Developing a Mobile Application "Educational Process Remote Management System" on the Android Operating System

Gulmira M. Abildinova[a], Aitugan K. Alzhanov[a], Nazira N. Ospanova[b], Zhymatay Taybaldieva[c], Dametken S. Baigojanova[a] and Nikita O. Pashovkin[a]

[a]L. N. Gumilyov Eurasian National University, Astana, KAZAKHSTAN; [b]S. Toraighyrov Pavlodar State University, Pavlodar, KAZAKHSTAN; [c]Zhetysu State University named after Ilyas Zhansugurov, Taldykurgan, KAZAKHSTAN

ABSTRACT

Nowadays, when there is a need to introduce various innovations into the educational process, most efforts are aimed at simplifying the learning process. To that end, electronic textbooks, testing systems and other software is being developed. Most of them are intended to run on personal computers with limited mobility. Smart education is currently very relevant. Therefore, it is necessary to develop a software package that would simplify the learning process in secondary and high schools. The mobile application under consideration was developed on the Android operating system, given the extensive use of mobile devices and a convenient application development toolkit. This mobile application can simplify the students' acquisition of information that is required for an effective educational process. The mobile application reaches a wide audience that includes both students and teachers of various disciplines. A pedagogical experiment was conducted as part of this research at the S. Toraighyrov Pavlodar State University; the experiment proved the need for and effectiveness of the developed mobile application in the field of education. The software can be used in educational institutions; it can simplify the organization of the educational process significantly.

Introduction

With the creation of the Internet, its further development, and increase of access speed, the technical equipment for distance education has taken a great step forward. The current pace of life forces people always to have access to all the necessary information. Therefore, the efforts of all engineering scientists were aimed at reducing the size of electronic devices, with a view to enabling carrying the device without being encumbered by its size. The field of education is also improving: new didactic means of teaching are being developed, while innovative methods change the content and trajectory of learning.

CORRESPONDENCE Gulmira M. Abildinova ✉ gulmira_2181@mail.ru

Mobile learning is a complex research subject due to its distinguishing features when compared to conventional education (Roudaki, Kong & Yu, 2015; Stark, 2008). Its advantages for education are as follows (Fulantelli, Taibi & Arrigo, 2015):

– accessibility: the use of inexpensive routine technologies; the possibility of learning at one's own pace and confidentially, which may be impossible when using a computer or other equipment that belongs to other persons; good support for popular ways of interaction, for instance, mobile access to audio materials or social networks (Darcey & Conder, 2012);

– compliance with learning demands: access to additional academic and scientific resources through podcasts or free learning material (for instance, OpenLearn) (Deitel et al., 2012);

– support of communication: possibility for students to share their impressions of the learning process instantly; assessment and diagnostics of possible learning problems; psychological support of students via social networks or with a personal mentor (Goloshchapov, 2012).

Literature review

I. Plaza et al. (2011) studied the peculiarities of mobile learning for elderly people. Mobile phones are a technology that has become a part of everyday life; it improves the effectiveness and accessibility of learning. Another research (Shuiba, Shamshirbandb & Ismai, 2015; Cheona et al., 2012) analyzed the scientific, methodological and educational literature, standards and programs related to the problem of remote management of the educational process, developed software, and academic and organizational support systems for remote management of the educational process.

Students are interested in using mobile devices at the university (Gikas & Grant, 2013; Pashovkin, 2014). Using mobile applications in education will give students constant access to the learning material. M. Kearney, K. Burden & T. Rai (2015) and M. Simkova, H. Tomaskova & Z. Nemcova (2012) studied the use of mobile technologies in teaching. The distinguishing pedagogical features of mobile learning were investigated – cooperation, personalization, and authenticity. The analysis shows that teachers and students are interested in the possibility of using mobile devices at the university. The policy of mobile information and communication technologies sets the course for the support of information systems.

Ch. Emmanouilidis, R.-A. Koutsiamanis & A. Tasidou (2013) studied certain aspects of mobile applications, including the realization of context, architectural and technological issues of their implementation.

Mobile Learning or M-learning is learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton 2013). E-learning is defined as an educational process for information technology support. M-learning can then be regarded as an expanded form of e-learning, where this form of education is used to support mobile computing and communication devices (Simkova, Tomaskova & Nemcova, 2012).

Learning Management System for Mobile Learning or M-learning includes the following modules: registration and management of students, accounting and management of courses, a catalog of academic courses and facilities,

management of syllabuses, registration of students' grades, testing and assessment of students, rights management, communication tools, authoring tools for creating training courses and learning objects, and repositories of content (Simkova, Tomaskova & Nemcova, 2012; Darcey & Conder, 2012).

Aim of the Study

To investigate the necessity of implementing an E-learning system in education.

Research questions

How are mobile applications developed?

How can a mobile application improve education?

Method

The research used a set of complementary methods, including:

– Theoretical methods: study and analysis of scientific and methodological literature on the research subject.

