

Software Engineering Mobile Learning Software Solution Using Task Based Learning Approach

Bekim Fetaji, Majlinda Fetaji

Abstract—The development and use of mobile devices as well as its integration within education systems to deliver electronic contents and to support real-time communications was the focus of this research. In order to investigate the software engineering issues in using mobile devices a research on electronic content was initiated. The Developed MP3 mobile software solution was developed as a prototype for testing and developing a strategy for designing a usable m-learning environment. The mobile software solution was evaluated using mobile device using the link: <http://projects.seeu.edu.mk/m-learn>. The investigation also tested the correlation between the two mobile learning indicators: electronic content and attention, based on the Task Based learning instructional method. The mobile software solution „M-Learn“ was developed as a prototype for testing the approach and developing a strategy for designing usable m-learning environment. The proposed methodology is about what learning modeling approach is more appropriate to use when developing mobile learning software.

Keywords—M-learning, mobile software development, mobile devices, learning instructions, task based learning.

I. INTRODUCTION

THE aspect of having all pertinent information accessible at a given important moment in real time has lead to the rapid development of the wireless communication and the demands for a low-cost mobile wireless device, especially mobile phones. This influenced many researchers to move from web-based and e-learning to mobile learning which promises easy and convenient ways of learning.

Lately, there is an increasing interest in delivering learning content using Personal Wireless Devices-PWDs. There are many evidences to confirm that cellular phones are the most widely used mobile devices nowadays and their high availability ([1], [2], [7]). However, the network unreliability except the convenience for having it all the time with us, might be one reason more to use mobile devices in accessing confidential information in learning or other sectors.

The small and limited display size and resolution of these devices and interaction styles impose new interface designs. In

this context, the interface has many constraints, needs to be simpler and can contain less number of components and objects. It needs to fit all in one small screen. Usually, the human computer interaction of mobile applications is left behind without consideration. In order to address these issues a case study experiment was initiated. It involved development of a web-based mobile application that students can use and learn within a particular study program.

II. LITERATURE REVIEW

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], [9], flexibility [8], personalized learning, interactivity, learner-centered and self-paced learning, ubiquitous and learning in a run or mobility in learning [9]. 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 [10], and possesses location awareness [7].

The ability to use the device anywhere and anytime is one of the major factors that distinguish mobile personal devices from stationary office-based devices [1]. Online access to information “just-in-time” rather than searching for hand taken notes makes the leaning process more efficient. Mobile devices provide opportunities for visual and literary expression thus the literacy and numeracy of learners improves. Users use mobile devices to process, compute and retrieve information instantly.

III. M-LEARN CASE STUDY IN SEE UNIVERSITY

In order to investigate the possibilities of using MP3 files and mobile devices a research on electronic content was initiated. Based on this previous research developed are usability guidelines by grounding the user interface on

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).

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).

usability theoretical framework, possible constraints, and unique properties of mobile computing.

Three categories of usability have been formulated: user analysis, interaction and interface design.

Usability guidelines will be suggested in aiming for designing highly efficacious, user friendly and usable mobile interface to support dynamicity of mobile and handheld devices.

According to Nielsen [6], usability is not a surface gloss which applied at the last minutes or before the releases of the system or product; but it is deeply affected by every stage of the analysis, design, and development [6].

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.

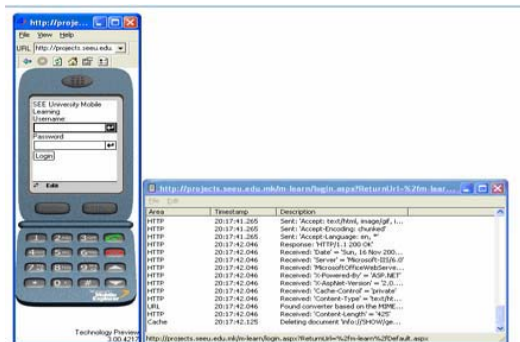


Fig. 1 LOGIN Screenshot of the M-Learn application in mobile emulator

IV. DEVELOPMENT CONCEPT

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

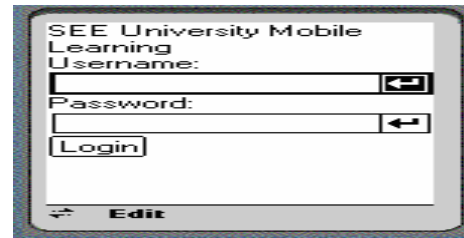


Fig. 2 Login Page

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.

