Are we ready to use mobile devices in higher education? A case study from a central-eastern European university

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Abstract

While international research indicates the positive impact of using tablets in teaching, successful implementation of mobile learning (m-learning) is no matter of accident but depends on users' approach to and acceptance of such technology. In this study, we examine whether students of the private European University are technologically ready for m-learning. We also sought to predict students' intention to use m-learning in future classes. To answer the research questions, a survey was administered to 640 students, and text-based answers were transformed into numbers. We then analyzed the questionnaire data and formulated 6 hypotheses, which were verified using a nonparametric method. The results revealed that participants are mentally and technologically ready for m-learning. They not only have positive attitudes towards m-learning but are also highly motivated to use mobile devices in their future education. Moreover, students already use mobile devices to support their learning despite it not being formally included in the curriculum. In analyzing what factors make students accept or resist m-learning, we found the technological maturity of our students—in this case to be vital. Furthermore, m-learning is a promising pedagogical technology to be implemented in higher education environments.

Keywords — mobile learning, e-learning, educational system, attitude, mobile devices, educational application, university management

I. INTRODUCTION

Mobile learning (m-learning) has become a popular research subject, with various articles on university students' attitudes towards using educational mobile applications in class [1, 2]. In this study, we explore this topic in the context of a central-eastern European university to achieve a better understanding of students' attitudes towards mobile learning, there is also a lack of research data at a national level about m-learning initiatives at universities, with only a few small-scale trials implementing m-learning [3].

We were also motivated by several international reports that indicate the positive impact of tablet use in teaching and learning [1, 4, 5]. This study investigates the attitudes toward m-learning of students at private University. The University has a practical profile focused on the use of computers. We examined whether students are technologically and mentally prepared for m-learning and also sought to predict students' intention to use m-learning during classes in the future. We aimed to use the study results to decide whether the university is ready – from the students' perspective – to use mobile devices in an educational context. The Authors of this article are in charge to implementing new technologies in teaching process in the last 20 years. This survey was approved by Ethics board at the University of Information Technology and Management in Rzeszow, Poland.

II. RESEARCH PROBLEM

Every professional planned learning initiative requires deep analysis to discover or identify the learning needs that the solution seeks to provide. It is clear that successful implementation of m-learning is no matter of accident, but depends on users' approach to and acceptance of mobile technology.

Features of mobile devices such as portability, continuous connection to the Internet and the ability to check the accuracy of information affect the way people both teach and learn. This leads to research on the advantages of mobile devices in teaching and changes that mobile devices will introduce into pedagogy [6]. As it turns out, the high expectations toward mobile devices, including educational applications, are not always the same, particularly between teachers and students [7]. Several surveys of student's attitudes towards m-learning have been conducted [1, 8] but further studies are needed to better understand the reality of developing countries.

In this study, we conducted a survey to reveal student's attitudes towards m-learning. We explored (1) how students use their mobile devices in everyday life, (2) whether they are technologically ready for m-learning, and (3) whether they are

willing to use educational applications during classes, to facilitate our decision regarding whether to adopt m-learning at the university.

The research questions were answered by verifying 6 hypotheses derived from survey data. The research design is in line with most studies and best practices [5, 9, 10, 11, 12, 13, 14, 15, 16]. The data were collected from students in a class and the instructor was one of the researchers.

III. METHOD

III.1 PARTICIPANTS

The research population comprised students from a private university that has 5157 students from three continents: Eurasia, Africa, and North America. Almost 12.5% of the overall student body participated in the study. As noted by Marshall [17], a sample is one that accurately represents a population in specified attributes. To verify whether our sample was representative of the overall student population, we checked two attributes: gender and level of education.

50.3% of students are female, while 49.5% of our research sample were female, a difference of only 0.8%. The male population differs by just 0.1%. The sample is almost identical to the population of interest. Furthermore, our study had 0.6% missing data, but as this amount is relatively small, we assume it does not influence the research results.

While 77.9% of students study at the bachelor's level, 80.8% of our participants did so, to give a nonsignificant difference of 0.1%.