– General logic methods (modeling, comparison). Study and generalization of experience in the research problem. Methods defined by the information paradigm.

– Empirical methods. Development of a mobile application on the Android operation system, with a view to improving the quality of education.

Data, Analysis, and Results

Mobile applications are developed in special development environments. The recommended multifunctional development environment is "Eclipse" with an installed "Android Development Tools" plugin. A recent alternative to this environment is "Android Studio", which is supported directly by Google. This plugin contains all necessary tools that may be required to develop various mobile application. Native mobile applications are generally developed in the Java object-oriented programming language. The XML markup language was used for the visual component and certain other aspects. In order to define the role of XML in the development, one can describe the functions of the manifest file. It describes the connections between various Activities, identifies the functions of any specific application, invokes applications when a user runs a certain file type, and indicates all the permissions, required for the application to run properly (Pashovkin, 2014). A more detailed classification of webpage view on mobile devices can be found in the research of J. Simon (2011). Android web applications, like all websites, are developed in HTLM and JavaScript with the use the Software Development Kit (SDK). The Google Play store may be used to distribute the application. Since the mobile application is executed in the Dalvik virtual machine, and since the Android operating system is based on the Linux kernel, each process is generally limited to sixteen megabytes of RAM (Darcey & Conder, 2012; Goloshchapov, 2013). The user interface screen of the mobile application is an Activity class. Each class generally has a dedicated XML file that determines the Activity appearance. These Activities mostly continue running even after the termination of the process that is responsible for their operation. Each Activity can be assigned a function via Intent. If a certain function has to be performed at a certain moment, the mobile device will scan

the applications and determine the suitable ones (Hashimi, Komatineni & MacLean, 2011). Content providers and the SQLite embedded relational database management system are used to exchange data between mobile applications and Activities.

Any mobile application has to have a visual design and display certain graphical information. As previously noted, a mobile application that is developed for the Android operating system consists of windows, called Activities. Only one Activity can be active at any given time, i.e. only one can displayed by the mobile device. Other Activities that were launched previously, but were not terminated, are paused and can be restored at any time without losing information (Darcey & Conder, 2012). Creating a separate class with an android.app.Activity superclass is necessary for the operation and display of the Activity. On launch, this class will invoke a layout file with an .xml extension. This is possible due to the setContentView method. However, before invoking the Activity, it is necessary write it down in the AndroidManifext.xml manifest file (Deitel et al., 2012). The file contains all the information about the application and, when installed, requests permissions to use various resources. For instance, a manifest file can request permission to use the Internet connection, GPS data, user data, etc.

All View Objects are located in a ViewGroup. Layouts generally act as ViewGroups. A Layout is responsible for the arrangement of Views in Activities. There are many layout types, each having a View according to different concepts (Table 1).

Table 1. Layout types

Types	Description
LinearLayout	ViewGroup is the "ancestor" of other layout types. When creating new Activities, it is this layout that provides the most convenient and flexible arrangement of views on the activity screen. LinearLayout has the Orientation parameter. By nesting LinerLayouts into each other, one can create a convenient interface with minimum effort required.
TableLayout	This layout arranges all View Objects as a table; therefore, it is necessary to indicate beforehand the number of rows and columns into which the layout will be divided. TableLayout forms columns by means of views.
RelativeLayout	This layout allows arranging View Objects in Activities in relation to other components.
AbsoluteLayout	This layout allows positioning a component across the entire screen, i.e. it is possible to position a component only by indicating its coordinates.

Once the objects are arranged on the screen of the mobile application and the resource file that contains the template for the object's appearance is assigned, it is necessary to assign Actions to these objects. All processes and tasks that a View Object has to perform are described in the same class that invokes an activity from the XML file (Goloshchapov, 2012). Before working with the object, it is necessary to describe the methods beyond methods. The spot before the onCreate method is ideal for describing objects. This way, it will be possible to refer to these views from any method.

The Parse cloud backend is responsible for the entire server component of the mobile application. This backend is currently among the leading cloud backends for mobile platforms.

Parse is a cloud backend for working with mobile applications, including those written for the Android operating system. Parse offers a remote storage service and processing of various data. Parse enables mobile application developers to solve several problems at once. For instance, a developer using Parse does not have to install his or her own servers. This saves money on the development and support of the mobile application. In addition, Parse solves the problem of storing user information. The service itself is responsible for the authentication process. Parse is used to process transactions from mobile devices. Furthermore, Parse enables easily sending push notifications to all registered users.

At present, more than 60,000 mobile applications function with the help of Parse. When working on a free basis, the developer has 30 requests per second. Calculations show that the number of requests with a free tariff can be about 70 million requests per month. This number can be increased by switching to a paid tariff. Every 10 additional requests per second will cost $100.

Other limitations besides the number of requests per second apply to the free tariff. The data and file storage limit is 20 gigabytes. Each additional gigabyte costs 3 cents. The data transfer limit between the service and mobile devices is two terabytes.

