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The application of mobile technologies in the processes of communication and information delivery to the students for the improvement of education process quality

Abstract: *One of the important elements of education process, on all level of education, is on-time and precise informing of all participants on all important news and events, as well as efficient communication between all actors in the education process. The basic idea of this paper is to show how introduction of mobile technologies can significantly improve the quality of education process through more efficient communication and faster and better information delivery to the students. All classic and modern methods of communication and informing in education are presented, with their advantages and disadvantages listed, and compared, with the emphasis on mobile technologies. Also, the results of the survey on the popularity and usage of mobile technologies in student population, conducted at Faculty of Economics, University of Kragujevac, Serbia, is presented.*

Keywords: *mobile technologies, mobile phone, m-learning, information delivery, education quality*

1. INTRODUCTION

Mobile technologies are nowadays one of the most emerging and fastest growing technologies. Mobile phones are becoming everyday necessity and now it is almost impossible to imagine how complicated our life would be without them. Never in the history has there been a technology so widely available as mobile technology – different surveys [1], [2], [3], [4] shows that we could consider that every citizen in developed countries, on average, has a least one mobile phone (because of economic, educational and technical reasons, this percentage is lower in developing and undeveloped countries). Also, wireless communication and access

to the Internet are the basis of future development of communication area, which is one of the most profitable and most expansive parts of the technology.

Thanks to the development of telecommunication technology and software, mobile phones are, except for its primary purpose – voice communication, today used for a variety of other objectives and purposes. Everyday they are becoming more like pocket computers, because every new generation of the phones brings some new hardware and software solutions. Thanks to its availability (“anytime, anywhere”), in the last decade there were many research projects [1], [5], [6], [8], [11] on the application of mobile phones in the education process. As a natural

extension of e-learning, the mobile learning (m-learning) is nowadays in getting more and more attention of scientists and educators [1], [2], [4], [8].

One of the important elements of education process, on all level of education, is on-time and precise informing of all participants on all important news and events, as well as efficient communication between all actors in education process. The basic idea of this paper is to show how introduction of mobile technologies can significantly improve the quality of education process through more efficient communication and faster and better information delivery to the students.

First, all classic and modern methods of communication and informing in education are presented, with their advantages and disadvantages listed, and compared, with the emphasis on mobile technologies. Also, the results of the survey on the popularity and usage of mobile technologies in student population, conducted at Faculty of Economics, University of Kragujevac, Serbia, will be presented.

2. METHODS OF COMMUNICATION AND INFORMING OF STUDENTS

The most important methods of communication and informing of students, that will be analyzed in this paper are:

- student information board,
- regular mail,
- phone call,
- voice message,
- web site,
- e-mail,
- mobile technologies (SMS and mobile web).

2.1 Student information board

Student information board is the oldest and still the most used method of

information delivery. All information (news, exam results, exam schedule, etc) are published on the board mounted on the wall inside the faculty building, usually by faculty administration staff.

The advantage of this method is that all information are published publicly, and all are in one place. But this method has many disadvantages:

- the student has to be personally present in the building to be able to read information;
- it is possible to view information only during the faculty building is open i.e. only during working hours, since faculty buildings are usually closed during nights and weekends;
- there is no way to know if new information is available, i.e. student has to regularly check the board, if some new information is added;
- because many information are at the same place, sometimes it is easy to miss some, etc.

2.2. Regular mail

In the early beginning of distance education, the communication with students was organized via regular mail, since there still was no electronic way of communication. All information were posted to the students via regular mail service, and students also sent their questions and requests via regular mail. Compared to the previously described method, this one had the advantage that student didn't have to be present in the building to receive the information, and that information were delivered after they were generated, i.e. there was no need for regular checks. But there were many disadvantages, of which the most important were:

- the way of communication was too slow (sometimes called snail mail); it took days for the simple information to

be delivered; two-way communication (request and answer) was often useless i.e. the answers could arrive when it was already too late;

- this method was quite expensive, since each information was delivered to each student in a separate message;
- also, since each information was delivered to each student in a separate message, this method was time-consuming, with a significant load on faculty administration service, etc.

Because of enumerated disadvantages and appearance of much faster and cheaper electronic ways of communication, his classical method is nowadays very rarely in use.

