

The Acceptance of E-Learning in Engineering Mathematics in Enhancing Engineering Education

¹N.M. Tawil, ¹A. Zaharim, ¹I. Shaari, ¹N.A. Ismail and ²M.A. Embi
¹Centre of Engineering Education, ²Centre for Academic Advancement,
Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia

Abstract: These days, e-Learning has become an educational technique due to its influential force in higher education. The convergence of Information and Communication Technology (ICT) provides powerful tools to introduce new educational technologies as well as the usage of online applications. Engineering students normally have problems with Engineering Mathematics which later will affect in other engineering subject. The objective of this study is to measure the importance level of e-Learning in the enhancement of one Mathematics Engineering course is Ordinary Differential Equations (ODE) among four main races in Malaysia. A questionnaire was distributed to all 2nd year students in 4 departments of the Faculty of Engineering and Built Environment, UKM. This study presents the results of a research project aimed at uncovering evidence that students perceived the importance of e-Learning in understanding ODE regardless of their race. The Chinese students show the lowest level of the perceived importance of e-Learning followed by Malay and Indian students. The other race students show the highest level of perceived importance of e-Learning. This study also provides a suggestion to improve the usage of e-Learning and the perception of the importance of e-Learning among Chinese, Malay and Indian students.

Key words: SPIN, e-Learning, level of importance, ODE, Engineering, Mathematics, Malaysia

INTRODUCTION

Rapid developments in computer and internet technologies have a large influence on life today including education development. Although, the traditional teaching method is well known to have a remarkable teaching function (Mandic, 2010) teaching and learning activities cannot escape recent advances in Information and Communication Technologies (ICT). These technologies have led to e-Learning as an important facet of education in the information age (Liaw *et al.*, 2007). Along with the development of information technology, the e-Learning tool plays an increasingly essential role in the teaching and learning process (Chang and Chen, 2009). The growth of e-Learning can be described as unprecedented, amazing and disruptive (Garrison, 2003). However, the quality of e-Learning tools, products and processes is very important for the success of education programs (Campanella *et al.*, 2008). The definition of e-Learning includes instruction delivered via any electronic media including internet, intranets, extranets, satellite broadcasts, audio/video tapes, interactive TV and

CD-ROMs. Chang and Chen (2009) mentioned that practically speaking, e-Learning refers to the use of internet technologies to deliver a broad array of solutions that enhance knowledge and academic performance (Chang and Chen, 2009). Students can perform various e-Learning activities in a virtual classroom. e-Learning is an online learning approach and a tool that can be accessed anytime and anywhere (Gutierrez de Rave *et al.*, 2011). It provides learners with another learning channel that enables them to break free from constraints on time and space and to engage in distance-based, non-synchronized learning activities (Chu *et al.*, 2009). Moreover, learners can individually access teaching-learning contents frequently and receive feedback according to their own capabilities and interests (Mandic, 2010). Furthermore, e-Learning has the potential to become an efficient education tool with low cost. Lord dearing of the United Kingdom proposed the use of e-Learning to resolve problems arising from growing numbers of students and to decrease universities' funding. He also agreed that e-Learning will accommodate new and innovative learning models and strategies (Woodfine *et al.*, 2008). In addition, university

graduates these days need to be familiar with and knowledgeable of contemporary issues including ICT knowledge (Zaharim *et al.*, 2009). e-Learning programmes not only reduce costs but also help students to enhance their ICT skills.

e-Learning is a self-learning tool that is well known as distance education, a term which became popular when technology was added to correspondence courses (Cheol, 2003). According to the Center for Adult Learning and Education Credentials of the American Council on Education in 1996 (Barclay, 2001), distance learning is defined as a system and a process that connects learners with distributed learning resources, for example the internet, computer-based training, satellites, virtual reality or teleconferencing. On the other hand, the National Council for open and distance education, 2002 of Australia defines distance learning as an integrated set of strategies to promote student-centred learning through a combination of specially designed learning resources and interactive media and technology. Specifically, distance learning (or learning on the internet, e-Learning, web-based learning or distributed education) in this study is comprehended as a just-in-time learning process in which the right people and/or organization acquires the right amount of contents at the right time at the right place through the use of internet technologies thus helping people enhance knowledge and performance (Cheol, 2003). This means that the learning process conducted online is done in a virtual classroom. Students can meet a virtual lecturer and interact with him or her through an e-Conference. Therefore, the learning process can still be conducted at a specific time although students and the lecturer do not attend a physical classroom.

