

MTEACHER: A TOOL FOR SELF ASSESSMENT AND PROVIDING PERSONALIZED ASSISTANCE TO M-LEARNERS: A FRAMEWORK AND EVALUATION

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The impact of the developments and popularity of mobile and wireless technology has given new direction for e-learning known as m-learning. The proper assessment of the learners' readiness to appear for placements merits attention at all levels in the learning system. Self-assessment is an important part in the learning process of the students to ensure their level of knowledge in the subjects as expected before going for interview and to decide the area to be concentrated more. In this paper, we propose mTeacher, a mobile-based self assessment system to assess the knowledge level of learners in their area of interest and to assist by giving feedback. The major objective of this study is to propose a framework and to evaluate the system and to explore the level of learners' acceptance towards the system. In this study the five factors (result of the learners, satisfaction level of learners, convenience of learners, feedback about skill level, assisting the learner) are investigated whether they have positive influence on mTeacher or not. The

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feedbacks of both teachers and learners were highly motivating.

1 Introduction

Mobile learning is defined as the delivery of learning content to learners utilizing mobile computing devices (Traxler, 2007). Currently mobile technology offers a good tool that can be used to deliver learning materials such as short messaging service (SMS), multimedia messaging service (MMS), Third Generation (3G) and Fourth Generation (4G). These technologies can make a learning process interactive, and collaborative. As a result new era of learning and training approaches have emerged where students can learn independently at any time and from any location (Anani, 2008).

Many advantages found in the traditional classroom learning scenario. For example, natural communications, direct interactions, gestures, mimicry, body language and recognize the emotional state. These features making learning in the classroom is still the most common way of learning (Singh & Bakar, 2006). Unfortunately, the increase the number of students is the serious problem for traditional way of assessment in class rooms. In the e-learning scenario the assessment mechanism is very important for the students to know whether they have gained the needed knowledge as expected after learning a topic. Every student wants to assess themselves before going for an interview. Self assessment is an important part in the learning process of the students to ensure their level of knowledge in the subjects as expected before going for interview and to decide the area to be concentrated more for better understanding.

In recent years, most universities and training institutes recognized the importance of wireless / paperless campus. So, the students can easily access the course materials and information systems by using their mobile phones and PDA devices from anywhere and at any time.

2 Related Work

The developments in information and communication technology (ICT) have moved the teaching learning process from teacher centric to learner centric and emerged new era in learning called as e-learning and m-learning. In e-learning, learner can communicate with teacher and other fellow learners asynchronously at the learner's own pace or on an as needed basis. Learner convenience can be improved when e-learning systems are coupled with more learner centred instructions (Liaw, 2010). E-learning is emerging as the new paradigm of modern education. Worldwide, the e-learning market has a growth rate of 35.6%, but failures exist. The failure of e-learning is because of the dissatisfaction of learner with e-learning system. The critical factors affecting

learners' perceived satisfaction in e-Learning are: i) learner computer anxiety, ii) instructor attitude toward e-Learning, iii) e-Learning course flexibility, iv) e-Learning course quality, v) perceived usefulness, vi) perceived ease of use, and vii) diversity in assessments (Sun *et al.*, 2008). In order to increase the satisfaction of the learners with e-learning, it is important to understand the learner's interest and attitude and providing suggestions / recommendations to reach the goal.

M-learning is considered as the next generation of e-learning using mobile technologies (Wu & Chao, 2008). Students' awareness of such technology is one of the most focuses for success adoption. Survey conducted by (Alzaza & Yaakub, 2011) shows that students have adequate knowledge and good awareness to use such technology in their education environment. As mobile technologies have become pervasive and popular, many researchers (Hwang & Chang, 2011) have questioned whether they can enhance learning experiences. It is proved that the learners will have different learning experience with m-learning. Mobile phones and PDAs are converging into mobile lifestyle devices that offer a wide range of applications to end users (Udanor & Nwodoh, 2010). The pedagogical and technological approach to the design of learning activities that can be conducted inside as well as outside the classroom by using iPads was introduced by Manfred Lohr (Lohr, 2011). There is an increase use of wireless technologies in education all over the world. In fact, mobile technologies are revolutionizing education and transforming the e-learning into anytime and anywhere education reference to the potential of learning new technical English language words using Short Message Service (SMS) text messaging (Godwin-Jones, 2011).