2.3. Phone call

After the invention of the telephone and its introduction in everyday life, it became obvious that regular mail will no longer be the primary way of communication in general. As well as in the other areas of life, telephones were used as information delivery tool for many years. The advantages over the prior methods are obvious: it's much faster, there is no need to be physically present in the faculty building to be informed, the information could be delivered as soon as it is generated, etc. But, this method has some disadvantages:

- some information can't be delivered only by voice (e.g. pictures, graphs, etc.),
- information delivery is usually limited on faculty working hours,
- high workload on faculty administration staff i.e. there should be someone who would only answered the phone and call other to tell the information,
- it is time-consuming, for only one information to be delivered to many students, it would take a lot of time,

- it also could be money-consuming, i.e. many phone calls for only one general information, etc.

Despite these disadvantages, phone call is still often used as information delivery tool in some specific situations.

2.4. Voice Message

In some cases, information could be also retrieved from automated phone system. Traditional solution, interactive voice response (IVR) [1], is the system in which customer calls certain number and after the connection is established, just follows the pre-recorded instructions, i.e. answers the questions guiding him to the needed information by pressing right button on the phone (e.g. "if you want ... press 1") i.e. using DTMF tones. All questions, messages and information are pre-recorded in the system. The system usually gives the answers to basic administrative and frequently asked questions (FAQ's), or could act as technical support.

Another, more advanced solution is based on voice i.e. speech recognition and its transformation to the text [1]. After customer calls and asks the question, it is recognized and transformed to the text. Then, the question is processed by sophisticated algorithm (very often based on artificial intelligence), which recognizes which information is needed and retrieves it from the information database. Finally, text to speech solution is used, so information is read to the customer by phone.

The main advantages of voice message system are [1]:

- non-stop (24/7) access,
- it could be used from stationary or mobile phone,
- no computer needed, if used from mobile phone, gives full mobility,
- allows the automation of basic and

repetitive assistance tasks, information providing, and, therefore, is a good way to help refocus the administrative or education staff to higher value tasks, etc.

The main disadvantages are that it usually covers typical, most frequent questions, so it is very difficult to get some more specific information and software for speech recognition and retrieval of right information from the database are still not perfect and under development.

2.5. Web site

One of the most popular and most used methods of informing students is through faculty web site. It is well known that today almost all educational institutions, even in developing countries, have their web sites, on which, except general information on the institution, give the latest news and information for the students (exam schedules, exam scores, etc.). It is often seen as an electronic substitute for classical student information board. An example of faculty web site is given in Figure 1.



Figure 1. Example of faculty web site as information delivery tool

The main advantages of web sites as an information delivery tool are:

- non-stop availability (24/7); information are available not only during faculty working hours;

- money-efficient; it's one of the cheapest methods of information delivery;
- time-efficient; it is easy to deliver an information very fast to a number of students;
- it's possible to deliver multimedia content (not only graphics, but also audio and video);
- security issues and personalized information delivery; some web sites have closed part, accessed through authentication with user name and password; in this way it is possible to give some information only to specific person or a group;
- on-line forums; some web sites have forums on which students can exchange information about different issues; etc.

Web sites are also the basic tool for the implementation of e-learning, i.e. they are used not only for informing but for delivery or learning material and on-line testing. One of only a few disadvantages is that student has to have computer with internet access to be able to use this method. Although the number of computer with on-line access is increasing rapidly, in many developing and undeveloped countries this could still be a problem.

2.6. E-mail

This electronic method is often more used for communication than for information delivery. It is not as popular as web site, but shares many of its advantages (it is fast, cheap, multimedia content could be sent as an attachment, etc.) and disadvantages. On some universities (for example, Faculty of Economics and Business, University of Maribor, Slovenia [9]), students on enrollment receive own university e-mail address, that is latter used for all information and notification delivery and communication.

2.7. Mobile technologies

Mobile technologies are one of the most expansive areas in the last decade. As every student has a least one mobile phone, it is natural to try to incorporate these devices in the education process. Except for information delivery, mobile phones are nowadays used also for learning in a narrow sense, and m-learning is natural extension of e-learning. Contemporary mobile phones, called smart phones, are the combination of mobile communication property of traditional mobile phones and computational characteristics of PDA devices, so they usually have own high-level operating system, various applications, wireless connection ability, etc. The main advantages of modern mobile phones are [1], [3]:

- it is wide-spread, i.e. almost everyone has one; the number of mobile phones is much higher than the number of computers,
- it is personal, so everyone could set it according to its personal needs and wishes,
- it's light and small, so it could be taken everywhere the owner goes,
- it offers various methods of connection to other devices,
- it offers connectivity to the internet,
- very often it offers e-mail ability, i.e. user could read on and send e-mails from mobile phone, etc.