In this study, researchers investigate student perceptions of the e-Learning Method that has been used as a tool to enhance student's understanding of Mathematics at the Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM). Previously, a survey was conducted on senior engineering students of Rose Hulman College. The results show these students agreed that Mathematics was essential in their education and future careers. The engineering students realized that Mathematics would play a major role in their education (Morsi and Tolliver, 2006). However, the new engineering students did not realize the need for or significance of Mathematics in the field of Engineering. As a result, they face problems understanding Mathematics. Hence, faculty need to find a suitable method to help these new engineering students understand Mathematics easily. One method is to teach Mathematics using a current technology tool, e-Learning. Morsi and Tolliver (2006) developed a new concept in

e-Learning known as practice tools. These tools allow the student to interact with a web-based tool as he or she would interact with a lecturer in a classroom.

The advantages of using an e-Learning programme have been discussed in previous studies but student participation in developing countries has not been widely engaged. Students in these countries have several constraints in ICT usage such as a lower likelihood of owning a computer, limited access to the Internet and a lack of awareness of the benefits of using e-Learning. Therefore, part of this study is to investigate UKM engineering students' awareness of the existence of e-Learning.

e-Learning System-SPIN: In an effort to train its engineering graduates to be aggressive and competent worldwide, the Faculty of Engineering, UKM requires engineering students to have certain skills such as lifelong learning skills, problem-solving ability and knowledge of ICT (Zaharim *et al.*, 2009). In one of their efforts, the faculty embraced the students with skills of ICT knowledge through an e-Learning programme. The development in ICT has put increasing demand for Higher Education (HE) institutions including UKM to implement e-Learning applications and networked learning programmes in the teaching and learning process. UKM's e-Learning System is known as SPIN (Sistem Pengurusan Pengajaran dan Pembelajaran Interaktif). It is a learning e-System that uses multimedia to improve the effectiveness of the teaching and learning process at UKM. SPIN can be accessed worldwide through the following url:<http://www.spin.ukm.my>. Using the e-Learning online system, teaching and learning become a one-to-one process.

The website facilitates online interaction between students and the virtual lecturer. Basic learning activities conducted in SPIN integrate the viewing of course materials, learning objectives, communication, tasks and download files (Fig. 1b). The lecturer's responsibility is to upload and update all the needed input and information into SPIN. The students are required to use the e-System to facilitate their studies. Figure 1 shows the SPIN welcome page. One of the compulsory Mathematics subjects in the Faculty of Engineering is Ordinary Differential Equations (ODE). ODE is always considered by engineering students as a subject that is difficult to understand. Students often struggle to understand the material delivered in the limited class time which consists of 3 h of lecture and a 1 h tutorial each week. They need more time, examples, information and interaction with their lecturer.