The push notification limit is 1 million. Most mobile applications can function under such limitations, since exceeding them is quite difficult.

The developed mobile application for remote management of the educational process includes the following functions:

1. Provision of general information regarding the schedule and detailed information regarding the schedule of a certain class or group, of which the mobile application user is a member. The application is arranged as a list that will load as the mobile device connects to the server that hosts the database. Information is downloaded from JSON databases containing the schedule of a group. When the user goes to this Activity, he or she is offered to choose from a list of the days of the week. When a user selects a day, the application will display the schedule for that day. Besides the name of the discipline, the application will also display the numbers of classrooms, in which the lessons will be held.

2. Provision of information regarding upcoming events in the news section. This function is provided by an Activity that displays information on the extracurricular events held by the educational institution.

3. Grading and subsequent provision of information about the current academic performance, which displays respective information in the "Grades" section.

4. Input of homework into the database by teachers and subsequent display of this information to the students. A number of classes that are responsible for synchronizing data with the server was created to assure that reliable information is displayed. When the user goes to this Activity, he or she is offered to choose from a list of the days of the week. When a user selects a day, the application will display the homework for that day. This Activity makes finding

out and doing homework easier. The function that is performed by this Activity enables fully abandoning class registers and grade books.

The application also enables taking exams, which are uploaded by teachers to the server. After the exams are uploaded, the student can take them and receive an appropriate grade. Such exams can be in the form of either tests or detailed answers to questions.

Each activity has its own functions. The user can go to these Activities from the main menu Activity, which can be accessed from the authentication and authorization Activity. To do so, one has to enter the login and password, contained in the database.

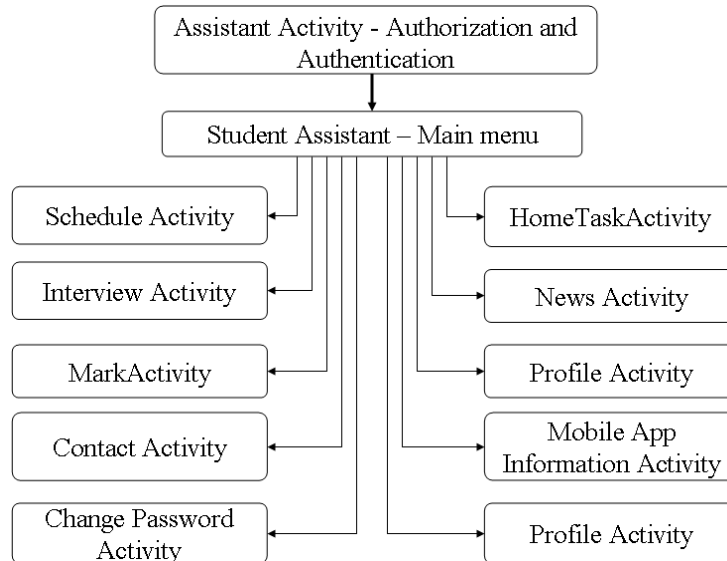A detailed description of the Activity structure is provided in Figure 2.

Figure 2. The Activity structure of the mobile application

In order to implement the user authentication system, it is necessary to use authentication system elements. The authorization Activity became the starting screen of the "Educational Process Remote Management System" mobile application. LinearLayout was used as the ViewGroup in this Activity, since it is easy to use and effective in this situation. View Objects were then arranged inside the LinearLayout. These included TextView, EditText, CheckBox and a button, to which the OnClickListener event handler will be assigned. In order to add new string constants to the application project, it is necessary to find the "res" folder among the project folders. This folder contains all the resources used by the application, such as the values of string constants, and graphical images (Kolisnichenko, 2013).

The user can access all the functions of the application from the main menu Activity (Figure 3). This Activity has a number of buttons that upon being tapped send the user to an Activity with specific functions.
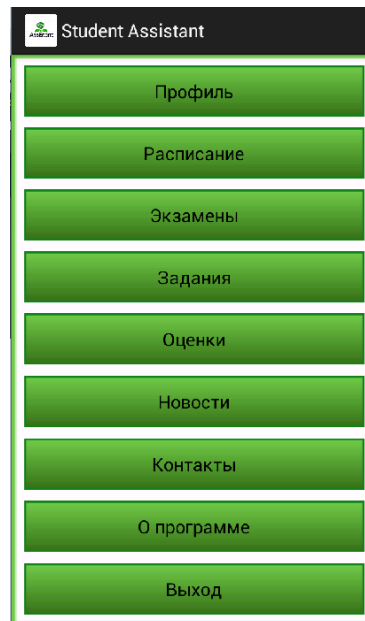
Figure 3. Main menu of the mobile application for users with "Student" level access

This Activity features Button-type View Objects in accordance with the Activity structure of the mobile application (Figure 2):

1) *Profile Activity*, which allows the registered mobile device user to access information, such as surname, name, patronymic name, age, educational institution, faculty, department, year, specialization or, in case of secondary education, group (class).