Thanks to its "anytime, anywhere" property, mobile phone is also becoming popular in official communication and information delivery in the area of education. There are several ways in which mobile phones could be used in this manner. As the main functionality of mobile phones is voice communication, students using them can use previously analyzed methods of phone call and Interactive Voice Response, with the main

advantage that they could be mobile, i.e. instead of calling from the stationary phone from their home or call box, they can do it from any place they are (for most mobile networks the coverage is very near to 100%, especially in the urban areas). Also, as mentioned before, many mobile phones offer the possibility to use e-mail, so this method could also be used, with the same advantage over PC.

As many mobile phones nowadays offer the possibility to access the internet, web sites could also be used as an information delivery tool on mobile phones. But, because of its specificities, this method will be analyzed in a separate section. Also, the application of SMS (Short Message Service), very popular service, especially among young population, in the area of communication and informing of students will be analyzed.

2.7.1. Mobile web

Mobile web refers to the use of internet-connected applications or browser-based access to the Internet from a mobile device. It is very difficult for mobile device to access web pages tailored for desktop computer, for the following reasons:

- screen size and resolution limitations; because of small screens, it is difficult to read a lot of text or to see big images;
- mobile devices often do not support all web-design techniques, so some content couldn't be seen (for example, only a few smart phones come with in-build support for Flash);
- memory size limitation; memory size on mobile device (especially the size of operative memory) is much smaller than on desktop computers; therefore it is very difficult to download large pages and files, etc.

There are several ways to adapt the

content of web page to mobile device (HTTP content negotiation, CSS – Cascade Style Sheets, etc.), which usually adapt the size of the content by reducing the size of the images (or even eliminating) and text. Another way, getting more and more popularity, is to produce web site optimized for mobile devices. On July 11, 2005, ICANN approved new TLD (Top Level Domain) - **.mobi**, specialized for the web sites for mobile devices. This domain was originally supported and sponsored by elite companies in the area of mobile communications and internet: Google, Microsoft, Nokia, Samsung, Ericsson, Vodafone, T-Mobile, GSM Association, etc.

It is expected further development of mobile web, because, as stated above, the number of mobile phones is much higher than the number of computer. In the education area, it offers all enumerated advantages of web-based e-learning (except maybe download of large amount of multimedia content and streaming video, but in the next few years this will be possible, too) with one important advantage over it: full mobility.

2.7.2. SMS

SMS (Short Message Service) was one of the first services available on mobile phones. Customer is able to send short text messages (up to 160 characters; modern mobile phones and systems are able to process longer messages, by dividing them into short ones). This service, active since 1992, is nowadays very popular, especially among young population. Only in USA, 4 billion SMS messages are sent everyday [16]. On average, each customer on Philippines sends 750 SMS messages per month [17].

SMS messages are also used in education, especially as notification and information delivery tool. For example [1], [18] at the University of Pretoria, South

Africa, in 2002. there were hundreds of students enrolled in the equivalent of a Post-Graduate Diploma in Education by distance education. None of these students had email or could avail of e-learning but all had a mobile phone. They were all full-time teachers employed in rural schools, often with no computer near.

The University used mobile phones very successfully in their paper-based distance education programmes for university administration, achieving almost immediate communication by SMS messaging in an area where e-mail was unavailable and post took 5 to 15 days.

Similar applications for SMS notification and m-learning were developed at Kingston University, UK, Auckland University of Technology, New Zealand, Trinity College, Ireland, University of Sidney, Australia, etc [1].

SMS provides all the advantages of mobile technologies, enumerated above. The most important specific advantages of SMS are:

- since its personal device, always with the owner, student is almost instantly aware of the information content i.e. there is no need for periodical checking (as with web site or e-mail account); therefore its very useful for short-time and urgent notices, like change in time/place or cancellation of lecture or exam
- SMS message is automatically saved in the mobile phone,
- it is usually very cheap method, etc.

At Faculty of Economics, University of Kragujevac, Serbia, in-house solution for SMS notification and informing of students was developed in 2005 [12], and successfully tested for sending the exam grades for the students, with very positive feedback. Since then, the solution is applied in enrollment process, for the informing of future students about the requirements for the enrolment, time and

place of pre-enrollment exams and its results, etc. Also, the solution was upgraded for send-on-demand applications i.e. two-way communication with the students via SMS messages [13].