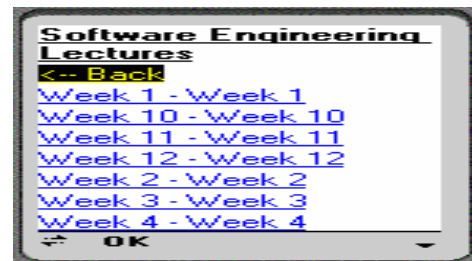


Fig. 3 User Profile Page

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.

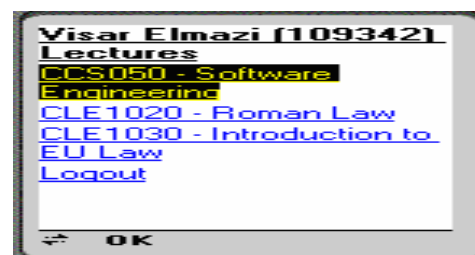


Fig. 4 Course Profile Page

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.

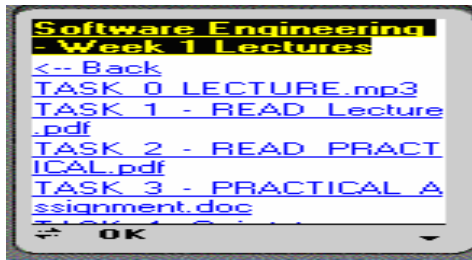


Fig. 5 Week Content for Subjects Organized for Task Based Learning

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.

V. EXPERIMENT

The content developed for e-learning and m-learning is very different from the classical one the print based. Preparing quality electronic content (e-content) delivered digitally is probably the major aspect for long term success of any m-learning endeavor. It is the content, however, that learners care for and they judge it with how much they learn from it. However understanding and managing attention is considered as very important determinant of successful learning. In order for the e-learning content to be considered successful it has to be good in getting attention. Attention by its nature is intangible asset and it is difficult to document its presence and to assess it. Attention cues when the learners begin to feel some mental workload, [1]. In order to assess the correlation between the e-content and attention we have chosen an approach of combining different methodologies: Psychometric tests, Psycho physiological measuring, and ELUAT (E-learning Usability Attributes Testing) methodology, which we named as PTPMELUAT methodology.

This methodology approach was realized in order to assess the correlation between the electronic content (e-content) and attention approaches in combining different types of measurements.

The experiment was based on the developed PTPMELUAT methodology consisted of 3 (three) types of testing and measurements:

1. Psychometric tests
2. Psycho physiological measuring - Biofeedback test
3. ELUAT (E-learning Usability Attributes Testing)

The psychometric test was the first testing realized and it was independent from the other two. The objective of the first testing was to assess the visual conceptualization and the type of learner the students respondents were.

The second and third testing and measurements were realized simultaneously and were conducted in parallel. The objective of the second testing was to measure the attention of the student respondents based on their task based learning

process. The objective of the third task was to measure the e-learning effectiveness assessing the e-content. The student participants were given 4 tasks:

- 1) TASK 1 - Read the lecture material
- 2) TASK 2 - Read the practical material
- 3) TASK 3 - Work on practical assignment and
- 4) TASK 4 - Answer the Quiz question by writing the result of the practical assignment.

Task-based learning is an educationally sound, effective and efficient instructional strategy for learning focusing the learning activities around tasks. The term "task-based learning" according to [10] originated primarily from the work done in language education. The learning tasks play a fundamental role in determining the learning outcomes. According to [10] it has three advantages:

1. Learning built round tasks is more effective than traditional didactic memory-based or purely apprenticeship-type learning;
2. Learning structured round the tasks is an efficient approach to learning;
3. task-based learning is likely to lead to more relevant and appropriate education.

Task-based learning offers action and reflection, while in contrast, rote learning is low in action and in reflection. According to [10] incidental learning, such as occurs in on-the-job learning, is rich in action but may be low in reflection. Classroom, or formal, learning is frequently high in reflection but low in action.

Before each task each student was first tested using the second biofeedback test and then moved to doing the next task. While doing the tasks they were at the same being observed and measured using the ELUAT methodology and then went back to the second testing, and then back and forth until they have finished all their tasks. The methodology was developed initially for e-learning and later decided to adopt for m-learning as well since electronic content (e-content) is considered as the same and the results are applicable.

