Digitalization Policy Influence: Implementation of Mobile Learning in the University Educational Process

Sergey Evgenievich Shishov
K.G. Razumovsky Moscow State University of Technologies and Management, Moscow, Russia.

Song Yu
Lomonosov Moscow State University, Moscow, Russia.

Nadezhda Borisovna Lyakhova
Russian State University of Tourism and Service, Cherkizovo, Moscow Region, Russia.

Svetlana Pivneva
Russian State Social University, Moscow, Russia.

Darya Mikhailovna Kapustina
Moscow Aviation Institute, Moscow, Russia.

Pavel Alekseevich Arkatov
Moscow Polytechnic University, Moscow, Russia.

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Abstract

The digitalization of higher education has led to the emergence of new teaching methods, including mobile learning methods.

The purpose of the study is to determine the prospects, advantages, and obstacles to the introduction of mobile learning in the university educational process in the context of the digitalization policy of education.

The study presents the prospects for the introduction of mobile learning in the university educational process; identifies the main components of mobile learning, which ensure the effectiveness of the implementation of mobile technologies and types of mobile content that can be used in the university educational process; an analysis of each type has been carried out; the advantages and obstacles of the introduction of mobile learning are highlighted.

In conclusion, mobile technologies allow introducing new forms of training organization, involving the interaction of learning subjects with each other not only during lessons but also outside them.

Keywords

Educational Process, Mobile Learning, Mobile Devices, e-learning, Blended Learning.

Introduction

The emergence of network technologies has intensified the connection of all educational institutions to the Internet and the introduction of distance learning methods by means of e-mail, conferences, forums, and subsequently platforms for the implementation of distance learning and courses. The pedagogical potential of the new generation of mobile devices – smartphones – has lead the scientific community and educational administrators to rethink mobile technologies and introduce them into the educational process (Pearce, Rice, 2013) and transform their application from entertainment to educational.

In Russia, according to Mediascope (2021), the number of Internet users among young Russians (12-24 years old) in 2020 approached 100%. Mobile devices are the main tools for accessing the Internet among Russians of all ages. In 2020, 86.6 million people (70.8% of the population) used the Internet on mobile devices at least once a month. 33.2 million people (27.1% of the population) used the Internet on mobile devices at least once a month. The average daily exclusive mobile audience is 29.3 million people (23.9% of the population). Although the indicators do not relate to the educational process, the presence of such a large number of users who use mobile devices to use the Internet indicates that the organization of training based on mobile technologies is promising.

In terms of curricula, based on research conducted by the global management consulting company McKinsey in 2020 (2021), we note that mobile learning applications form a relatively small part, accounting for 10% of the total e-learning market. However, researchers believe that the global market for mobile applications from 2020 ($32.8 billion) to 2025 ($43.6 billion) will grow by $10.8 billion (Transforming learning through mEducation, 2012). Another important determinant of the prospects for using mobile learning is wireless access to Internet networks (Wi-Fi or mobile communication zones).

Literature Review

The problem of using mobile technologies is at the initial stage of its development along with the formation of a methodology for mobile learning, improving the principles, methods, means, forms, and technologies of teaching.

The essence and concept of mobile learning are described in several studies (Table 1).

Table 1 The essence and concept of mobile learning

№	Definition	Source
1	e-learning using mobile devices and wireless networks; when mobile devices become the main way to access the Internet, e-learning will become mobile without any changes in learning technology	Kukulska-Hulme (2013)
2	innovative pedagogical technology, in which the educational process is geographically and situationally dependent, that is, contextually related to the place and state in which the student is	Camilleri, Camilleri (2017)
3	direction of development of distance learning systems using mobile devices	Martin, Ertzberger (2013)
4	a new stage in the development of e-learning, which uses mobile devices and wireless access to learning resources as a learning tool	Singh (2010)
5	any type of learning in which the student does not have a fixed, predetermined place, or uses the opportunities offered by mobile technologies for learning	. Cheong, Bruno, Cheong (2012)

Mobile learning can be used in combination with traditional learning, as well as distance learning, ICT-assisted learning, which together allow for blended learning (Ciampa, 2014). The difference between mobile learning and other learning systems is the use of a mobile device as the main means of learning and access to resources (Traxler, 2010).