2) *Schedule Activity* (Figure 4) provides information about the schedule of the user's group or class. The information is downloaded directly from the databases that contain the schedule of the group. When the user goes to this Activity, he or she is offered to choose from a list of the days of the week. When a user selects a day, the application will display the schedule for that day. Besides the name of the discipline, the application will also display the numbers of classrooms, in which the lessons will be held.
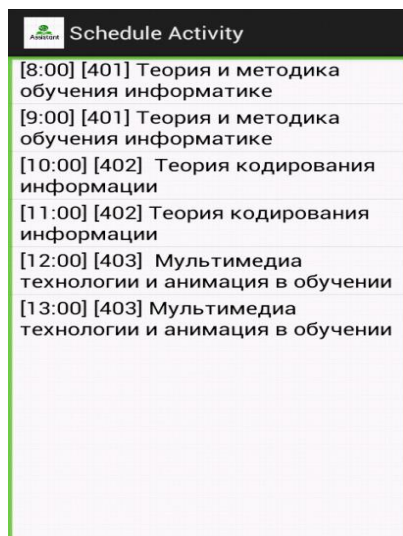
Figure 4. Example of the Schedule Activity of the "Educational Process Remote Management System" mobile application for Android

3) HomeTask Activity (Figure 5) provides information about homework. When the user goes to this Activity, he or she is offered to choose from a list of the days of the week. When a user selects a day, the application will display the homework for that day.
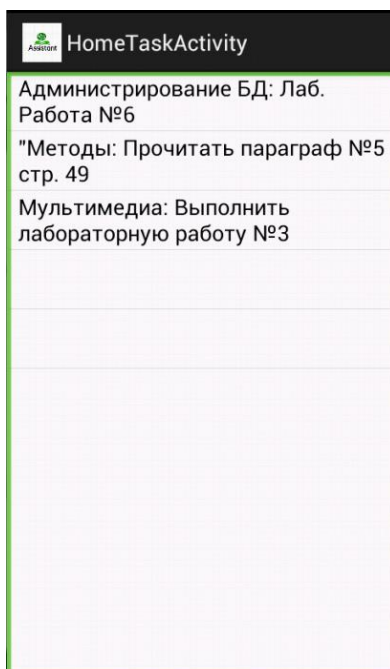

Figure 5. Example of the HomeTask Activity of the "Educational Process Remote Management System" mobile application for Android

4) *Mark Activity* (Figure 6) provides information about grades. The user is shown a list of disciplines. When the user selects a discipline, he or she is shown

a list of grades in this discipline. The grades will be shown starting with the date on which the system was accessed the last time. All the data are synchronized with the server, which loads information about the student's academic performance.
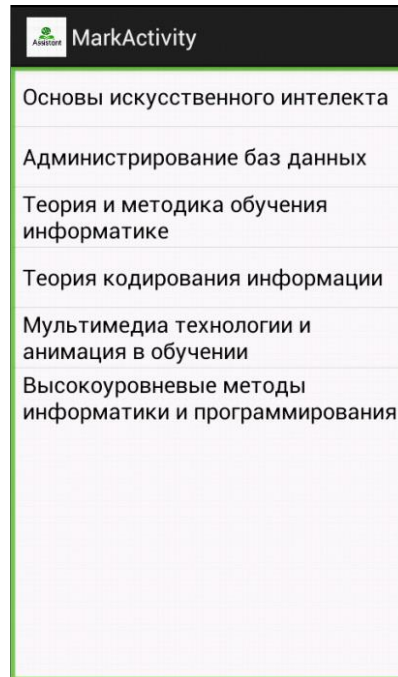

Figure 6. Example of the Mark Activity of the "Educational Process Remote Management System" mobile application for Android

5) *Interview Activity* (Figure 7) allows doing various surveys. The surveys include a number of questions with answer options. The answers can be given by inputting data into JSON tables, wherefrom they are read by the application.
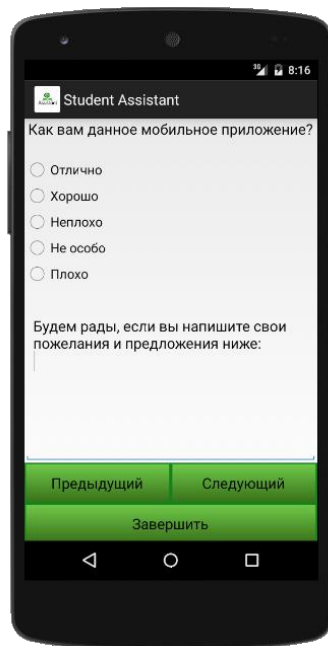
Figure 6. Example of the Interview Activity of the "Educational Process Remote Management System" mobile application for Android

6) *Assessment Activity* assesses students' knowledge through testing.