VI. PSYCHOMETRIC TESTS

The Trail Making Test (TMT) is measuring abilities of visual conceptualization and visual-motor tracking as well as attention and concentration. It has two forms - form A and form B. In form A, subjects are asked to complete number connection task (1, 2, 3...) while in form B, subjects are asked to complete a number - letter connection task (1-A, 2-B, 3-C...), requiring them to switch between two sets of stimuli, hence adding the cognitive load of directing behavior according a complex plan. - Rey Auditory Verbal Learning Test (RAVLT) is one of the most common and useful methods of assessing memory functioning. Using the word list-learning paradigm, subjects are asked to remember as many words as they can in five repeated readings.

VII. PSYCHO PHYSIOLOGICAL MEASURING

Is realized with Instruments constructed by Biofeedback

Computer Systems Laboratory, Research Institute for Molecular Biology and Biophysics, Novosibirsk, Russia.

We have realized this measurements having as subject 36 students from East European University- Tetovo, Macedonia.

Time of reaction to the obstacles which appeared occasionally on the racer's way measures the power of the distributed attention and correlates with the performance level. The game-based biofeedback technology in our study was used to achieve the following goals:

- to model situation of ambiguity
- to reveal individual stress response pattern
- to train self-regulation techniques

The experimental situation involved high level of ambiguity for subjects because:

- Biofeedback method appeared to be new and unknown for a subject
- Information incompleteness for a subject was based on the use of uncertain instructions
- A subject was aware of the aim of the experiment but was not instructed how to achieve this aim.



Fig. 6 Reaction Rime (RT)

In this test, attention concentration level was registered determined by the latent response time (RT) to obstacles (rocks appearing on the road).

Successful performance during stress test depended on the subject's skill of heart rate control. We calculated: reaction time (RT), omissions (inattention), commissions (impulsive reactions) and time of performance (PT) as indicators of attention and concentration and heart rate (HR) as indicator of stress-regulation ability.

We had student participants out of which: 36 healthy students, 12 girls, 24 boys, mean age $20, 9 \pm 2, 15$. Example for RT of one student:

The reaction time is diminished 60%, which is an excellent result.

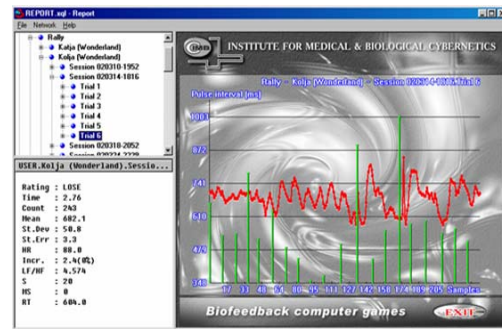


Fig. 7 Display of the original instrument

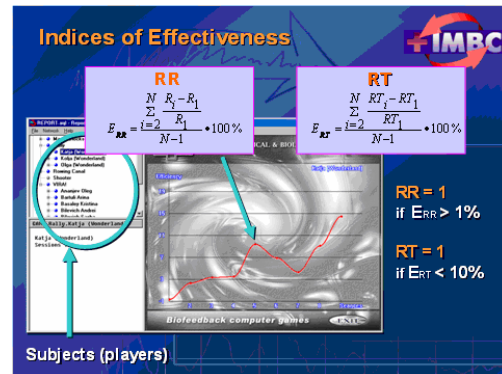


Fig. 8 Indices of Effectiveness

VIII. ELUAT TESTING

- 1) ELUAT methodology as described in a previous study [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 under the other 4 experiments. The observed route of a learner has been used to give feedback information on the level of learning and its effectiveness.

IX. RESULTS

Psychological tests: Rey Auditory Verbal Learning Test (RAVLT) showed highly organized ability for learning new knowledge as well as attention and concentration, which can be seen from the progression in the obtained new knowledge. Female subjects are learning much faster than the male subjects.

The Trail Making Test (TMT) showed generally that visual conceptualization and visual-motor tracking as well as attention and concentration are highly organized in both groups of subjects. In form A, male subjects have better time of completion the form than the girls (boys on 75 percentile, girls on 50 percentile) which differs from the data in the literature. In more complex task, as form B, girls have better

performance than the boys, but both groups are at 50 percentile.

Correlations:

- Reaction time: commission
- Reaction time: omission
- Reaction time: heart rate
- Reaction time: time of performance

A high positive correlation between RT and omission, RT and commission and RT and performance time (PT) in all 6 trials was obtained. In addition there is negative correlation between RT and HR.