Studies (Diliberto-Macaluso, Hughe, 2016; El-Hussein, Cronje, 2010; Heflin, Shewmaker, Nguyen, 2017; Pereverzeva et al., 2020; Matraeva et al., 2020; Dorofeyev et al., 2018) emphasize that the entertainment functions of mobile devices fade into the background compared to educational areas of their application. As noted by F. MacNeill (2015), many mobile technologies are designed to improve learning and student engagement. The integration of mobile technologies in education and the use of mobile devices in the classroom is already a common traditional method in education. Some educational institutions produce special software for students' mobile devices and provide access to mobile web resources, course content, and specially created practical exercises (Stephens, Pantoja, 2016).

Almost all students have a smartphone with them. Research results (Foti, Mendez, 2014; Abdulaeva et al., 2017; Dudin et al., 2020) confirm the fact that 70% of students are more inclined to work using a mobile device than a computer or laptop. Therefore, mobile learning is seen as one of the best ways to increase teacher productivity and motivate students to learn.

Analysis of the literature revealed that the problem of mobile learning has not been solved and needs to be improved. In particular, the issue of identifying the main components of mobile learning, the positive and negative aspects of using mobile devices, identifying and overcoming the software and hardware difficulties of mobile learning, and the like, requires a solution.

The hypothesis of the study: mobile technologies allow introducing new forms of training organization, involving the interaction of learning subjects with each other not only during lessons but also outside them.

The objectives of the study:

1. To identify the main components of mobile learning, which ensure the effectiveness of the implementation of mobile technologies;
2. To determine the types of mobile content that can be used in the university educational process and analysis of each type;
3. To highlight the benefits and obstacles to implementing mobile learning.

Methods

Research Model

At the first stage, the sources of information necessary for the implementation of the research goal were selected.

At the second stage, considering the existing limitations in the application of the document analysis method (the quality of the selected sources, their completeness, and the subjective positions of the authors), we conducted an expert survey to assess the reliability of the selected sources, which included scientific (research) articles published in indexed journals Scopus and Web of Science over the past 10 years, and presentations at conferences by researchers from different countries.

The selection criteria for experts (25 people) were the presence of at least 3 articles on this topic published in journals included in the Scopus or Web of Science citation bases or at least 10 years of work experience in higher education institutions.

E-mails were sent to the experts with a list of sources to assess the reliability of the selected material in accordance with the research topic. The experts evaluated the list of sources on the Harrington scale.

The experts were given 20 calendar days to respond. The experts rated the selected documents at an average high level (according to the criterion of assessment on the Harrington scale, the "high" value starts from 0.64 to 0.8).

At the third stage, the information was processed and the results were interpreted.

Research Methods

In our study, we used the following research methods:

- Theoretical analysis of scientific and methodological literature to clarify the conceptual apparatus of the research, with regard to the definition of the term "mobile learning";
- Qualitative analysis to determine the types of mobile content that can be used in the university educational process;
- Systematization and generalization allow us to determine the advantages of mobile learning and obstacles to its application.

Results

Since mobile learning is used in a blended learning system in a higher education institution, it is assumed that e-learning is already being implemented as an integral component of blended learning. It is necessary to ensure the availability of the main components of mobile learning based on the existing e-learning model (Table 2).