Our sample has characteristics of the whole population in the specified attributes of gender and level of study. Thus, we conclude that our sample is representative, and thus we can confidently generalize our study results to the whole population of our students.

III.2 SURVEY STRUCTURE

The survey comprised of questions grouped into three sections. The first section comprised personal information on age, field of study, year of study, gender, sex, and country of origin. The second section asked about the specifications of mobile devices owned by students and how they use mobile tools. The final section asked about attitudes towards current and, more importantly, future use of mobile devices in education. Questions were formulated following a review of literature on the topic [16, 18, 19]. The survey was conducted in October, November, and December 2018. All data were collected anonymously after classes and all students participated voluntarily in the survey. Thus, we assumed that students would express their views and feelings honestly and reliably.

The Statistical Package for the Social Sciences (IBM SPSS Statistics 25) was used to compute all data and analyze the main output. All survey variables were provided in a nominal scale.

Before computer analysis text-based answers were coded and transformed to numbers. In the next step, we analyzed the questionnaire data. Finally, we verified the 6 hypotheses derived from the data using descriptive statistics and correlational survey research. We used a nonparametric method to verify the hypotheses. Table 1 shows the variable names and characteristics, while Table 2 provides a description of the hypotheses.

TABLE I. DESCRIPTION OF THE INDICATORS (VARIABLES) USED IN THE SURVEY

Indicator	Abbreviation of indicator	Description
Owner of tablet	OT	Shows how many students own tablets
Owner of smartphone	OS	Shows how many students own smartphones
Screen size of smartphone	SS	Shows the screen size of smartphone
Awareness – smartphone	AS	Measures awareness of smartphone parameters
Awareness – tablet	AT	Measures awareness of tablet parameters
Attitude	A	Measures attitude towards future use of m-learning
Expectation	E	Measures expectation of educational content for mobile devices
Scores	S	Measures predicted influence of mobile education on university scores
Risk	R	Measures risk of using mobile education apps
Educational Apps	EA	Measures students' level of knowledge about mobile education apps in the field of study

To determine whether a significant relationship exists between variables, we used Pearson's chi-squared test. Because our data were qualitative, we were unable to use standard measures for data analysis used for quantitative data, such as Pearson's correlation coefficient or standard deviation.

TABLE II. DESCRIPTION OF HYPOTHESES

Id	Variable 1	Variable 2	Description
H1	OT	A	Students who are tablet owners are more interested in m-learning
H2	SS	A	Students with smartphones with bigger screens are

			more interested in m-learning
H3	EA	A	Students who claim that there are educational apps related with their study subject have a better attitude to m-learning
H4	S	A	Students who claim that mobile education will help them gain better scores at the university have a better attitude to m-learning
H5	R	AS + AT	Students who know the parameters of mobile devices better discern less risk in m-learning
H6	E	A	Students who have a particular expectation of educational content for mobile devices have a better attitude to m-learning

Table 5 contains the results of verification of all hypotheses.

IV. RESULTS

IV.1 DATA ANALYSIS FROM QUESTIONNAIRES

IV.1.1 PART 1. PARTICIPANTS' DEMOGRAPHICS

In total, 322 (50.3%) female and 318 (49.7%) male students participated in the survey. The students ranged in age between 17 and 26. Regarding nationality, 62% came from Poland, 15.2% from Kazakhstan, 12.7% from Ukraine, and 10.1% from Bangladesh, Belarus, Bulgaria, China, Egypt, France, Germany, Hong Kong, India, Jordan, Kyrgyzstan, Malaysia, Morocco, Nigeria, Russia, Spain, Tajikistan, Thailand, Turkey, USA, Vietnam, Zimbabwe. A total of 80.8% are studying at bachelor's level and just 19.2% at master's level. Research participants represent 11 fields of study provided by University, with 69.9% of all participants and the majority of the overall University student body studying in the five fields of Management, Computer Graphics, Information Technology, Aviation Management, and International Management.

IV.1.2 PART 2. MOBILE DEVICES

Part two of the survey indicates that 99.7% of participants own a smartphone, 17.8% own a tablet, while just 0.3% (2 students) own neither. Furthermore, every student who owns a tablet also owns a smartphone, while the most commonly used operating system for both smartphones (394 from n=638) and tablets (86 from n=149) is Android.

