analyzed (intensification of learning due to the use of attractive and rapidly changing forms of information presentation, promotion of individualization of learning; interconnection of portions of information and test tasks; strict logical sequence, structural and logical schemes; doing control test tasks and solving tasks; having several attempts, studying the material anew or repeating tasks).

2. Characteristics of online platforms for use in the process of applicants' for education forming environmental competence due to their features, advantages and disadvantages, including Google Apps Education Edition, Google Classroom, Google Meets, Teams,

Moodle, Zoom, Classtools, LearningApps, Edmodo, etc., were studied.

3. The method of using mobile applications with ecological content in the formation of applicants' for education environmental competence has been developed through the determination of ways of their integration into educational and cognitive activities, locations (autonomous work in the educational buildings or remotely); frequency of their application (a prepared educational course, a project using mobile technologies or a one-time integration into an educational session in the process of studying a certain topic); creation and use of existing mobile applications; use of personal mobile devices or devices of educational institutions.

## Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results, presented in this article.

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## Data availability

Data will be made available on reasonable request.

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