Table 2 Main components of mobile learning

№	Main components	Content	Source
1	Educational and methodological support for the study of disciplines	adapted learning resources, mobile content, etc.	El-Hussein, Cronje (2010); MacNeill (2015); Sung, Chang, Liu (2016)
2	Mobile-oriented environment for placing educational resources of disciplines	adapted distance learning platform for mobile use	Ciampa (2014); Traxler (2010); Heflin, Shewmaker, Nguyen (2017); Stephens, Pantoja (2016)
3	Teaching staff who have provided training in the use of mobile technologies and mobile learning methods	professional development of the teaching staff	Martin, Ertzberger (2013); Cheong, Bruno, Cheong (2012); Diliberto-Macaluso, Hughe (2016); MacNeill (2015)
4	Technical support	each subject of training has a mobile device, wireless access to the Internet via Wi-Fi or mobile communication	Singh (2010); Cheong, Bruno, Cheong (2012); Sung, Chang, Liu (2016); Garcia, Welford, Smith (2016)

Today, all components are the subject of active discussion of scientists in the field of organizing mobile learning. In particular, educational and methodological support provides that the teacher has the necessary knowledge to create adapted mobile content and can provide the student with the necessary educational resources in a particular discipline (Liu, Li, Carlsson, 2010).

According to researchers, modern mobile devices can create the following types of content (Table 3).

Table 3 Types of content and its possibilities for use in training

№	Types of content	Source
1	Mobile site	Camilleri, Camilleri (2017); Martin, Ertzberger (2013); Diliberto-Macaluso, Hughe (2016); Garcia, Welford, Smith (2016)
2	Mobile app	Kukulska-Hulme (2013); El-Hussein, Cronje (2010); Foti, Mendez (2014); Wang, Higgins (2006)
3	Study apps for specific disciplines	Cheong, Bruno, Cheong (2012); El-Hussein, Cronje (2010); Foti, Mendez (2014); Sung, Chang, Liu, (2016)
4	Adapted electronic teaching aids	Singh (2010); Ciampa (2014); Ciampa (2014); Traxler (2010); Graham (2016)
5	Separate type of content	Cheong, Bruno, Cheong (2012); Ciampa (2014); Heflin, Shewmaker, Nguyen (2017); Garcia, Welford, Smith (2016)
6	Social media and user content	Traxler (2010); MacNeill (2015); Nesbit, O'steen, Bell (2014)
7	Unique mobile content (augmented reality)	El-Hussein, Cronje (2010); Heflin, Shewmaker, Nguyen (2017); Wang, Higgins (2006); Harrison, Flood, Duce (2013)

Educational and methodological support can be presented in various forms and types, which has a positive effect on the educational process as a whole.

The ability to present educational material by means of mobile technologies allows determining the benefits of mobile learning (Table 4).

Table 4 Benefits of mobile learning in providing learning material

№	Benefits	Source
1	efficiency of production and delivery of educational material	Pearce, Rice (2013); Camilleri, Camilleri (2017); Singh (2010); Traxler (2010)
2	flexibility of replication, providing for the distribution of material in any amount	Kukulska-Hulme (2013); Camilleri, Camilleri (2017); MacNeill (2015); Luna-Nevarez, McGovern (2018)
3	quick and constant access to training materials at any time	Diliberto-Macaluso, Hughe (2016); MacNeill (2015); Garcia, Welford, Smith (2016); Luna-Nevarez, McGovern (2018)
4	compatible work on educational materials using mobile applications (disk, calendar, documents, etc.)	Heflin, Shewmaker, Nguyen (2017); Stephens, Pantoja (2016); Foti, Mendez (2014); Graham (2016)
5	fixation of educational material by means of mobile devices (photographing, filming, recording, and listening to lectures)	Martin, Ertzberger (2013); Ciampa (2014); Diliberto-Macaluso, Hughe (2016); Liu, Li, Carlsson (2010)
6	dynamic generation of educational material depending on the location of the subjects of training, the content of the training, and the way of using the mobile device	Heflin, Shewmaker, Nguyen (2017); Liu, Li, Carlsson (2010); Nesbit, O'steen, Bell (2014)
7	using a mobile device as a library of educational resources	Cheong, Bruno, Cheong (2012); MacNeill (2015); Sung, Chang, Liu (2016); Nesbit, O'steen, Bell (2014)

Wide opportunities in the use of mobile devices also open up in the organization of communication and interaction of subjects of learning, in particular, the following advantages (Table 5).