TABLE III. CHARACTERISTICS OF STUDENTS' MOBILE DEVICES

VARIABLE	DESCRIPTION	FREQUENCY	%
Tablet owner	yes	149	23%
	no	491	77%
Smartphone owner	yes	638	99.7%
	no	2	0.3%
Brand name of smartphone	Apple	254	39.8%
	Samsung	122	19.1%
	Huawai	86	13.5%
	Xiaomi	74	11.6%
	LG	30	4.7%
	Sony	24	3.7%
	other	48	7.6%
Screen size of smartphone	>6"	35	5.5%
	4,3" - 4,7"	72	11.3%
	4"	13	2%
	5,3" - 5,7"	183	28.7%
	5"	94	14.7%
	6"	43	6.7%
	7" - 7,9"	2	0.3%
	I don't know	196	30.8%
Mobile Internet	up to 250 Mb	9	1.4%
	up to 500 Mb	16	2.5%
	I don't know	45	7%

The findings showed that students use mobile devices to support learning despite m-learning not being formally included in the curriculum (Figure 1). This indicates their positive attitude to m-learning.

FIGURE 1. MOBILE APPLICATIONS USED BY STUDENTS
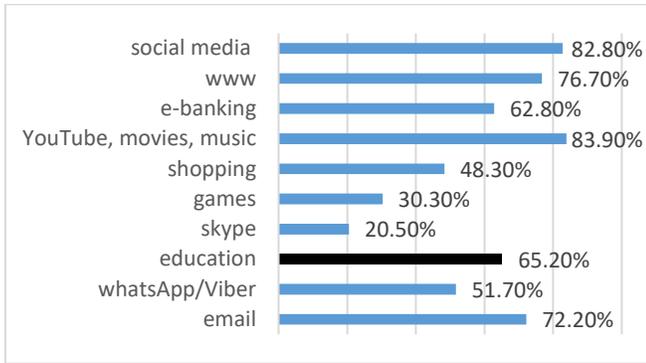
Surprisingly, only 30% of students reported using mobile devices to play games. The most popular applications are YouTube, movies, music, and social media. Students are definitely prepared to use educational applications. Using websites, writing posts in social media, sending emails, using messengers performs similar activities as when using educational applications. Nevertheless, research also shows that 65.2% of students use educational applications. Thus, part 2 of the survey confirmed that students are technologically prepared for mobile education.

IV.1.3 PART 3. ATTITUDES

In total, 65.3% of students reported wanting lecturers to integrate mobile applications into courses, while only 24.7% preferred conventional education. Furthermore, 4.5% feared that mobile applications would make their lives difficult; 44.4% were confident that there are educational applications related to their study subject; students definitely prefer to use free applications; 58.1% believe that mobile education will help them gain better scores; Almost 54% declared that they learn faster, when they learn using mobile devices; 23.6% claim that educational applications will help them be more focused and involved during study; students have specific high expectations regarding the content of educational applications; 38% want to use only mobile devices and not use pen and notebook; 52.7% are ready to learn directly from mobile devices without printing the text; 44.5% claim that mobile devices can replace books; and finally, students do not only use mobile devices during the study process but also expect teachers to include educational applications in the curriculum. These data demonstrate that students' attitudes towards m-learning are positive. Interestingly, however, 73.4% of students do not want to completely give up direct relationship with other students. In the era of social media, students are not satisfied with just online contact with friends.