There are some m-learning systems available in the market such as "Moodlible", a mobile extension for Moodle e-learning system (Alier *et.al.*, 2007), LMS:Moodle, a mobile scenario for the most popular Free Open Source (FLOSS) learning management system (Alier *et.al.*, 2012). Much of the interest so far in m-learning has been focused on development of tools for teacher administration, course management, notes taking, course material delivery, UI design, personalizing course content, learning the learners behaviour and interest, personalization, collaborative learning. Many of these applications will have the ability to adapt themselves to the user's situation, commonly referred to as context awareness. To our level best knowledge, no paper is available for self assessment of learner.

A study was made to determine the impacts of paper based, web based and mobile based assessment on the achievement of the students in the Internet assisted instruction. It was found that students had positive perceptions on mobile based test (Karadeniz, 2009).

3 mTeacher Framework

The framework for mobile learning proposed by (Wu *et al.*, 2012) supports the concepts such as a provision of interactive forum for asking questions of the professor, a place to comment on information about the class or related topics, a delivery system for submitting or presenting assignments or class announcements, and development of a 24/7 learning community for the class. This framework does not talk about self assessment of learners. mTeacher supports the concepts outlined by (*Ibidem*) and the feature for self assessment and assistance. The “Exam Generation” module generates the exam and after answering every question it gives assistance to the learner in terms of more explanation and suggestions/guidance. “Performance Analysis” module gives feedback about the performance of the learner at the end of the exam.

4 System Overview

The purpose of m-teacher is to allow the students to test their knowledge in their area of interest and to get feedback about their strength and weakness. Based on the feedback the students can assess their readiness before going for placements. We use mobile because it is the most popular communication device among the students and they can take the test at any-time from anywhere. This will attract the students’ community more.

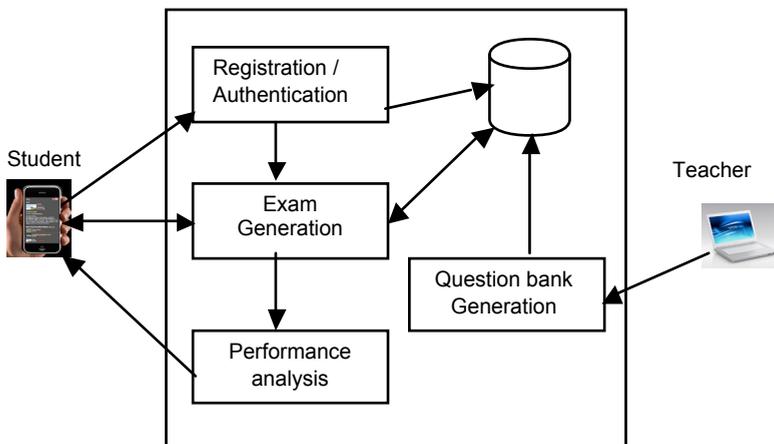


Fig. 1 - Architecture of the Assessment system

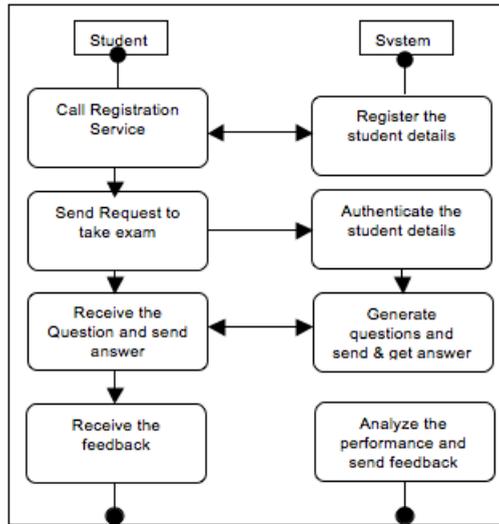


Fig. 2 Activities diagram for the mobile-based self-assessment system

The system contains the following entities: i) Student Registration ii) Question Bank Creation iii) Exam Generation and iv) Performance Analysis and feedback. Fig. 1 shows the entities involved in the system and the activities diagram for the self-assessment system is given in Fig. 2.

