DEVELOPMENT OF e-ASSESSMENT SYSTEM FOR LABORATORY PRACTICAL TEST: e-PraTeSiM

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Abstract: The development of e-assessment system of laboratory practical exam/test for Civil Engineering Diploma students is presented. The conventional laboratory practical exam requires lecturers to be on-site or in campus to make the assessment for their students. This new approach provides a broad access for a lecturer who is not able to attend the conventional laboratory exam at the laboratory and on the scheduled time. Furthermore, the e-PraTeSiM system also allows:- (i) the enhancement of practical exam assessment standard due to the mechanism used in the system; and (ii) the improvement of digital student record. This system is simple, flexible and user friendly. The implementation of this system was done, firstly, by recording or lives streaming of the student who is doing the practical exam in the laboratory. Then, the student was asked with some questions provided in the system and his/her answer was recorded. The body gesture and voice level of the student were recorded in the system and used to evaluate the level of psychomotor and affective domains of the students that are included in the Outcome Based Education (OBE) requirements. Thus, the overall assessment for the student can be done efficiently and accurately. This system also includes a QR code for each student, displaying their results and performance individually. This data will be included in the student digital record as a reference for lecturers and future employers (for student). This system is an evolution of practical test assessment that fulfils the vision and mission of UiTM towards Industrial Revolution (IR4.0).

Keywords: e-assessment, student assessment, practical test, civil engineering

Introduction

The implementation of laboratory or practical demonstrations are required for engineering students, particularly civil engineering. These are essential to develop their engineering skills which involves techniques, procedures, handling machines and others. Many technology advances have been applied in teaching and learning process, thus, to be in line with the current education demand. The teaching and learning process has always been updated to be in line with recent technology such as Industry Revolution 4.0 (IR4.0).

The teaching and learning process involves delivery, evaluation and implementation. The process of transferring knowledge and skills is strictly associated with the measurement of its effectiveness – checking the results and evaluation the students. The current educational system is based on the conventional paradigm – face-to-face (F2F) contact between tutor/lecturer and student (Betlej, 2013). Consequently, this system faces a big resistance and difficulty to implement new educational solutions- expected by young generation due to the rapid changes in technology. This is closely linked to the examination system and the revolution of existing conventional exam evaluation into e-examination (e-Exam). E-exam is defined as the use of information technology for any assessment related activity (Hamsatu, *et al.*, 2016). This study focuses on the development of an e-evaluation system (e-PraTeSiM) to assist on the evaluation of student practical examination/test and enhance the assessment standard. Furthermore, this system also aims to facilitate the implementation, validation and documentation processes of the practical courses.

Materials and Methods
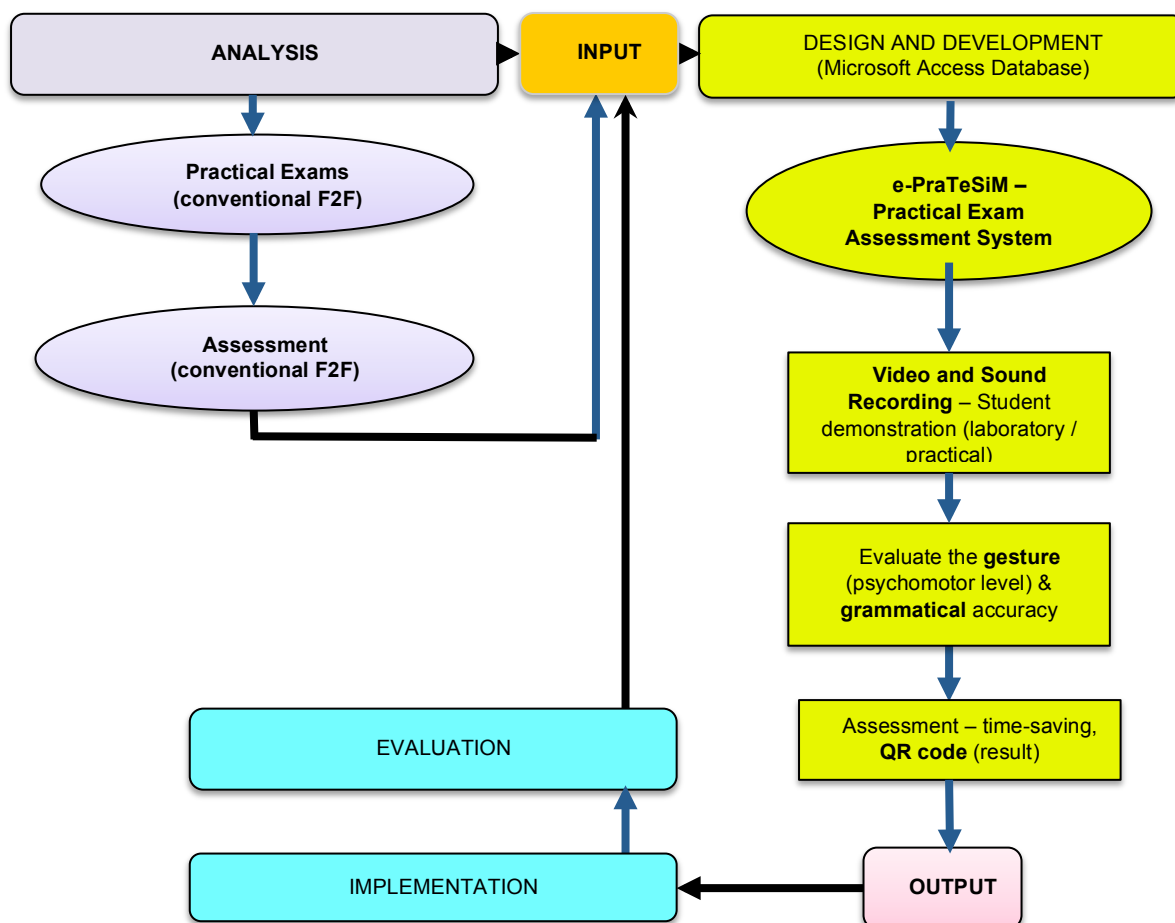
i) e-PraTeSiM System