TABLE IV. STUDENTS' ATTITUDES TOWARDS M-LEARNING

VARIABLE	DESCRIPTION	FREQUENCY	%
ATTITUDE	I would like my lecturer to integrate mobile apps in my course	418	65.3%
	I prefer conventional education	158	24.7%
	I don't know what it is	35	5.5%
	I think mobile apps will make my life difficult	29	4.5%
There are educational apps related with your study subject?	yes	284	44.4%
	I don't know	271	42.3%
	no	85	13.3%
Do you think mobile education will help you gain better scores at university?	yes	372	58.1%
	no	35	5.5%
	I don't know	146	22.8%
	Probably not	87	13.6%
What do you expect from digital education content on your tablet or smartphone?	Presentations	407	63.6%
	Articles	273	42.7%
	Videos with instructions	394	61.6%
	Lecture recordings	299	46.7%
	Educational games	219	34.2%
	Quizzes	351	54.8%
What advantages can be gained from using mobile tools during study?	I think I will be more focused and involved during study and I think I will learn faster.	495	77.4%
	I think I will have a lower	122	19.1%

	cost of education.		
	None	23	3.5%
Can you learn directly from tablet or smartphone without printing the text?	yes	337	52.7%
	no	111	17.3%
	I don't know	43	6.7%
	probably not	149	23.3%
During study, do you use mobile tools instead of notebook and pen?	yes	244	38.1%
Could mobile tools replace books?	yes	285	44.5%
Could mobile tools replace notebooks?	yes	347	54.2%
Could mobile tools replace direct relationship with other students?	yes	170	26.6%
What risks can occur while using mobile tools in the classroom?	Communicators on my mobile tool will distract me.	296	46.3%
	I will surf the Internet.	221	34.5%
	There is a risk I will forget to charge a mobile tool.	230	35.9%
	There is a risk I will forget a mobile tool.	114	17.8%
	I am afraid some of the apps will not work on my mobile tool.	22.5	22.5%

IV.2 Hypothesis Verification

For this test, the null hypothesis is when there is no relationship between two tested variables, whereas the alternative hypothesis says that there is a relationship between the two variables. The Chi-Square test of independence was used to determine whether a significant relationship exists between two variables, at $p < .05$.

HYPOTHESIS 1: Students who own tablets are more interested in m-learning.
We tested the relationship between OT (Owner of tablet) and A (Attitude) and found chi-square=0.478, df=2, p=0.787. Thus, Hypothesis 1 is rejected because $p > .05$. Since only 23% of the sample has tablets, when designing m-learning applications, smartphone parameters need to be considered.

HYPOTHESIS 2: Students whose smartphones have a bigger screen are more interested in m-learning.
In this study, we used the following taxonomy of screen size: 4" – 4.7" – small; 5" – 5.7" – medium; 6" – 7.9" – large. We tested the relationship between SS (Smartphone screen size) and A (Attitude) and found chi-square=8,549, df=6, p=0.201. Thus, Hypothesis 2 is rejected, which reflects the tendency toward mobile devices with larger screen size. In our study, only 13.3% of participants had a small screen size - up to 4.7". Educational materials, for example, figures are easier to read on a larger screen. Screen size is also a crucial guideline for designers of m-learning education applications.

HYPOTHESIS 3: Students who claim that there are educational applications related with their study subject have a better attitude to m-learning.
We tested the relationship between EA (Educational Apps) and A (Attitude) and found that chi-square=23.497, df=4, p=0. Thus, Hypothesis 3 is verified. Students who use mobile devices to support learning - despite it not being formally included in the curriculum – had a positive attitude to m-learning. This also demonstrates that the current generation verify knowledge from classes and compare that knowledge with content on educational mobile applications. It seems to be a natural course of events for the current student body to employ mobile education.

HYPOTHESIS 4: Students who claim that mobile education will help them gain better scores at university have a better attitude to m-learning.
We tested the relationship between S (Scores) and A (Attitude) and found chi-square=85.250, df=4, p=0. Thus, Hypothesis 4 is verified. Ambitious students who are focused on high scores are searching for advanced, up-to-date resources for educational materials.

HYPOTHESIS 5: Students who know the parameters of mobile devices better discern less risk in m-learning.

We tested the relationship between R (Risk) and AS (Awareness – smartphone) and AT (Awareness – tablet) and found chi-square=2.372, df=2, p=0.305. Thus, Hypothesis 5 is rejected. Students are not afraid to use m-learning education even if their knowledge of the parameters of mobile devices is low.

HYPOTHESIS 6: Students who have a particular expectation of educational content for mobile devices have a better attitude to m-learning.

