Devising and Assessing the Efficacy of Mobile-Assisted Instructional Modes in Mobile Learning

Majlinda Fetaji, Alajdin Abazi, Zamir Dika, Bekim Fetaji

***Abstract*—**The assessment of the efficacy of devised Mobile-Assisted Instructional Modes in Mobile Learning was the focus of this research. The study adopted pre-test, post-test, control group quasi-experimental design. Research instruments were developed, validated and used for collecting data. Findings revealed that the students exposed to Mobile Task Based Learning Mode (MTBLM) in using Mobile-Assisted Instruction (MAI) performed significantly better. The implication of these findings is that, the Audio tutorial and Practice Mode (ATPM) (Stimulus instruments) of MAI had been found better over the other modes used in the study.

***Keywords*—**Mobile-Assisted instructions**,** Mobile learning, learning instructions, task based learning.

I. Introduction

THE portability features and portable and wireless technologies of mobile devices enable learning from anywhere, anytime removing the limitation of time and location which implies that mobile devices enable students to use their time more efficiently.

These technologies are offering new way of learning and teaching which is more comfortable in accessing and sharing electronic learning content. “Just-in-time” instruction via mobile devices is very important and giving opportunity for education to distance students.

Anytime /anywhere access to the learning content promotes collaboration [1], flexibility [8], personalized learning, interactivity, learner-centered and self-paced learning, ubiquitous and learning in a run or mobility in learning [8]. Learning is not constrained by schedules and physical spaces; rather, it is pervasive and ongoing [1]. Learning becomes more situated, personal, collaborative and lifelong and embedded in everyday life [3] and even more constructive informal/learning [8] and [9], and possesses location awareness [7].

Majlinda Fetaji, is with the South East European University Contemporary Sciences and Technologies, Ilindenska bb, 1200 Tetovo, Macedonia, (phone: 00389-70-880-948; fax: 00389-44-356-001; e-mail: m.fetaji@ seeu.edu.mk).

Alajdin Abazi, is with the South East European University Contemporary Sciences and Technologies, Ilindenska bb, 1200 Tetovo, Macedonia, (phone: 0038944-356-110; fax: 00389-44-356-001; e-mail: a.abazi@ seeu.edu.mk).

Zamir Dika is with the South East European University Contemporary Sciences and Technologies, Ilindenska bb, 1200 Tetovo, Macedonia, (phone: 00389-70-330-550; fax: 00389-44-356-001; e-mail: z.dika@ seeu.edu.mk).

Bekim Fetaji, is with the South East European University Contemporary Sciences and Technologies, Ilindenska bb, 1200 Tetovo, Macedonia, (phone: 00389-71-381-384; fax: 00389-44-356-001; e-mail: b.fetaji@ seeu.edu.mk).

In order to investigate the possibilities of using mobile devices [9] especially in devising and assessing the efficacy of two mobile-assisted instructional modes in mobile learning this research was initiated.

The project has been developed under the .NET framework platform using C# language. For content generation purposes we have decided to use the factory pattern which is able to generate parameter specific content in accordance parameter values. In e.g. if required to generate an HTML compatible content the parameter is HTML or default NULL. If required RSS content, the parameter is RSS, and so on. Currently we have developed only HTML and RSS support but future generation of browse specific content is easy as we have developed the core features into an abstract content generation component.

According to the Task Based Learning methodology the process of acquiring material from this application is in this order:

1. Login to personalized page
2. Browse registered courses
3. Browse course weeks
4. Browse course week tasks.

The software solution can be evaluated using mobile device (or a web browser from any computer) using the link below: http://projects.seeu.edu.mk/m-learn

In order to Login please use a valid student account or for testing purposes: Username: ve09342 and for Password: 123abcD.

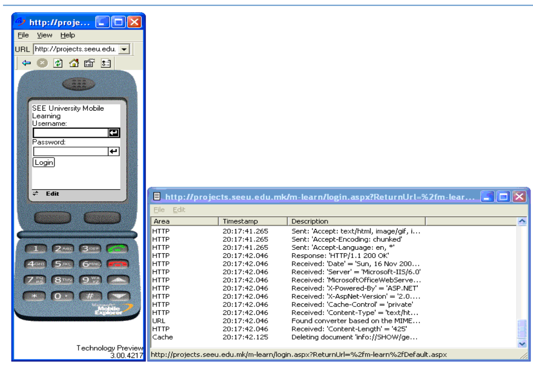

Fig. 1 LOGIN Screenshot of the M-Learn application in mobile emulator

Login page is integrated with the infrastructure authentication services and provides direct matching of usernames and passwords with the ones from the domain services. It means that users do not have to setup and remember new password for using this service, but they can use the passwords they are already using. This is very helpful functionality since it enhances and shortens the user acceptance curve.