The mobile application under consideration can be used by various educational institutions. The mobile application was developed using a version control system. This enabled using the modular method that is intended for the development mobile applications with various modules, which may operate alongside the development and operation of other modules. Despite the complexity of the mobile application development, the modular approach allowed simplifying the process.

In order to implement the user authentication system, it is necessary to use authentication system elements. The authorization Activity became the starting screen of the "Educational Process Remote Management System" mobile application. LinearLayout was used as the ViewGroup in this Activity, since it is easy to use and effective in this situation. View Objects were then arranged inside the LinearLayout. These included TextView, EditText, CheckBox and a button, to which the OnClickListener event handler will be assigned. In order to add new string constants to the application project, it is necessary to find the "res" folder among the project folders. This folder contains all the resources used by the application, such as the values of string constants, and graphical images (Kolisnichenko, 2013).

Testing the mobile application

Testing is an integral part of any software development. Testing the application before launching and distributing it helps to prevent many problems for end users. The end user is willing to purchase and install only the software that works without crashing and has an intuitive interface.

Mobile application testing differs considerably from the testing of software that is intended to run on personal computers. Numerous requirements emerge during the testing of mobile application.

Testing the operating system updates. Unlike the developers of operating systems for personal computers, Google updates its operating system on a regular basis. Furthermore, unlike Windows and Linux updates, these updates can have a considerable effect on application development. Devices that run an older version of the operating system can either not support a part of the mobile application's functions or not support the application altogether (Ledford, Zimmerly & Amirthalingam, 2009).

Therefore, it is necessary to update the software at least when Android operating system updates are launched. It is advisable to set the application to automatic updating once the device is connected to the Internet.

If the application is developed for users of different countries and nationalities, it should be tested for the required language packs. For instance, in order to expand the audience and distribution of the application in Kazakhstan, it is necessary to develop the project in two languages – Russian and Kazakh. Due to the presence of several language packs, it is necessary to ensure the correct display of text information in View Objects.

Random testing of the mobile application. This allows preventing an unwanted reaction of the mobile application to various user actions.

Cross-platform and cross-device testing. This type of testing is required for the mobile application to run properly on different mobile device configurations. This testing is intended to discover various problems related to the variety of mobile devices with radically different specifications, operating systems, screen resolutions, and functionality. This type of testing is the most difficult one, but it is necessary for the mobile application to reach the most users.

Laboratory testing of the mobile application. When performing this type of testing, the developer has to test various conditions, in which the mobile application may be used. These include various Wi-Fi signal strengths, different network connection types, and different user's balances.

Problems that have to be solved during testing.

1. Screen parameters and mobile application interface:

The mobile application was tested for the absence of activities that do not indicate the list of actions that the user can perform (Murphy, 2011). The ability to tap different objects repeatedly was tested, since this may lead to an application error. In addition, if the mobile application is intended to run on devices with a multi-touch screen, it is necessary to test the simultaneous tapping of several objects in an Activity. Native gestures should also be tested, if such gestures are featured in the mobile application. They include pinch-to-zoom and double-tap that are intended for zooming and highlighting objects.

2. Mobile application resources. A memory leak can occur when displaying an Activity with a multitude of displayed information. A leak can also occur when the mobile application is used for a long time or due to incorrect caching (Hellman, 2013). Testing was performed for situations with a lack of memory for the proper functioning of the operating system. The mobile application size was also tested, since too big an application size can make it so many users are unable to install the application due to lack of space. The application was tested

on many mobile devices with different functions. For instance, some devices lack a 3G network connection, SD card, etc.

3. Different operating system versions and screen resolutions of mobile devices. The performance of the mobile application was tested on both devices with a multi-touch screen and devices without a Retina display. Retina displays have a higher pixel density; therefore, the human eye cannot distinguish individual pixels. High pixel density usually displays View Objects and text on a smaller scale. An image that is properly displayed on a Retina screen may have an improper size on other screens, since may be magnified. It is necessary to test the performance of the application with different orientations – portrait and landscape. The application was tested for the ability to be installed on all versions of the operating system, for which it was developed. It is also necessary to disable the ability to install the application on an unsupported operating system, since it may cause serious problems for the performance of both the device and the application. It is necessary to ensure the support of various file formats, required for the application to run properly.

4. Mobile application testing for various external interrupts. The reaction of the mobile application was tested for notifications of incoming and outgoing SMS and MMS messages, calls, and notifications from other mobile applications. The mobile application's reaction to the mobile device being turned on and off, as well as different states of battery health was tested. The performance of the mobile application was tested when the mobile device went into standby mode. The performance of the application was tested during the connection and disconnection of the cable (generally, a micro-USB cable) that connects the mobile device to a personal computer's USB port. Testing was also performed for the performance during connection and disconnection of headphones via a mini-jack port, connection to and disconnection from the Internet, activation and deactivation of Bluetooth, airplane mode, and GPS. The establishment and loss of connection to the server was tested, as well as the connection of various peripherals to the mobile device and the connection and disconnection of memory cards in the phone. The performance of the mobile application was tested with different battery power allocation. When an accelerometer was turned on, all its intended functions had to be tested in the mobile application.