Fig. 1 Flowchart of designing e-PraTeSiM

e-PraTeSiM was designed using Microsoft Access Database by integrating softwares such as gesture detection and others. Fig. 1 shows the overall process of the development of e-PraTeSiM to fulfil the needs of syllabus, Outcome Based Education (OBE) and Engineering Technology Accreditation Council (ETAC).

ii) Implementation of Practical Exam and e-PraTeSiM Assessment

The practical exam by the student was arranged in the laboratory and recorded (video) using a camera by a technician. The exam time given was about 15 minutes/ student. Then, the student were required to answer several questions set in e-PraTeSiM. Three levels of questions, short, medium and long, were asked and the answers were recorded (audio). Both recorded video and audio were uploaded on the e-PraTeSiM system by the student via e-PraTeSiM app. Finally, the student practical and cognitive performances were evaluated by the lecturer.

Results and Discussion

Conventional practical exam assessments have drawbacks as summarised in Table 1. These drawbacks were considered in the process of developing e-PraTeSiM system. Furthermore, the requirement of OBE and ETAC were also included to support the system and suitable to be implemented for Diploma of Civil Engineering students.

Table 1 Factors considered in developing e-PraTeSim

Factor	Drawback
Face to Face	Lecturer has to be present during the exam
Time	Time consuming
Accuracy of the assessment	No standard system to assess on psychomotor and affection domains

The laboratory practical exam was conducted twice of the semester (in Week 7 and Week 14). The practical exam consisted of two parts: (i) Part 1 was to determine the student ability to conduct or demonstrate the experiment/ practical. In this part, students were asked to set up the apparatus, prepare the sample and demonstrate the experiment by following the procedures. All these steps were recorded and the student performance was assessed. (ii) Part 2 was to identify the student ability to recognize the objective and basic concept of the experiments. The students were asked questions on the objectives, concept and understanding of the topic related to the experiments.

The interface of the e-PraTeSiM system is shown in Fig. 2. The e-PrateSiM system was designed with details of lecturers, students and assessment. It is more flexible and enhances the quality of the assessment and student digital record.

Fig. 2: Interface of the whole e-PraTeSiM system

Flexibility

Previously, the laboratory practical test was monitored by two lecturers with ratio lecturer: student of 1:15. These lecturers were responsible to do both oral and practical examinations. The evaluation of both examinations were done in situ within the time scheduled (2 hours/ session). However, it required extra time when a large number of students were sitting for the practical exam. This affected the student class schedule. Therefore, the features developed in e-PraTeSiM offers a flexibility assessment, where lecturers can evaluate the performance of the student either in the laboratory or beyond the actual practical exam session. Thus, this offered flexibility for lecturers who is not able to attend practical exams in the laboratory at the scheduled time and can still do the assessment off campus.