The user profile page contains the list of registered courses for this semester. Each of the registered courses is listed with its corresponding course code and course title.

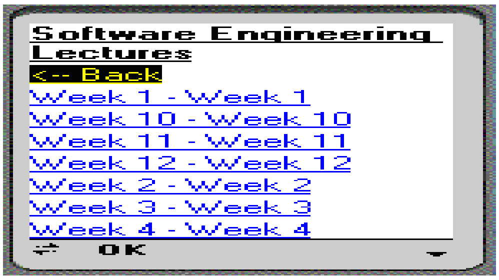

Fig. 3 User Profile Page

This is also very familiar for students because they already are aware of the courses they have registered in the enrollment phase, so they simple can choose one of the courses available in the enrollment list.

The course profile page provides the order list of weeks and selecting the material corresponding to the specified week. The student can choose to go back the course list page to chose another course if prefers so.

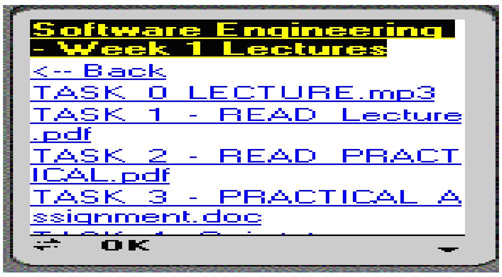

Fig. 4 Week Content for Subjects Organized for Task Based Learning

After the student chooses the required learning week, the complete task set is provided to him in the form of list orders by the requirements of the task based learning methodology.

Starting from the course introduction and slowly progressing to the upper level of the tasks, closing with appropriate tests.

II. Conceptual Framework of MAI

Several technological innovations have been developed to enhance individualized instructions. One of such innovations is the Mobile-Based Instruction (MBI). MBI is the instruction that is mobile-oriented. It is in two folds: 1) mobile-Assisted Instruction (MAI) and 2) Mobile-Managed Instruction (MMI). In MAI, mobile solution delivers instruction directly to students by allowing them to interact with the instructions which are programmed into the system; while, in MMI, the mobile solution helps teachers to administer and guide the instructional process [1]. The possibilities of MAI in various uses are demonstrated in several instructional modes such as tutorial, games, drill and practice, simulation, problem analysis, dialogue, information handling and modeling [2]. However, in this study, practice mode was adopted because it could be easily adapted to the subject matter that is, task based learning mode. The first two modes, that is written tutorial and quiz were used for the two experimental groups because they are unfamiliar to learners while the audio tutorial and practice mode was used for the control group because, it is regarded as the conventional mode of MAI.

III. Study Problem

This study investigated the efficacy of the Mobile-Assisted Instructional mode on students' academic performance in Contemporary Sciences and Technologies (CST) Faculty. The three MAI modes used are written tutorial, quiz and audio tutorial and practice.

This hypothesis was tested at 0.05 level of significance.

H: There is no significant main effect of treatment viz: 1) written tutorial, 2) quiz, 3) audio tutorial and practice on students' academic performance (achievement).

This study adopted the pre-test, post-test, quasi-experimental design with two experimental groups (tutorial and games modes and the control group (audio and practice). The conceptual model for the design is illustrated thus:

E1 A1 T1 B2 (Experimental group 1)
E2 A3 T2 B4 (Experimental group 2)
C A5 T3 B6 (Control group)
Where
A1 A3 A5 - the pretest scores for the three groups;
B2 B4 B6 - the post-test scores for the three groups;
T1 T2 T3 – the treatments: 1) written tutorial, 2) quiz, 3) audio tutorial and practice respectively.

IV. Instrumentation

Four major research instruments were used in the study for data collection. They are Written Tutorial Mode (WTM), Quiz Mode (QM), Audio tutorial and Practice Mode (ATPM) (Stimulus instruments) and Practical Achievement Test (PAT) (response instrument. The instruments: WTM, QM and ATPM were programmed to be used in mobile devices as well as using computers. WTM, QM and ATPM were designed and programmed based on the following procedural steps:

Functional specification of requirements
Systems specification
Programme specification
Writing and testing of the programme
Acceptance by the user.

WTM: A courseware written tutorial was offered following the procedure and topics afore-mentioned. The presentation took the form of a Programmed Instruction (PI). The presentation consisted of short summary of topic information, stimuli (questions) and correct responses in the form frequently asked questions.