3. SURVEY RESULTS

The research on the students' attitude and preferences towards mobile phones was conducted on March 2010, at Faculty of Economics, University of Kragujevac, Serbia. In this survey, 223 undergraduate students of I study year, at Information Technology course, were participated. The aim of the research was to find out the widespread and popularity of mobile phones and personal computers among student population, students' mobile habits and willingness to incorporate mobile technologies in their education.

First two questions were if student has desktop and/or laptop computer and the results are shown on the Figure 2.

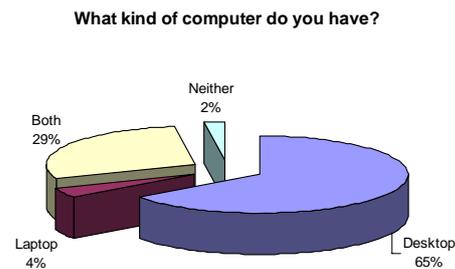


Figure 2. Possession of desktop and laptop computers

Although the situation on this manner is significantly improved in the last decade, and the number of computer is dramatically increased, there are still 2% of the students that do not have any computer. The situation in the rural areas and developing and undeveloped countries is much worse.

On the other hand, the number of mobile phones is increasing even faster, and according to this research, all students have at least one mobile phone. The results

on the number of mobile phones used by students are shown on Figure 3.

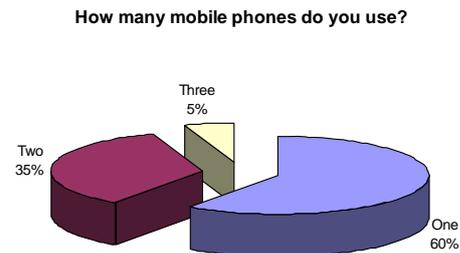


Figure 3. Number of mobile phones per student

This result was quite surprising, that 40% of the students use two or more mobile phones. The reason for this probably lays it the fact that different mobile operators offer different benefits and offers for the consumers, and that the students use the one that is in particular situation more cost-effective. This result confirms that mobile phones are widely spread among students and that mobile phone is the most frequently used technical device.

The distribution among the manufacturers of mobile phones used by students (Figure 4.) shows that the most frequently met company is Nokia, the world biggest mobile phone manufacturer, followed by Samsung and Sony-Ericsson.

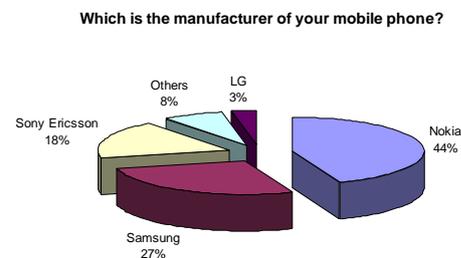


Figure 4. Distribution among manufacturers

On question if their mobile phone is enabled to connect to the Internet, the majority of the students said Yes (Figure 5.). It is probable that the real number of

the phones that supports internet connection is even higher i.e. that the students that don't know or don't use this option said No on this question. Almost all new models of mobile phones offer the possibility of internet connection, usually through GPRS, EDGE or UMTS standards. Many of them even support wireless LAN connection – WiFi. This property is essential for the application of mobile web method.

Does your phone supports connection to the internet?

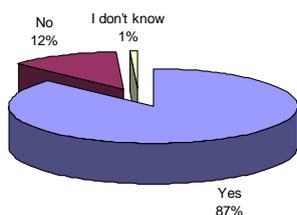


Figure 5. Mobile phone internet connection ratio

Currently in Serbia three mobile operators (Telekom, Telenor and Vip Mobile) have the license to provide this service. On Figure 6, the customer distribution among them is given. The most popular is obviously state-owned company Telekom, primarily because of the good offers and the prices for the pre-paid customers, dominant category of students.

Which mobile operator do you use?

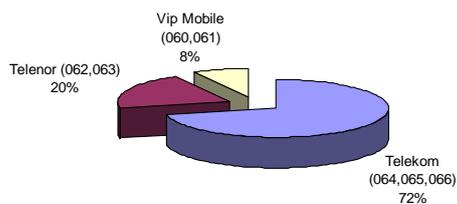


Figure 6. The distribution among mobile operators

The two main categories of mobile numbers (and consumers) are pre-paid (the account is filled with certain amount of

money; on every call or message this amount is reduced for the price of service; if the balance reaches zero, the customer is not able to call but can receive calls for certain period; the account should be periodically charged) and post-paid (the customer calls and sends messages freely, usually on the beginning of the month he receives the invoice of all the services in previous month, to be paid). Because it is usually more cost-effective, students usually use pre-paid numbers, as shown on Figure 7.