5. In-app store performance:

If an in-app store is included in the mobile application, the conformity of the items for sale should be checked, as well as the price of each item. The amount that the user is charged has to correspond to the amount, indicated in the mobile application with a detailed description of the item. The performance of the application was tested after a purchase is made and an item is paid for.

6. Internationalization of the mobile application:

During the development, the accuracy of the application's translation into its different languages was checked. The appearance of objects when working with different languages was also tested, since in many cases the amount of text differs in each language, which may cause the signs not to fit into their intended object.

7. Feedback testing:

It is worth noting that in all Android applications, all View Objects have several different states that they enter after various user actions. Therefore, the

correct switch between states after all possible user actions was tested, as well as the speed of different mobile application objects. The reaction should be instantaneous. This type of testing should be performed on the least powerful mobile devices. It also includes the test of popup notifications that inform of the current application activity, the accuracy of progress bar (loading bar) filling to avoid misleading the user, popup notifications that indicate whether the mobile application is connected to the network and GPS, correct and accurate wording of confirmation messages for deleting files in the application or when exiting the application.

8. Update installation:

It is necessary to assure that the work of the application on different operating system versions is not disrupted after the installation of new operating system updates that are launched after the release of the mobile application. After updating, the mobile application should save all settings and personal information.

9. Certification check:

If the application is developed for many versions of the operating system, it is necessary to assure that the mobile application complies with the rules and conventions of these versions.

The experiment. Implementation of the mobile application in the field of education

The pedagogical experiment allows for a deeper assessment of the effectiveness of technologies and other innovations in the field of education when compared to other methods. It also allows comparing the significance of various factors in the structure of the pedagogical process, choosing their optimal combination in any given situation, as well as determining the conditions, required to achieve the goals set by the teacher.

The goal of the experiment was to confirm empirically the hypothesis regarding the effectiveness of the mobile application in education management.

In order to achieve the goal, the following stages of the pedagogical experiment were completed: searching, summative, and formative. Consider the main aspects that affect the result of the pedagogical experiment.

The searching stage included the following activities:

1. gathering and analysis of studies on mobile applications in the field of education;

2. comparative analysis of existing mobile applications;

3. study of textbooks, scientific, technical, and methodological literature;

4. investigation of the means of informatization of mobile application programming courses.

The theoretical research found that using a remote access mobile application to manage the educational process is effective.

The summative stage of the pedagogical experiment used such research methods as questionnaire and interview of teachers and students. Four groups were selected from a higher educational institution – 130 people in total. One hundred fifteen of them own devices with the Android operating system. The questionnaire was based on the following criteria (Table 2).

Table 2. Criteria of assessment of the remote access mobile application for managing the educational process

Criteria	Characteristics
Visual design	- color palette (good choice of the color palette; contrastive combination of the font color and background); - peculiarities of text material presentation (good choice of font and font size, line and paragraph spacing, text fragment design, best size of sentences, lines, paragraphs, presence of lists, marking, highlights, alignment); - peculiarities of illustration presentation (presence of images, drawings, video and audio materials, animation, quality of the material, expedience of its use); - means of emphasis; - organization and structure.
Navigation	- perspicuity, simplicity of means of navigation, clear arrangement on the screen; - possibility of determining the location, return to the start of the section or the main page.
Mobility	- personalized secure access to information and reference materials via mobile devices; - using the mobile device as a personal library of academic, methodological, and reference materials, as a player to record and listen to audio lectures; - incorporation of app stores and learning content (Apple AppStore, Google Play, iTunes, etc.) into the educational and research infrastructure, which gives remote access to electronic academic and scientific resources, allows downloading, playing back, rating, and editing.

In addition, a number of suggestions were obtained that allowed assessing the vector of development of the mobile application. Ways of simplifying the application were suggested. The survey results are presented in Figure 8.
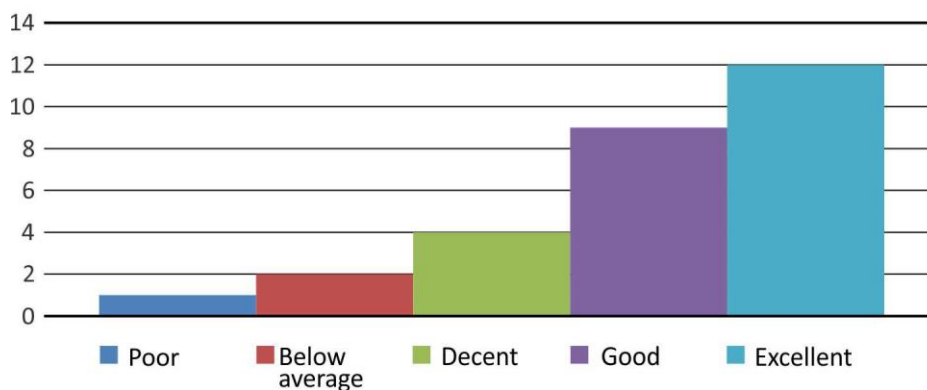

Figure 8. Chart of mobile application assessments

The formative stage of the experiment involved the performance of a final assessment. The experiment was conducted in the form of tests in the "Database Administration" discipline. Fifty students were tested in two ways. Before the

experiment, students had a traditional test (on paper). After the experiment, the testing was carried out using the remote access mobile application. The results of the experiment showed the average time the students required to do the test, the time required to collect the results, and the tire the teacher requires to check the results and announce them to the class.