QM: The quiz mode were the user will go through and respond to the questions designed and produced through the team work of the researcher, computer programmer and game-instructional designer based on the topics and procedure mentioned above. There are 10 questions the learner will attempt to answer, each with 5 points. The user will go to the next question until the 10 questions are attempted. At the end of the 10 questions, the total obtainable mark scored by the user is 50.At the end of the all questions, the points scored by the learner will be displayed on the mobile screen. If the learner scored

50 is excellent (total mark obtainable)
above 40 is very good
between 30 and 40 is good
between 20 and 30 is fairly good
20 is fair
below 20 is not encouraging

ATPM: The presentation is made up of mp3 audio files which represent a short audio summary of the lecture and practical assignment given to the student selected for the study. After the student learners listen to the mp3 audio files they will move and work on the given practical assignment.

PAT: This instrument was developed by the researcher to test the students' knowledge in the selected three topics. It consisted of multiple choice objective test of 30 items with four tasks options 1-4 which centred on the following levels of cognitive domain, remembering, understanding and thinking based on the scheme used by the Educational Testing Service. It was used for both pre and post-tests. ELUAT methodology as described in [8] combines an inspection technique with e-learning effectiveness evaluation based on 4 (four) usability attributes we have set. The usability attributes we have set are: 1) Time to learn, 2) Performance speed; 3) Rate of errors; 4) Subjective satisfaction. The e-learning-methodology is necessary for presenting and evaluating e-learning in an efficient aspect. The testing procedure and methodology is similar to the previous testing realized. The observed route of a learner has been used to give feedback information on the level of learning and its effectiveness [8] and [9].

V. Data Collection Procedure

The main study lasted for eight weeks. The first week was used for the training and orientation of the tutors and computer instructors that were involved in the study after the researcher had solicited for the cooperation of the principals and those tutors and instructors for the study. During the second week the administration of the instrument, PAT was administered to the students in the three groups: first experimental group that were exposed to WTM, second experimental group that were exposed to QM and those in the control group that were treated with ATPM concurrently as pre-test. The 3rd to 6th weeks were used for the instruction of the students in the selected topics for the study through computer. After the treatment, the 7th and 8th week were used for the administration of PAT again as post-test, simultaneously involved in the study. Four students were assigned to the mobile system. That is, it was ratio 4 students to a mobile. In all, 32 students participated in the study. The instructors worked hand-in-hand in assisting the students on how to use the instruments. A student was allowed to go through the mobile programme for twenty minutes. Each student's score displayed by the mobile monitor was recorded by the computer instructor assisted by the tutor. By the end of 4th week, all students had been given the opportunity to learn through the mobile system several times (3nd – 6th week). After the treatment, the 8th week was used for the administration of PGAT again as post-test, simultaneously in the three schools involved in the study.

VI. Data Analysis and Findings

The data collected were analysed in consonance with the hypothesis tested in the study.

Hypothesis: There is no significant main effect of treatments viz WTM, QM and ATPM on students' academic performance (achievement).

In testing the hypothesis, data were collected and analysed using Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA) to find out the source of significant variation. Tables I to IV present the findings.

Discussion of Findings

TABLE I
Summary of ANCOVA for post achievement scores according to treatment

Source of variation	Sum of Squares	Df	Mean Square	F	P
Covariates (pretest)	10.997	1	10.99	.500	.481
Main Effects	2928.95	2	7	66.52	.000*
Treatment	2	2	1464.	4	*
Explained	2928.95	3	476	66.52	.000*
Residual	2	1	1464.	4	*
	2939.94	1	476	44.51	.000
	8	6	979.9	6	
	2553.64		83		
	3		22.01		
			4		
Total	5493.592	119	46.165		

** Significant at $P<0.05$

Table I shows that the treatment contributed significantly to the variations in students' achievement scores with the result [$F(2,119) = 66.524$; $P<0.05$]. Table 2 shows the pre and post-test achievement mean scores according to treatment.

TABLE II
SUMMARY OF THE PRE-TEST AND POST-TEST ACHIEVEMENT MEAN SCORES ACCORDING TO TREATMENT

Variable Category	N	Pre-test mean scores	Post-mean scores	Gain mean scores
Exp. 1 (TM)	40	35.15	55.75	20.6
Exp. II (GM)	40	35.05	45.18	10.13
Con (DPM)	40	36.04	41.40	5.36

Table II shows the differences in the achievement gain mean scores of 20.6, 10.3 and 5.36 for TM, GM and DPM respectively. However, Multiple Classification Analysis was carried out to detect the source of significant variation. Table 3 reveals the finding.

TABLE III
MULTIPLE CLASSIFICATION ANALYSIS OF THE POST ACHIEVEMENT SCORES ACCORDING TO TREATMENT GRAND MEAN = 46.44

Variable Category	N	Unadjusted Deviation	Eta	Adjusted for Independent Deviation	Beta
Exp. I (TM)	40	9.31		6.76	
Exp. II (GM)	40	7.26		-1.22	
CON (DPM)	40	-5.04		-5.54	.75
Multiple R^2			.70		5.35
Multiple R					2.31

From table III, the Exp I (MAI Tutorial Mode) group recorded the highest post achievement mean score of 55.75 while the control group had the lowest score of 41.402. The R^2 of 0.535 was obtained indicates that 53.5% of the variance in achievement mean scores accounted for by treatment and the rest as a result of error variance.