We tested the relationship between variable II (Use of Internet) and variable A (Attitude) and found chi-square=27.845, df=4, p=0. Thus, Hypothesis 6 is verified. Students who have a high expectation of educational mobile applications are aware of the value added by m-learning. It is important for educators to use valuable mobile applications to encourage students to appreciate this way of learning.

TABLE V. **RESULTS OF VERIFICATION OF THE 6 HYPOTHESES**

NR	HYPOTHESIS	APPROVED
1	Students who own tablets are more interested in m-learning	No
2	Students who own smartphones with bigger screens are more interested in m-learning	No
3	Students who claim that there are educational apps related with their study subject have a better attitude to m-learning	Yes
4	Students who claim that mobile education will help them gain better scores at university have a better attitude to m-learning	Yes
5	Students who know the parameters of mobile devices better discern less risk in m-learning	No
6	Students who have a particular expectation of educational content for mobile devices have a better attitude to m-learning	Yes

The results revealed that participants are mentally and technologically ready for m-learning. They not only have positive attitudes towards m-learning but are also highly motivated to use mobile devices in their future education. We also discovered that students use mobile devices to support learning despite it not being formally included in the curriculum. The positive attitude to m-learning also underlines students' expectations regarding the future curriculum, with 65.3% of participants declaring that they want their lecturers to integrate mobile applications in courses. Students are not afraid

of using m-learning education even if their knowledge of the parameters of mobile devices is low. Only 4.5% are afraid that mobile applications will make their lives difficult.

All the hypotheses except 1, 2 and 5 are empirically supported, and confirmed that students are willing to use mobile devices in class. The rejected hypotheses 1 and 2 concern mobile devices. Their rejection shows that owning a tablet or size of smartphone screen do not impact attitude to mobile education. Students are not afraid of using new technologies and new learning methods (Hypothesis 5). Our concern that students with tablets are more interested in m-learning (Hypothesis 1) has been abated because only 23% of our students have tablets. Interestingly, older participants were more likely to have tablets, suggesting that the next generation of students will tend to minimize the number of mobile devices only to smartphones. This is also validated by a global tendency toward a drop-in tablet sales (www.idc.com/getdoc.jsp?containerId=prUS44191918).

The results of our study demonstrate the technological maturity of students at the private University in Europe. They also indicated that m-learning is a promising pedagogical technology to be implemented in higher education environments.

V. CONCLUSION AND FUTURE WORK

The development of information technologies opens up great opportunities for new ways of delivering education. We are aware that the rapid development of mobile education applications is forcing university authorities to create pedagogical strategies to implement m-learning in classes. The society of the 21st century is the society of the World Wide Web. In this context, new competences and skills are required to help university graduates to adapt to the new expectations of employers, and educators are responsible for preparing students to meet those expectations. Students are becoming increasingly involved in new technologies. Thus, it is difficult for educators to beat students in this technological race.

Many factors have been analyzed while examining the attitudes of students towards m-learning. Our research has helped us to create the first reports in central-eastern European area about mobile devices at university and about attitudes toward m-learning among students from 11 different fields of study. Those reports comprise the knowledge base that will facilitate the creation of pedagogical strategies to implement m-learning in classes. On the one hand, this will help our students to gain new competences and skills, while on the other hand, it will increase the status of the University as a modern and technologically developed institution.

Future research should be divided into five stages. The first stage should comprise a systematic review of related literature, familiarizing us with present-day solutions and strategies of m-learning used in university education. The study results have

demonstrated the technological maturity of our students. We must now analyze teachers' attitudes towards m-learning because the success of implementation of m-learning at university depends not only on students' but also on educators' attitudes. To formulate a model of optimal educational applications, the functionality of available mobile applications should be analyzed for selected subjects.

In our study, 58.1% of students reported that mobile education would help them gain better scores, while 53.8% reported that they learn faster thanks to using mobile devices. This information encourages us to analyze the results obtained in particular subjects by students who use mobile education applications and to compare such scores with students who have traditional lessons. The final field of study in which we are interested is to generate a coherent model of strategy implementation for m-learning at the university.

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