For instance, it was found how much time and effort was saved by using the mobile device to conduct the test. The mean values of the experimental results are presented in Table 3.

Table 3. Mean values of the experimental results

Test mode	Average time of doing the test, in minutes	Average time of collecting results, in minutes	Average time of checking the results, in minutes	Average time spent on the test
Without the application	31.862	0.1704	2.172	34.2044
With the application	27.444	0.05	0.06	27.554

The experimental results enabled formulating statistical hypotheses.

To that end, it is necessary to do a number of calculations. The significance level is 0.05, as in most pedagogical studies. The Cramer-Welch test was used to determine the similarity of or difference in data, according to equation 1.

$$T_{emp} = \frac{\sqrt{M \cdot N}\,|\bar{x} - \bar{y}|}{\sqrt{M \cdot D_x + N \cdot D_y}} \tag{1}$$

In this case, D_x and D_y are sample variances, calculated according to equation 2.

$$D_x = \frac{1}{N-1}\sum_{i=1}^{N}\left(x_i - \bar{x}\right)^2 \tag{2}$$

The values of D_x and D_y were calculated for data obtained during the experiment. The N value was the number of students in the control and experimental group – 25. The descriptive statistics tool in Microsoft Excel 2010 was used to provide a more accurate calculation.

All calculations were done twice. The first calculation used the data on the control and experimental group obtained before the experiment was conducted.

The sample variances were D_x=3.69901666666666 and D_y=7.547346.

$$T_{emp} = \frac{\sqrt{25 \cdot 25}\,|32.838 - 33.6372|}{\sqrt{25 \cdot 3.69901666666666 + 25 \cdot 7.547346}} = 1.191569662 \approx 1.19 \tag{3}$$

The empirical value of the Cramer-Welch test is 1.19. Since T_{emp} = 1.19 < 1.96, the hypothesis regarding the matching characteristics of the control and experimental groups before the experiment is true at 0.05 significance level. This means that the characteristics of the control and experimental group before the test match.

The second calculation found the empirical value of the Cramer-Welch test in the control and experimental group after the experiment.

The sample variances were D_x=5.92256666666667 and D_y=15.3471506666666.

Then the empirical value of the Cramer-Welch test for data obtained from the experiment was calculated.

$$T_{emp} = \frac{\sqrt{25 \cdot 25}\,|27,554 - 34.2044|}{\sqrt{25 \cdot 5.9225666666666 + 25 \cdot 15.3471506666666}} = 7.210028602854773 \approx 7.21 \quad (4)$$

By following the calculation algorithm and the offered formula, the empirical value of the Cramer-Welch test was obtained – 7.21.

Since the empirical value of the Cramer-Welch test at 0.05 significance level was 1.96, while the obtained value of 7.21 is a number that is greater than 1.96, it was concluded that the confidence of differences in the characteristics of the control and experimental groups after the experiment was 95%.

Therefore, since the characteristics of the control and experimental group marched before the experiment and differed after the experiment, the conclusion is that these differences were caused by the experimental learning method.

Discussion and Conclusion

V. Charushnikov (2008) expresses his concern with the rapid computerization of education; his main concern is that this could eliminate the exiting educational system and the institution of pedagogy. However, the modern modification of the educational system is aimed at improving both the educational and the organizational aspects, which will cut the time cost and give the students a simpler and more efficient means of acquiring knowledge.

The developed mobile application can be considered innovative, since it allows simplifying the students' acquisition of information significantly. Almost every student has a mobile device. The development of mobile applications in and of itself is considered innovative. As of today, the development of mobile applications is just starting to emerge, both in Kazakhstan and in the entire world. The development of a mobile application for the field of education is a complicated task that requires a substantial amount of knowledge and skills in both the development mobile applications for the Android operating system and the administration of servers and databases.

Methodological and educational literature, standards and programs related to remote management of the educational process were analyzed. Developed software, academic and organizational support systems for remote management of the educational process were investigated. A software package for remote management of the educational process was developed with regard to the abovementioned comparisons.

Implications and Recommendations

A mobile application on the Android operating system was developed and tested. Both teachers and students expressed their interest in learning to use and using this application. This application can assist teachers and students in the learning and organizational process.