Are you pre-paid or post-paid customer?

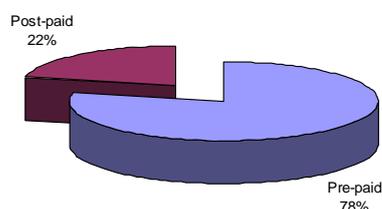


Figure 7. The distribution between pre-paid and post-paid numbers

Also, because it's more cost-effective, students prefer to use SMS messages to phone calls. It is shown on Figure 8 that most of them use these two methods of communication evenly, but it's much higher number of those who use predominantly SMS messages, than those who predominantly make phone calls.

Which way of communication do you predominantly use?

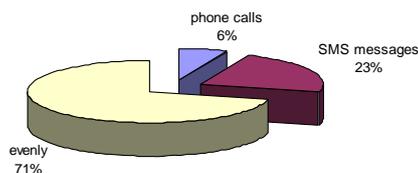


Figure 8. The distribution between phone calls and SMS messages

Students that have participated in the

survey still don't use the mobile internet very often, for many reasons (money, low visibility on small displays, difficult to set-up the phone settings, etc.). The most of those who said that they use mobile web, said that they use it for news and sport results, Facebook, internet surfing, music download, etc.

One of the main goals of this research was to prove that students would prefer mobile technology-based methods for information delivery over other classic and electronic way of informing. Students were asked to make a list which way of informing they would prefer, among:

- student information table,
- faculty web site,
- SMS message,
- e-mail message.

The results to this question are given in Table 1 (grade 1 is the most desirable, grade 4 is the least desirable).

Table 1. Results of grades for the most desirable method of informing

Informing method \ Grade	1	2	3	4
Student info. board	36	54	55	77
Faculty web site	54	74	79	15
SMS message	120	43	42	17
E-mail message	12	51	46	113

As it can be seen, SMS message was the most time the most desirable method (more that half of students consider it the best method), which confirms the willingness of students for the stronger use of mobile technologies in their informing on study-related news. Web site is the second, student information table third and the least desirable method is e-mail.

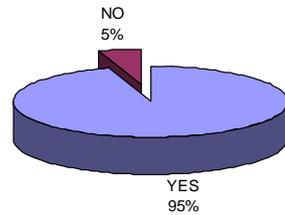
Also, students were asked do they think that it would be useful for them if mobile phone would be more incorporated in their education (YES/NO answers), in the following ways:

1. Information delivery via SMS,

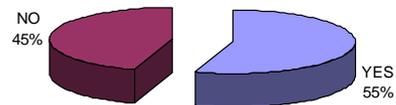
2. Receiving and listening of audio files with the lectures,
3. Solving the training tests for exams,
4. Consultations with professors,

and the results are given in Figure 9.

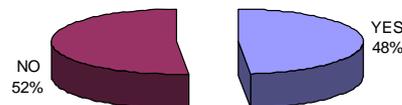
Information delivery via SMS messages



Audio files with the lectures



Training tests for exams



Consultations with professors

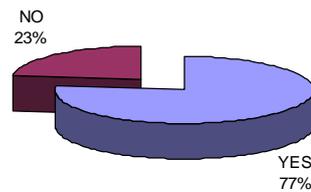


Figure 9. Students' attitude on the higher introduction of mobile technologies in their education

It can be seen that the students are

very positive towards higher introduction of SMS informing in faculty administration, but also that the percentage of readiness for other ways of mobile learning (m-learning) is lower.

4. CONCLUSION

Mobile technologies are the one of the fastest developing and spreading technologies today, with the applications in almost all areas of living. One of the important areas, in which mobile technologies are started to be successfully implemented is education.

It was shown that mobile technologies have many advantages over classical and other electronic methods of communication and information delivery (especially its ubiquity, speed and location-independence), and that, if implemented, could significantly improve the quality of education process on all levels.

Also, the results of the survey were

presented, showing that the students are very positive towards mobile technologies and willing not only to accept it for communication and information delivery purposes, but also for wider introduction of mobile phones into education i.e. mobile learning (m-learning).

Therefore, introduction of mobile technologies in education can significantly improve its quality on different levels and aspects and it is to be expected that it will become one of important supporting education technology in the very near future.

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