Table 5 Advantages of mobile learning in organizing communication and interaction of learning subjects

№	Advantages	Source
1	subjects of the educational process can interact with each other "face to face", since mobile devices are small in size and allow free movement, unlike computer-based learning, when each subject of the educational process is "tied" to one place	Pearce, Rice (2013); Garcia, Welford, Smith (2016); Liu, Li, Carlsson (2010)
2	the ability to interact with both one student and the group as a whole	Stephens, Pantoja (2016); Wang, Higgins (2006); Graham (2016)
3	use of various mobile applications for organizing training sessions and communicating (Viber, Skype, WhatsApp, etc.)	Foti, Mendez (2014); Sung, Chang, Liu (2016); Harrison, Flood, Duce (2013)
4	the ability to communicate regardless of location and time	Diliberto-Macaluso, Hughe (2016); Liu, Li, Carlsson (2010); Harrison, Flood, Duce (2013)

These advantages generally affect the organization of the educational process and stimulate students to work. In particular, it is advisable to note such positive processes that occur when organizing mobile learning (Table 6).

Table 6 Positive processes in the organization of mobile learning

№	Positive processes	Sources
1	activation of educational and cognitive activities of those students who, prior to the use of mobile technologies, did not show interest in learning	Singh (2010); MacNeill (2015); Graham (2016)
2	the learning process becomes more individual when students have the opportunity to choose the content of the study, considering their interests. Such learning becomes student-centered	El-Hussein, Cronje (2010); Heflin, Shewmaker, Nguyen (2017); Luna-Nevarez, McGovern (2018)
3	increasing the productivity of educational work due to flexibility and quick access to educational resources	Camilleri, Camilleri (2017); Ciampa (2014); Diliberto-Macaluso, Hughe (2016)
4	wide opportunities for organizing self-study	Stephens, Pantoja (2016); Garcia, Welford, Smith (2016); Nesbit, O'steen, Bell (2014)
5	the possibility of implementing blended learning	Heflin, Shewmaker, Nguyen (2017); Harrison, Flood, Duce (2013); Luna-Nevarez, McGovern (2018)
6	increased interactivity of training	MacNeill (2015); Foti, Mendez (2014); Harrison, Flood, Duce (2013)

Discussion

Now, we will analyze each type of content and its possibilities for training.

Using a *mobile site* is by far the most common way to access educational materials. It can be a regular site built by means of a specific content management system (Joomla!, WordPress, etc.), a teacher's personal blog, or a distance learning platform (Stephens, Pantoja, 2016). Such sites use simplified methods of displaying educational information adapted to mobile devices and are not burdened with additional functionality (Cheong, Bruno, Cheong, 2012).

The mobile app is the main software used on smartphones, tablets, and other mobile devices. In addition to the basic system apps that are installed by default on the user's mobile device, it is possible to download additional apps from online stores (App Store, Google Play, Windows Phone Store, and others), free of charge or for a fee (MacNeill,

2015). Mobile apps allow one to quickly check e-mail, view mobile content, communicate with other people using various instant messengers, etc. (Garcia, Welford, Smith, 2016). A feature of educational mobile apps, in addition to educational content, is a notification system (a reminder to work) and the ability to work offline (individual components of the mobile app are downloaded to the phone and one can work with them) (Liu, Li, Carlsson, 2010).

Educational apps for individual disciplines are very rarely created since for this the teacher needs to know the corresponding programming language. However, it is possible to use ready-made apps for organizing training – informational (informing students about important events), communication (communication and organizing various types of communication – seminars, conferences, etc.), mobile versions of computer software (browser, text, tabular, graphic, video and other editors), calendars (to create a general training plan), etc. (Singh, 2010).

The use of *adapted electronic educational tools* is not yet a very common type of content, as it requires certain skills from the teacher, who is a potential developer, but is not an IT professional. However, confident PC users can easily create such an electronic tool in the form of an electronic textbook or manual and place the necessary elements in it – text, graphics, formulas, videos, etc. (Diliberto-Macaluso, Hughe, 2016). The difficulty lies in the development of more complex tools that are implemented using interactive elements, such as tests or feedback (Traxler, 2010).