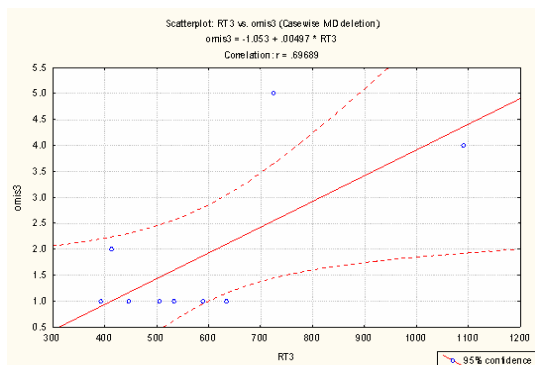


Fig. 9 ScanPlot of the Results from the Machine

X. CONCLUSION

This study investigated human computer interaction by testing the correlation between the two m-learning indicators electronic content and attention as defined in [8] and [9] based on the Task Based learning instructional method.

The results of measuring the attention and e-content through the realized tests we have concluded that the attention is dropping early in the beginning after the first task, being the reading task that requires the learners to concentrate on reading new information.

Later after the second task attention is again increasing and it reaches its maximum at the fourth task being the quiz task. And later for the final task it drops again as a result of the relief that they have come to the end and expressed boring / fatigue.

Key Auditory Verbal Learning Test (RAVLT) showed highly organized ability for learning new knowledge as well as attention and concentration, which can be seen from the progression in the obtained new knowledge. Female subjects are learning much faster than the male subjects. No changes in the time of performance. After a few bad results, the students manifested improvement of the total time for performance (adaptation in the test situation).

The commission's number is much greater after the third task (they are bored or tired, or the task is too hard). Omissions are greater after the fourth task (attention is diminishing because of boring or tiredness).

The greater impulsive reaction (commissions) after the 5-th task could be interpreted with the feeling of boring / fatigue. Statistical analysis showed significance at the level $p < 0.03$.

We recommend focus on the three dimensions of strategic instruction given below in order to increase attention:

- Think-ahead instruction (to activate students' background knowledge, motivate students, create student-interest and create an anticipation for learning);
- Think-during instruction (to use as new subject-matter is explored); and
- Think-back instruction (to facilitate student review of main ideas and essential details, reflection, evaluation, and elaboration of the information presented during the lesson).

REFERENCES

- [1] Hyypää, K., Tamminen, S., Hautala, I., Repokari, L. (2000): The effect of Mental Model Guiding User's Action in Mobile Phone Answering Situations. In *Electronical proceedings from The 1st Nordic Conference on Computer Human Interaction*. 2000. Stockholm, Sweden: NordiCHI 2000.
- [2] Iacucci, G., (2001) Bridging Observation and Design in Concept Development for Mobile Services. In *Third International Symposium on Human Computer Interaction with Mobile Devices, IHM-HCI 2001*. Lille, France
- [3] Jones, M., Marsden, G. (2005): *Mobile Interaction Design*. John Wiley and Sons, Hoboken, NJ
- [4] Kiljander, H. (2004): *Evolution and Usability of Mobile Phone Interaction Styles*. Thesis, Department of Computer Science and Engineering, Helsinki University of Technology
- [5] Kukulska-Hulme, A., & Traxler, J. (2005). Mobile teaching and learning. In A. Kukulska-Hume & J. Traxler (Eds.), *Mobile Learning: A Handbook for Educators and Trainers*. London: Routledge.
- [6] Nielsen, J. (2000). *Designing Web Usability: The Practice of Simplicity*. New Riders Publishing, Indianapolis, ISBN 1-56205-810-X
- [7] Palen, L., Salzman, M., Youngs, E. (2000) : Going wireless: behavior & practice of new mobile phone users. In *Proceedings from the 2000 ACM Conference on Computer Supported Cooperative Work*. 2000. Philadelphia, PA: ACM Press.
- [8] Fetaji B., Fetaji, M. (2007) "E-learning Indicators Approach to Developing E-learning Software Solutions" – EUROCON 2007, IEEE conference, (pp 2687-2694), Warsaw, Poland, 9-12 Sept. 2007.
- [9] Fetaji M., Fetaji, B., (2008). "Universities go mobile -Case study experiment in using mobile devices", IEEE conference, Information Technology Interfaces, 2008. ITI 2008. 30th International Conference, Dubrovnik, Croatia, 23-26 June 2008, Page(s):123 - 128
- [10] Garner, S. (2005). The Use of Task Based Learning in a Web Commerce Development Undergraduate Unit. In P. Kommers & G. Richards (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2005* (pp. 3117-3122). Chesapeake, VA: AACE.