The first stage in the assessment process is registration of students. Students who want to take test for the first time has to register their name, qualification, mobile number and their area of interest. After registration, the student can take the test only from that mobile.

When the students wish to take the test on the particular topic, the exam generation module will generate the test based on the qualification, subject, the tests already taken and the performance in the previous exams. The question_bank.xml document contains the question, answer options, correct answer, difficulty level, subject category, type of question, maximum time for answering the question and credit for correct answer. The teacher specifies the difficulty level of the questions. Five difficulty degrees have been considered ranging from level 1 to level 5 (1 for easy and 5 for difficult).

The main objective of the exam generation module is to generate balanced set of questions that containing different type of questions, covering the entire content and displaying gradually from easiness to difficulty based on the students qualification, tests taken so far and performance in the previous exam. We have used “GenerateExam” algorithm for generating the exam questions. GenerateExam Algorithm is explained below.

Algorithm GenerateExam

```

Calculate_Difficulty(); /* determines the difficulty level of
                        the question */
for i = 1 to No. of Questions to generate
{
    Select_and_Pick_Question(); /* selects the type of
                                question and pick the question based on difficulty level and previous exam */
    Display_Question(); /* sends the question with
                        answer option to the mobile */
    Get_Answer(); /* calculates the time for answering
                  the question and gets the answer from the user mobile */
    if answer is correct then
        switch (TypeofQuestion)
        {
            case Aptitude: Correct_Aptitude++;
                          break;
            case Logical: Correct_Logical ++;
                          break;
            case Analytical: Correct_Analytical ++;
                          break;
            case Technical: Correct_Technical ++;
                          break;
        }
    else
        Wrong_answer++;
    ReCalculate_Difficulty(); /* recalculates the difficulty
                              of the question */
}
end GenerateExam

```

The following are the methods of our algorithm.

- **Calculate_Difficulty():** This method determines the difficulty level of the question to generate based on the qualification, performance in previously taken exam. Current difficulty level of each question is available in the XML document. This method will calculate the capability of the learner and based on the capability this method will calculate the difficulty level of the question to be presented to the learner. Since the learner not yet started answering questions, this method calculates the difficulty based on the capability of the learner.
- **Select_and_Pick_Question():** This method the selects the type of question and pick the question based on difficulty level and previous exam.
- **Display_Question():** This method sends the question with answer option to the mobile.
- **Get_Answer():** This method calculates the time for answering the question and gets the answer from the user mobile.
- **ReCalculate_Difficulty():** This method recalculates the difficulty of the question to generate next based on the answer to the current question and time taken. We used Item Response Theory (IRT) to measure the ability of the learner after answering every question. IRT attempts to model student ability using question level performance. We used IRT to

recalculate the capability of the learner, the difficulty level of the question attempted and the difficulty level of the question to be presented next based on the answer to the question attempted and time taken to answer it. Based on the IRT, it is easy to get more information about the capability of the learner from the question answered and more information about the level of the question from the learner. This makes our proposed algorithm more adaptable for different learners.

From the question answering session of the Exam Generation module, the response of the students for each question was accounted. Based on the scores of each question, the system automatically calculates the scores in each of the category of questions. Performance analysis and feedback entity consults the Bayesian network for the probability of the student having excellent, very good, good, satisfactory, average or below average performance in each category. The system takes the category with the higher probability and stores the information along with values of other attributes. Then the system will provide the feedback accordingly to the user.

5 Case study design and implementation

The development of the mTeacher was done at our college and integrated with our existing Moodle tool. The total number of participants of the implementation were 500 Computer Science and IT students with 300 at Undergraduate (UG) level and 200 at Postgraduate (PG) level doing their final year of their degree and preparing for placements. Table 1 shows the total participants. Each student was equipped with a mobile device. The students were advised to take two tests one in the course “Data Structures” and another in “General Aptitude” and they took the test at their own time. The same set of students took the test using e-learning and also hard paper exam. We designed a questionnaire and collected feedback from all the students through the feedback tool in Moodle in order to express anonymous their opinion about taking assessment using hard paper, e-learning and mTeacher.