A separate type of content. Modern mobile devices can reproduce almost all types of information – text, graphics, sound, video, animation, etc. Therefore, the teacher can prepare in advance a set of educational materials that the student can use both during classes in the classroom and during an independent study (Graham, 2016). The greatest value is multimedia materials because they have a positive effect on the perception of educational information.

Social networks and user content. Any popular social network has its own implementation for mobile devices. Despite the entertainment functions, social media can be used in teaching. They allow to quickly exchange data; teachers can submit various kinds of educational material or report important events and students – their own developments for general consideration, etc. (Harrison, Flood, Duce, 2013).

To implement *unique mobile content* (augmented reality), a special program is installed on a mobile phone, which supplements the image of a real object with the necessary

virtual objects (video and audio materials, 3D models, text content, etc.) and displays them on the mobile phone screen (Foti, Mendez, 2014). The app first finds and identifies the object and then displays the virtual objects. The process of creating augmented reality takes place using a video camera of a mobile device (Traxler, 2010). All virtual objects are located in the cloud and called in the process of recognizing the real object to which they belong (Kukulska-Hulme, 2013).

Despite the significant advantages of mobile learning (Tables 3-5), educational institutions do not hurry to use smartphones and mobile learning technologies to improve the quality of education. Educators who are trying to implement mobile learning are concerned about the stability of the Wi-Fi network, problems related to IT security, the implementation of technological infrastructure, etc. (Wang, Higgins, 2006).

Although the use of mobile devices has increased significantly among students, most of them continue to work with a computer or laptop, since almost all educational resources are focused on these devices and specific implementations for mobile platforms exist in small numbers (Nesbit, O'steen, Bell, 2014).

Along with the wide possibilities of using mobile technologies, it is advisable to note some obstacles to their use. In particular, this applies to the software and hardware (Table 7).

Table 7 Hardware and software obstacles to mobile learning

№	Obstacle	Source
1	small screen sizes limit the type and amount of information displayed. Although this disadvantage can be interpreted as an advantage since the amount of information could be dosed and information in a small amount is better remembered	MacNeill (2015); Sung, Chang, Liu (2016)
2	limited phone memory, so not all content can be saved. One can solve the problem by partially hosting training resources in the cloud	Sung, Chang, Liu (2016); Liu, Li, Carlsson (2010)
3	smartphone battery life is quickly consumed, and one needs to provide for the ability to recharge the device	Diliberto-Macaluso, Hughe (2016); Heflin, Shewmaker, Nguyen (2017)
4	the rapid development of technology leads to the obsolescence of technology, including mobile devices	Nesbit, O'steen, Bell (2014); Luna-Nevarez, McGovern (2018)
5	decrease in network bandwidth when a large number of users are using mobile devices at the same time	Heflin, Shewmaker, Nguyen (2017); Garcia, Welford, Smith (2016)
6	low speed of data transmission by means of mobile communication	MacNeill (2015); Graham (2016)
7	the need to adapt the LMS system to the capabilities of mobile devices	MacNeill (2015); Graham (2016)
8	not all software tools can be implemented and effectively used in a mobile phone	Martin, Ertzberger (2013); Heflin, Shewmaker, Nguyen (2017)

Conclusion

The results of the study confirmed the hypothesis that mobile technologies allow introducing new forms of organization of education, involving the interaction of subjects of learning with each other not only during lessons but also outside them.

Instant delivery of educational material helps to increase student productivity, and the use of a mobile device and a large amount of interactive educational material enhances educational and cognitive activities. Compactness, small size, and wireless access to the learning environment allow students to be online almost constantly and regardless of location. Therefore, we can only talk about the positive impact of mobile technologies on the organization of the educational process. However, it should always be borne in mind that the use of any teaching technology and the use of information and communication tools should be pedagogically balanced.

Further research can be aimed at preparing content for mobile devices, assessing the quality of educational resources, and building a methodological system for mobile learning in specific disciplines.

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