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BUSINESS AND EDUCATION**

**Proceedings of the International Conference
dedicated to the
50th anniversary
of the Department of Informatics**

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FOREWORD

These proceedings contain the papers of the International Conference “Information and Communication Technologies in Business and Education” which took place at the University of Economics – Varna, Bulgaria, 18 October 2019.

The international scientific conference is dedicated to the **50th anniversary of the Department of Informatics at the University of Economics – Varna**. The conference is also dedicated to the 100th anniversary of the University. The included papers describe recent scientific and practical developments in the field of information and communication technologies, information systems, and their applications in business and education.

The papers in the Proceedings are peer reviewed and are checked for plagiarism.

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M-LEARNING APPLICATIONS

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Abstract

The expansion of mobile technologies and their wider usage are transforming the process of e-learning into m-learning. The purpose of the article is to analyze the popular m-learning applications, to highlight their basic features and to outline the basic requirements for their development. Based on the current state of mobile phone market share the object of the research is Android learning apps. The applied approach includes analysis of the ten most popular m-learning applications. The results of the study show that all of the reviewed applications have a version for Android and for iOS operating systems. However, most of them are not typical m-learning applications, but rather they are e-learning libraries. In this regard, there is a need to find a way that more quickly introduce new learning approaches including the active use of mobile devices and applications in the learning process. First step must be to define a comprehensive framework for development of m-learning applications.

Keywords: *mobile learning, mobile applications, mobile technologies.*

INTRODUCTION

The use of mobile technologies in education is not a new concept. The active development in this area is for almost 20 years. One of the first publications in this scientific field, which is cited by a number of authors – “m-learning: Mobile, Wireless, In-Your-Pocket Learning”, has been published in 2000 (Quinn, 2000). This year is also associated with the generation Z¹. The representatives of this generation are surrounded by technology throughout their whole life and it is neither logical, nor useful to exclude this technology from the learning process. Therefore, these days the number of e-learning resources provided through content management platforms is very high. The access to these platforms is

¹ Generation Z – those born from the mid-1990s to the early 2000s.

established not only from desktop computers and laptops, but also from mobile devices. The learners are provided with educational materials in different formats – text, images, audio, video, etc. But this approach is not interactive enough and leads to limited interaction between learners and educators. Forums, chats, polls and tests, which are usually part of mobile learning platforms, are commonly used to improve communication and to provide better feedback. With the development of technology, mobile devices have improved their technical parameters. This in turn is a prerequisite for the creation of m-learning applications with rich functionality, attractive design and easy-to-use interface.

1. M-LEARNING APPLICATIONS DEVELOPMENT

Back in 2005, Traxler gave the following definition of m-learning: “any educational provision where the sole or dominant technologies are handheld or palmtop devices” (Traxler, 2005). With the development of technology, this definition still remains relevant: “m-learning is the use of mobile technology to make learning materials accessible and effective at a time and place convenient to the learner” (E-learning center, 2019). From the definition given nearly 15 years later, it becomes clear that the learner is already at the center of mobile learning, that he is getting used to working with mobile devices and to using more intuitive mobile applications.

In this paper, mobile applications are considered as application software intended for use on mobile devices such as smartphones and tablets. This type of software is tailored to the specific features of mobile devices and its market share is growing significantly. On the other hand, the development of mobile learning is leading to the development of m-learning applications. They are more often used in the learning process and are inherently the introduction of new learning methods. M-learning application advantages are generally:

- easier access to learning materials;
- synthesized learning materials²;
- provision of learning materials in a more accessible way – with many examples, illustrations, effects;

² The volume of learning units in m-learning is significantly smaller than that of e-learning materials.

- no need of print resources;
- significantly reduced time and effort required to search the needed information;
- facilitated communication between learners and educators;
- significantly better awareness of the learners.

The usage of such applications makes the learning process more accessible, more interesting and more engaging for the learners.

The development of m-learning applications is not an easy task. Lots of researchers, such as (Pastore, 2014), look in detail and analyze the advantages and disadvantages of the basic development approaches – native, web or hybrid applications. Generally, native applications are developed for a specific mobile platform (operating system). This allows the application to use the full functionality of the device on which it works but limits it to work only on the platform for which it is created. In contrast, web applications are used through a mobile web browser and have no restrictions on the type of the platform on which they will be used. However, they do not fully exploit the capabilities of the mobile devices. To overcome these drawbacks, hybrid applications could be used. They transform web applications into native applications. All three approaches have both advantages and disadvantages. In order to select the most suitable one for the development of a particular application, it is necessary to conduct a survey among the potential users. It should start with the type of mobile devices and their operating system.