Table 1
TOTAL PARTICIPANTS

	Sex		Discipline		Experience in e-learning	Total
	Male	Female	Science Stream	Engg. Stream		
UG Level	186	114	100	200	210	300
PG Level	134	66	160	40	114	200

6 System Evaluation

The two major goals for evaluating our system were to:

- observe the impact of using mTeacher in the results of the learners in a classroom setting with students and obtain student feedback on our mTeacher, and
- determine the learners interest, satisfaction of learners, learners acceptance on mTeacher, in general, after participating in our study.

Therefore, the evaluation process was broken into two phases. Students were shown how to access and use mTeacher during a class session and were instructed to take test within 10 days at any time which is convenient to them and then we have conducted the test using hard paper and e-learning system. In first phase, the emphasis was only on the result of the tests and pass percentage and the assistance given to them at the time of taking the test, while in phase two the emphasis was on student satisfaction, interest and their general perceptions on mTeacher.

The pass percentage in all three test modes (hard paper, e-learning system and mTeacher) of the learners at UG level is given in Table 2.

Table 2
RESULT OF THE LEARNERS AT UG LEVEL

Category of learner		Total Learners	Pass % in Paper Exam	Pass % in EL	Pass % in mTeacher
Sex	Male	186	68.8	71.5	90.9
	Female	114	79.8	86.8	93.0
Discipline	Science	100	72.0	83.0	91.0
	Engg	200	73.5	74.5	92.0
Exp. in EL	Yes	210	71.0	76.2	93.8
		90	77.8	80.0	87.8
Total		300	73.0	77.3	91.7

To analyze the result we have categorized the students based on sex, discipline and their experience in using e-learning system. To the surprise, the pass percentage is more in mTeacher irrespective of the category of learners.

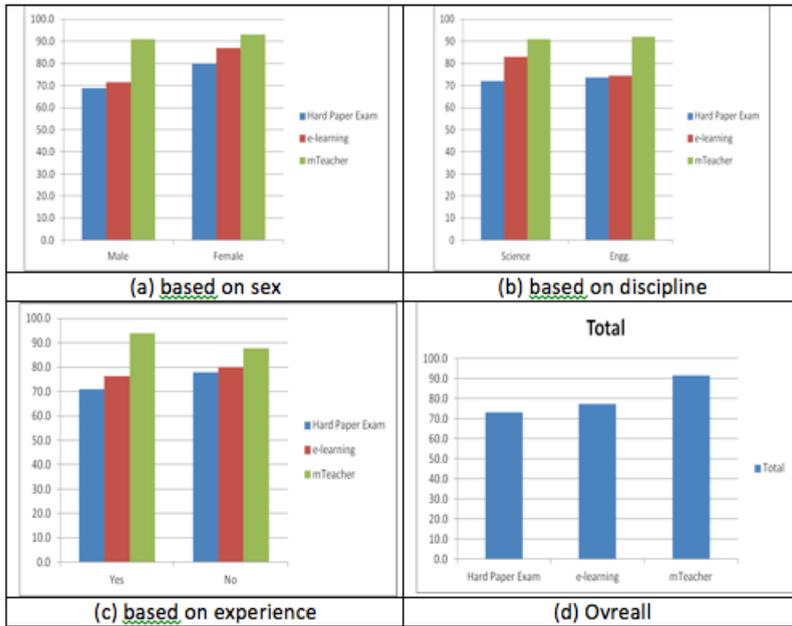


Fig. 3 - Chart showing the result of the learners at UG level in hard paper, e-learning, mTeacher

Fig.3 shows the result of the learners at UG level in various categories like sex, discipline, experience in e-learning and for all learners respectively. We infer that female learners pass percentage in hard paper and e-learning system is more than that of male learners. Generally female students will be more focused on learning than male learners and their presentation is good. But the pass percentage in mTeacher is almost the same for both. So, mTeacher has increased the pass percentage of male learners. Even though science stream and engineering stream students' performance is at the same level in hard paper exam, their e-learning result differs. But again their performance is at the same level in mTeacher.

The pass percentage of the learners at PG level is given in Table 3.