The function of video (Fig. 3) and voice recordings (Fig. 4) features in this system assisted in accessing student practical skills based on psychomotor and affective domains. Both recordings can be played repeatedly to assist in the evaluation of student performance.

Fig. 3 The recorded video was uploaded into the e-PraTeSiM system and can be watched repeatedly to evaluate the performance of the student
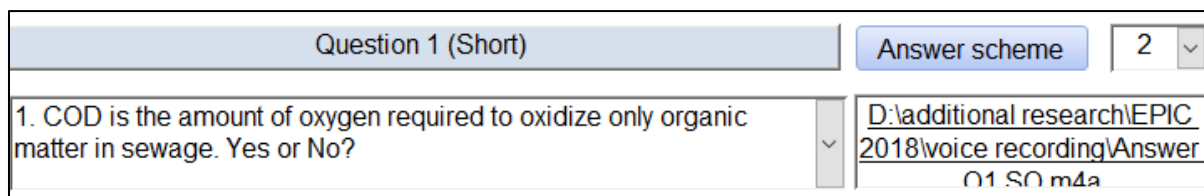

Fig. 4 The recorded audio was uploaded into e-PraTeSiM system and can be played repeatedly to assess the answer given by the student.

Enhance the Standard of Assessment

Assessment is an accurate measurement of the student performance which requires evidence of the student knowledge, skills and abilities (Alias, 2005; Harlen, 2007). In Diploma of Civil Engineering, student ability in integrating theory and practical is important to ensure learning objectives stated in OBE and ETAC are achieved. The conventional assessment method for practical works evolved from the evaluation of technical report to practical skill exam (Zaghloul, 2001; Alinier & Alinier, 2005; Salim et al., 2012). This is due to the ability of the students performing specific laboratory activities such as setting up the equipment and demonstrating the experiment could not be assess from the technical report. Thus assessment method changed to the physical actions evaluation of the engineering students in laboratory works, the psychomotor domain with different level was used for reference to grade the students (Kennedy, 2006; Salim et al., 2012)

A comprehensive and reliable assessment mechanism is essential to have an accurate evaluation of the student performance. To enhance the assessment of the practical exam, this system provided automation evaluation based on the student body gestures (movements) to give an overview of the psychomotor level during demonstrating the experiment. Furthermore, the system included automation evaluation for language used such as grammar accuracy and voice and sound clarity to guide the lecturer to grade the students. Therefore, the overall assessment for the students completed efficiently and accurately (Fig. 5). Although five different lecturers involved in assessing the students, the special features in e-PraTeSiM allowed fair and standardized assessment for all students.

Fig. 5: Special features in e-PraTeSiM (shown in red box) use to detect language proficiency, voice and sound clarities and body gestures.

Consolidation and Management of Documentation

The e-PraTeSiM system is a database to obtain all necessary documents involve laboratory activities such as rubric, questions and answer of practical exam, grading, student information, student performance and others. These documents may be required for audit purposes, that is conducted every semester at Faculty Civil Engineering (FCE). Eventually, this system facilitates the lecturers obtaining relevant information related to teaching and learning. This system can be a digital evident to the auditors who are assessing the syllabus, assessment scores and others. For example, if the auditors did not satisfy with the score given by the lecturer during the practical exam, they were allowed to check by reviewing the videos uploaded into e-PraTeSiM system.

The students could check their results via e-PraTeSiM online, thus, it made the system more transparent in scoring and grading the students. Furthermore, the student could use the QR code embedded in the system (Fig. 3), consisting of the details and practical performance of the student as their additional digital information data for work application.

Reduce lecturer's workload

The e-PraTeSiM system was able to reduce works loads of a lecturer. In FCE, we have a large amount of students enrolling Diploma of Civil Engineering. The average number of student is 30 students/class. The growing of students indicates that the time required to do practical test individually will increase. The flexibility of e-PraTeSiM system allows the laboratory technical assistant in assisting the practical exam, with the quality of assessment is still can be maintained. The technical assistant is only required to assist in recording the video and audio during the practical test, while the assessment is still done by the lecturer

Further study are required to improve the video and audio uploading method into the system and apps.

Conclusion

The e-PraTeSiM system is an option for conventional practical exam assessment. It has provided wide accessibility and administrative convenience for lecturers and students. The use of Information and Communication Technology (ICT) in the practical exam was an indication of education transformation. This assessment system can guarantee every candidate was assessed precisely and fairly.

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