The statistical data (Newzoo, 2018) shows that there is an increasing use of mobile devices, and in particular of mobile phones – in 2016 worldwide smartphone users are 2.5 billion. It is estimated that by 2021 this number will reach 3.8 billion. On the other hand, the results of different mobile phone market researches show a steady dominance of Android OS over iOS devices. The tendencies are these two operating systems to be the most used (fig. 1).

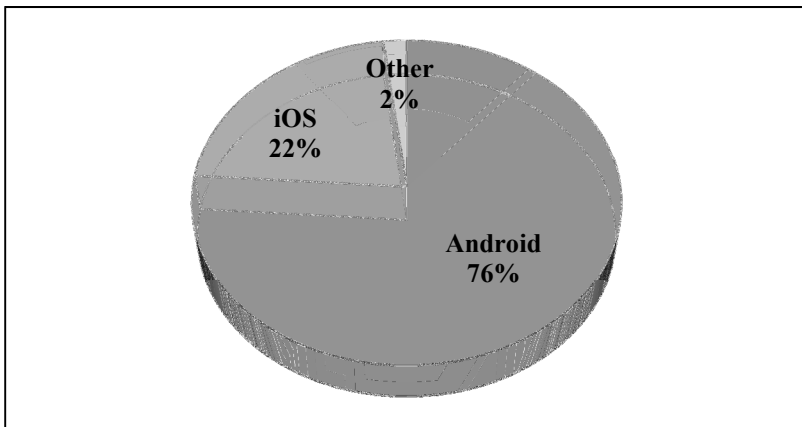


Figure 1. Mobile Operating System Market Share Worldwide (July, 2019)

Source: Statcounter, Mobile Operating System Market Share Worldwide (July 2018 – July 2019), <https://gs.statcounter.com/os-market-share/mobile/worldwide/> [Accessed 26/08/2019]

These data indicate that m-learning applications should be created in such way that they can function equally well on these both operating systems. Examples of development tools that can be used for this purpose are PhoneGap, Appcelerator Titanium and RhoMobile suite.

Currently, mobile application users could choose to download between 2.46 million applications from Google Play (Statista, 2019), and almost 1.96 million available applications in Apple's App Store (Statista, 2019). With such a large number of applications, it is important to meet user expectations in order to convince a certain user to use one application instead another. If the application is not meeting user expectations, he can easily remove it from his device and download another one. These expectations are related both to the functionality of the applications and to the user experience. Therefore, creating useful and user-friendly applications is a difficult task. In their study Sulova and Nacheva (Sulova, Nacheva, 2018) conclude that the successful implementation of the UX strategy depends directly on the study of the target audience of the digital service or the software product as a whole. This is

due to the fact that the potential users are very different – they differ in gender, age, education, interests, nationality, etc.

2. BASIC FEATURES OF M-LEARNING APPLICATIONS

In this research paper we analyze existing m-learning applications in the market and explore their basic features. Undoubtedly, all of them have features such as flexibility, collaboration, motivation, accessibility, portability (Color, Atagan, 2009), efficiency, learnability, satisfaction, effectiveness and accessibility (Alotaibi, 2017) because they are crucial for the quality of this kind of software applications.

In order to facilitate any analysis, it is important to classify in advance the studied objects. However, this is a difficult task in terms of m-learning applications. One possible classification could be based on the right of use – free or paid, but it does not help to better analyze this kind of applications. Another very general classification is proposed by Mary Brown (Brown, 2014) and it has the following groups:

- Science Educational Apps – applications related to education in physics, biology or mathematics;
- Apps for Language Learning – support foreign language learning;
- Apps for Dyslexic students – for learners with Dyslexia and other learning disabilities;
- Apps for classroom education – support classroom learning;
- Apps for educators – help the development of educators;
- Learning apps for kids and elementary school – target the youngest users of mobile devices.

However, the available internet rankings do not include a breakdown by the aforementioned categories. There, applications are most often divided by subject area or mobile platform for which they are developed.

Most of the applications listed in a certain ranking, as well as those with similar functionality, are also found in many other similar rankings.

Table 1 presents the leading applications (Android Authority, 2019), the operating system for which they are developed and the area of specialization (subject area for which they are intended).