Table 3
RESULT OF THE LEARNERS AT PG LEVEL

Category of learner		Total Learners	Pass % in Paper Exam	Pass % in EL	Pass % in mTeacher
Sex	Male	134	77.6	88.8	94.8
	Female	66	74.2	81.8	93.9
Discipline	Science	160	77.5	86.3	94.4
	Engg	40	72.5	87.5	95.0
Exp. in EL	Yes	114	73.7	88.6	96.5
		86	80.2	83.7	91.9
Total		200	76.5	86.5	94.5

Fig. 4 shows the result of the learners at PG level in various categories like sex, discipline, experience in e-learning and for all learners respectively. After taking the exam all the learners had to fill in a questionnaire with general and specific questions related to the method of testing, usefulness and satisfaction. The most significant questions reflecting student opinion are given in Table 4 with the average and standard deviation. An empirically validated survey instrument developed for measuring learner satisfaction for e-learning systems was customized for this study. Questions focusing on both usefulness of the mTeacher as well as learners' satisfaction with mTeacher were asked using a 5-point Likert scale with strongly agree as 5, neutral as 3 and strongly disagree as 1 on the Likert scale. The results from the survey are shown in Table 4. The results from the survey indicated that the learners found our mTeacher useful and a good complementary tool for other assessment tools. Learners expressed their satisfaction with the assistance and feedback given by mTeacher. The highlight of mTeacher is learners' convenience in terms of time of use. However, learners are not satisfied with the way of reading and in entering the answer because of the size of the portable devices display and keypad. But some learners were satisfied because they used large display devices.

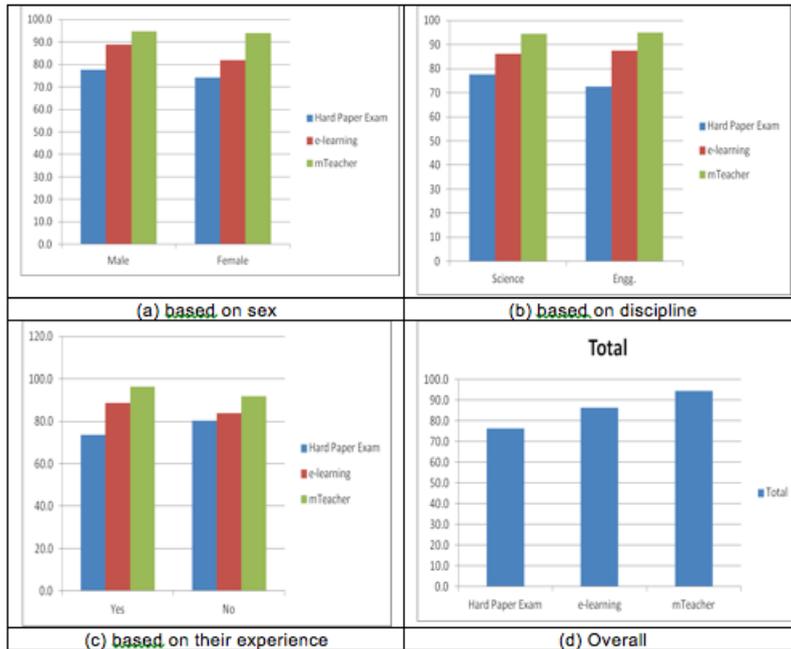


Fig. 4 - Chart showing the result of the learners at PG level in hard paper, e-learning, mTeacher

Table 4
RESULTS OF THE QUESTIONNAIRE FOR 500 LEARNERS

	Average	Std. Dev
1. Do you trust the mTeacher assessment system?	4.25	0.62
2. How do you feel in reading the question and in entering the answer? mTeacher was easy to use?	3.01	0.93
3. Are you satisfied with your result given by mTeacher?	4.7	0.56
4. Whether mTeacher was convenient?	4.66	0.63
5. Are you satisfied with the feedback given by mTeacher?	4.25	0.72
6. mTeacher was easy to understand	4.15	0.84
7. Satisfied with the assistance provided by mTeacher	4.81	0.54
8. overall satisfaction with mTeacher	4.56	0.61
9. Ready to use mTeacher for self assessment	4.42	0.78

As a result of, the system is working properly. Most learners consider that the system is useful and they are satisfied with their result and feedback. Finally majority of the learners trust more on mTeacher than web-based and

paper based methods.

Conclusion

In this paper, we proposed mTeacher, a simple and easy to use mobile-based self-assessment system. The study investigates that the five factors (result of the learners, satisfaction level of learners, convenience of learners, feedback about skill level, assisting the learner) have positive influence on m-teacher.

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