The main feature of the developed application is the synchronization of user information with the database, its processing and provision to other users. It is worth mentioning the need to upgrade the application and add certain functions, such as:

– A special mode, which can be accessed by the group or class monitor. In this mode, the monitor can edit or add information that will be displayed to his or her classmates or fellow students.

– Additional functions that may be of use to students.

– Localization of the mobile application into other languages, including the Kazakh language.

– New authorization options, for instance, with various social networks.

– An information portal that will enable contacting the developer, displaying news on the updating of the mobile application, and general statistics.

– Porting of the mobile application to other operating systems.

Nonetheless, despite the number of upgrades to the mobile application, this research does not deny the necessity and effectiveness of the existing version of the application.

This application can be used by students and teachers in any educational institutions.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Gulmira M. Abildinova is a PhD, Associate Professor of the Computer Science Department, L. N. Gumilyov Eurasian National University, Astana, Kazakhstan.

Aitugan K. Alzhanov is a PhD, Associate Professor of the Computer Science Department, L. N. Gumilyov Eurasian National University, Astana, Kazakhstan.

Nazira N. Ospanova is a PhD, Associate Professor of the Computer Science and Mathematics Department, S. Toraighyrov Pavlodar State University, Pavlodar, Kazakhstan.

Zhymatay Taybaldieva is a PhD, Associate Professor of the Music Education Department, Zhetysu State University named after Ilyas Zhansugurov, Taldykurgan, Kazakhstan.

Dametken S. Baigojanova is a PhD, Associate Professor of the Computer Science Department, L. N. Gumilyov Eurasian National University, Astana, Kazakhstan.

Nikita O. Pashovkin Holds a Master Degree at Computer Science Department, L. N. Gumilyov Eurasian National University, Astana, Kazakhstan.

References

Charushnikov, V. (2007). E-Learning: Pros and Cons. *Higher Education in Russia, 12*, 55-62.

Cheona, J., Lee, S., Steven, M. Crooks & Jaeki, S. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education, 59*, 1054–1064.

Crompton, H. (2013). A historical overview of mobile learning: Toward learner-centered education. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning*. Florence, New York: Routledge, 253 p.

Darcey, L., & Conder, Sh. (2012). *Android Application Development in 24 Hours, Sams Teach Yourself*. New York: Sams Publishing, 253 p.

Deitel, P., Deitel, H., Deitel, A., & Morgano, M. (2012). *Android for Programmers: An App-Driven Approach*. St. Petersburg: Piter, 275 p.

Emmanouilidis, Ch., Koutsiamanis, R.-A., & Tasidou, A. (2013). Mobile guides: Taxonomy of architectures, context awareness, technologies and applications. *Journal of Network and Computer Applications. 36,* 103–125.

Fulantelli, G., Taibi, D., & Arrigo, M. (2015). A framework to support educational decision making in mobile learning. *Computers in Human Behavior, 47,* 50–59.

Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. *Internet and Higher Education, 19*, 18–26.

Goloshchapov, A. L. (2012). *Google Android: System Components and Network Communication.* St. Petersburg: BHV, 353 p.

Hashimi, S., Komatineni, S., & MacLean D. (2011). *Pro Android*. St. Petersburg: Piter.

Hellman, E. (2013). *Android Programming: Pushing the Limits*. Wiley Press.

Kearney, M., Burden, K., & Rai, T. (2015). Investigating teachers adoption of signature mobile pedagogies. *Computers & Education, 80,* 48-57.

Kolisnichenko, D. N. (2013). *Android for Users. Useful Programs and Advice.* St. Petersburg: BHV.

Ledford, J., Zimmerly, B., & Amirthalingam, P. (2009). *Web Geek's Guide to the Android-Enabled Phone.* Que Press.

Murphy, M. (2011). *Beginning Android*. London: Apress, 242 p.

Pashovkin, N. O. (2014). Android Operating System Advantages and Peculiarities of Developing Mobile Applications for It. *Proceedings of the IX International Scientific Conference of Students and Young Ccientists "Science and Education – 2014"*. Astana, 2793-2796.

Plaza, I., Martin, L., Martin, S., & Medrano, C. (2011). Mobile applications in an aging society: Status and trends. *Journal of Systems and Software, 84(11),* 1977-1988.

Roudaki, A., Kong, J., & Yu, N. (2015). A classification of web browsing on mobile devices. *Journal of Visual Languages and Computing, 26*, 82-98.

Shuiba, L., Shamshirbandb, Sh., & Ismai, Mohammad Hafiz. (2015). A review of mobile pervasive learning: Applications and issues. *Computers in Human Behavior, 46*, 239–244.

Simkova, M., Tomaskova, H., & Nemcova, Z. (2012). Mobile education in tools. *Procedia - Social and Behavioral Sciences, 47*, 10-13.

Simon, J. (2011). *Head First Android Development.* London: O'Reilly Media, 185 p.

Stark, J. (2008). *Building Android Apps with HTML, CSS, and JavaScript*. London: O'Reilly Media, 253 p.