Table 1

Features of leading m-learning applications

Application	Mobile OS	Specialization
Amazon Kindle	iOS, Android	No
Coursera	iOS, Android	No
Khan Academy	iOS, Android	No
LinkedIn Learning	iOS, Android	No
Udemy	iOS, Android	No
Wolfram Alpha	iOS, Android, Windows ³	No
YouTube	iOS, Android	No
Duolingo	iOS, Android, Windows	Language learning
PhotoMath	iOS, Android	Math Problems
SoloLearn	iOS, Android	Coding learning

Back in 2013, a study conducted by Setiabudi and Tjahyana (Setiabudi, Tjahyana, 2013) among students from the Petra Christian University from the Informatics Department showed that 100% of the respondents use their mobile phones to download study materials. This indicates that mobile phones are used in education mostly for this purpose. It is also evidenced by the analysis of the main features of the presented applications – 70% is the share of m-learning applications that provide educational materials in the form of books, courses, videos. These are *Amazon Kindle*, *Coursera*, *Khan Academy*, *LinkedIn Learning*, *Udemy*, *Wolfram Alpha*, *YouTube*. The learning materials available in them are not limited to a specific subject area.

Coursera is a platform that provides a large number of courses accessible through mobile devices. The courses are organized into 11 main categories. Another popular platform similar to *Coursera* is *edX*. The number of courses in it is over 2500, organized in 30 thematic areas. It is also available for iOS and Android. In both platforms, the provided courses are developed by leading educational institutions.

³ Some of the courses do not support all operating systems.

The mobile application *Udemy* provides over 100,000 educational courses in 13 general categories. Since the number of courses is very large, after selecting a course category, the user can test his knowledge and on the basis of the result, he is offered with the most suitable courses in the selected category.

The application *Khan Academy* provides access to courses created by specialists in their respective subject areas. They are more specialized than those in *Coursera* and *edX*. *Khan Academy* is similar to the application *LinkedIn Learning*, which gives access to over 13,000 courses.

Wolfram Alpha contains a number of mobile applications providing deep computational knowledge in specific educational, professional, and personal areas.

Amazon Kindle is an application that provides access to over six million Kindle books. It has a very similar functionality to this in *Google Books*.

The application *SoloLearn* is more specific than the ones discussed above. It includes a set of 13 programming training courses. The lessons in every course are organized into modules. Each module ends with a test of the acquired knowledge.

However, with the development of technology, the share of specialized m-learning applications such as *Duolingo* and *PhotoMath* is expected to grow. They have features such as personalized experience, higher engagement level and notifications.

Applications related to language education (such as *Duolingo*) are being actively developed. They have specific functions that are required when learning a foreign language: determining the level of the learner; providing lessons (tailored to this level), exercises, task assessment and feedback.

PhotoMath is an application that not only provides math tutorials through many examples but also gives learner the opportunity to solve problems that are printed or handwritten. It is an example of an application that uses the basic functionality of mobile devices – the camera.

The widespread usage of mobile devices running Android and iOS has inevitably influenced the creation of m-learning applications. All of the applications reviewed have a version for both operating systems.

However, most of them are not typical m-learning applications, but rather they are e-learning libraries.

The real m-learning applications should have the following capabilities:

- online and offline access to learning units;
- optimized learning materials for small screens;
- bite-size tutorials;
- automatically synchronizes user activity across devices;
- enhanced interaction;
- immediate feedback;
- track course histories and progress;
- students must be engaged before, during and after class;
- entertainment.

These features are rather technological and are crucial to the imposition of one application over another. Therefore, they are more often taken into account.

The educational value of the learning content included in the m-learning applications should also not be forgotten. In the development of e-learning units it is not enough the participation of IT professionals. The importance of the educators, the people who prepare the curriculum and the regulation of intellectual property rights is enormous. For example, reducing the volume of the offered material compared to e-learning units should not be at the expense of missing out on important topics, but rather by synthesizing the main points. This cannot be accomplished without the help of the educators leading the certain course.

Research shows also that developers of modern m-learning applications are increasingly relying on the inclusion of artificial intelligence and augmented reality in their applications. In general, their purpose is to generate innovation in schools, offer new and different possibilities in the teaching and learning process, and help students to better understand content and information (Sonego, Machado, Torrezan, Behar, 2016).

CONCLUSION

The development of technology and the active usage of smartphones in everyday life require working towards a major change in the traditional education process. The millennium generation that is now starting university is "addicted" to mobile devices and they cannot be

excluded from their daily routine, in which is included the learning process. Therefore, there is a need to find a way that more quickly introduce new learning approaches including the active use of mobile devices. To this end, educators' training should be considered in order to take full advantage of the capabilities of modern mobile devices (in particular smartphones). In addition, educators should be actively involved in the process of creating m-learning applications in specific courses.

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