Meanwhile, to determine the actual source of significant differences indicated in the ANCOVA, a Duncan Post-Hoc analysis was carried out on the mean scores of the groups. Table 4 shows the findings

TABLE VI
SUMMARY OF DUNCAN POST-HOC ANALYSIS ON POST-TEST ACHIEVEMENT MEAN SCORES ACCORDING TO TREATMENT GROUP

		GRP	GRP	GRP
Means	Groups	3	2	1
41.40	3			
45.18	2	*		
55.75	1	*	*	

* Pairs of groups significantly different at $P<0.05$.

From table 4, it could be observed that the experimental group 1 differed significantly from those of group 2 and control group in their mean scores 55.75, 45.18 and 41.40 respectively.

This implies that, the learners differed significantly in the mean post test achievement scores according to the treatment they were exposed to. That is, the experimental group 1 performed significantly better than those of group 2 and 3 (control group).

VII. CONCLUSION

In table II, the findings reveal significant differences among the three modes of MAI used for treatment in the study with the results 55.75, 45.18 and 41.40 post-test achievement mean scores for groups 1, 2 and 3, that is WTM, QM and ATPM respectively. The findings show that learners exposed to written Audio tutorial and practice mode of MAI performed significantly better than those exposed to quiz and written tutorial modes. Those that were exposed to quiz mode also performed significantly better than those exposed to written tutorial mode. These imply that, tutorial mode of MAI seems to be the best mode which can enhance learners' academic performance in mobile learning of the subject Software Engineering. These findings are in support of [5] who found that tutorial mode of MAI enhances academic performance of students in mathematics more than drill and practice mode. [6] carried out a study using drill and practice mode of MAI. She found out that the drill and practice mode contributed significantly to the learners' academic performance in mathematics. She therefore recommended games and problem analysis as modes that can equally enhance learners' academic performance not only in mathematics, but also in other school subjects viz: biology, physics, and chemistry among others. Furthermore, WTM is comprehensive, sequential and in fact easy to operate, while, QM is complex and technical to administer, the ATPM is less comprehensive but interesting to manipulate hence it is good for drilling the students on the already treated topic(s) based on the users' experience during the treatments. Thus, the ATPM was found most superior among the three modes used in the study.

The implication of these findings is that, instructors should be more technologically inclined particularly in the adoption and utilization of mobile devices in pedagogical practices, most especially in efficient and meaningful adoption and utilization of MAI in the development of mobile learning software solutions.

REFERENCES

[1] Abimbade, A. (1997). *Principle and Practice of Educational Technology*, International Publishers Ltd, Ibadan.
[2] Akinyemi, K. (1988). Computer in Education in Agun, A. and Imogie, A. (Eds.) *Fundamentals of Educational Technology*, Y-B Books, Ibadan.
[3] Egunjobi, A.O. [2008]. Effectiveness of the tutorial and games modes of computer- assisted instruction on students' cognitive performance in secondary school mapwork in Ibadan metropolis. *Journal of Applied Education nd Vocational Research*
[4] Jackson, A. and Yamanaka, S. (1995). *Computers and Education*, Collins, New York.
[5] Wilson, P. 1993. An Individual Self-Study System in a Numerical Mathematics Course based on Education Software. *International*

Journal of Mathematics Education in Science and Technology, Vol. 26, No. 1, 5-10.

[6] Shackel, B. , Richardson, S., (1991) "Usability- Context, Framework, Design and Evaluation," in: Human FActors for Informatics Usability, Cambridge University Press, Cambridge, 1991, pp. 21-38.

[7] Nielsen J. (1993) Usability Engineering, Morgan Kaufmann.

[8] Malliou, E., & Miliarakis, A. (2005). The MOTFAL project: mobile technologies for ad hoc learning, in: J. Attewell & C. Savill-Smith (eds) (2005) Mobile Learning Anytime Everywhere: Papers from Mlearn 2004. LSDA, 119-122.

[9] Fetaji B., Fetaji, M.,(2007) "E-learning Indicators Approach to Developing E-learning Software Solutions" – EUROCON 2007, IEEE conference, (pp 2687-2694), Warsava, Poland, 9-12 Sept. 2007.

[10] Fetaji M., and Fetaji, B., (2008)." Universities go mobile — Case study experiment in using mobile devices" – IEEE conference, ITI, Dubrovnik, Croatia, 23-26 June 2008, pp (123 - 128).