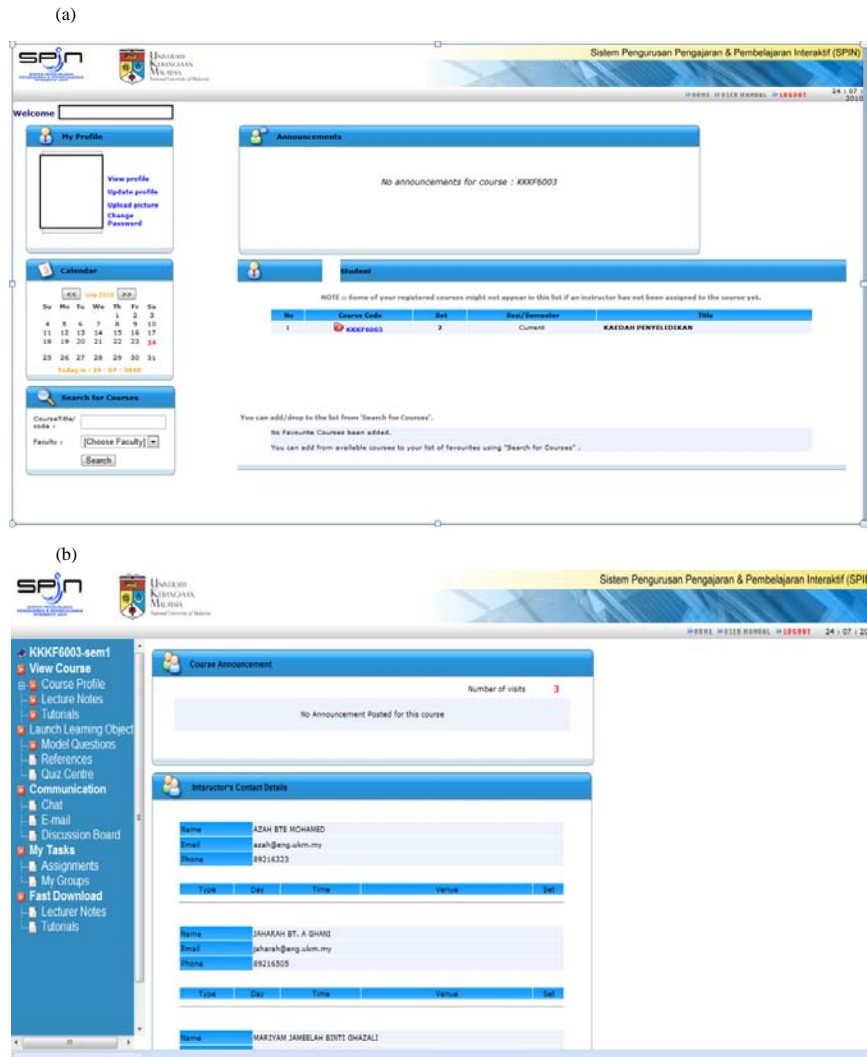


Fig. 1: UKM's e-Learning System-SPIN: a) Welcome page; b) Activities page

The students must have a good understanding of Mathematics to apply their knowledge in Engineering subjects. SPIN helps students to obtain more information and examples in Mathematics as well as other subjects.

MATERIALS AND METHODS

This study uses action research that focuses on identifying ways to improve the teaching and learning process and to increase student achievement. The process of action research helps academicians to determine needs, document the steps of inquiry, analyse data and make decisions towards desired outcomes (Ferrance, 2000). According to Miller *et al.* (2003), action research is a work in progress. Organizational research seeks to advance the understanding of people, process,

business and management issues to improve individual and organizational performance and effectiveness (Wheeler, 2009). The purpose of organizational research is to determine the successful factors of the issues studied and the outcomes will be used in future. According to Wheeler (2009), work-based research projects are often extremely focused and practical. They have clearly defined goals and are seen as the key to on going organizational development and innovation. This study is the 1st phase of action research.

The objective for this phase is to determine the importance level of the e-Learning approach in Mathematics as perceived by students in the Faculty of Engineering and Built Environment, UKM. The outcomes of this study will be used for the 2nd and 3rd phases of the study.

The development of the questionnaire was based on a literature review. The questionnaire was designed to gather information on engineering students' perceptions of the e-Learning approach for delivering ODE at UKM. To do so, it used a 5-point Likert scale (1: Not important at all to 5: Very important). Respondents were 2nd year students of the Faculty of Engineering and Built Environment in the academic session 2009/2010. About 239 students completed the initial questionnaire. The four departments in the faculty that took part in the survey were the Department of Mechanical and Materials Engineering, Department of Chemical and Process Engineering, Department of Civil and Structural Engineering and Department of Electrical, Electronic and Systems Engineering. Data were analysed using the Software Package for Social Sciences (SPSS 16.0). Descriptive analysis was employed to obtain student profiles. The compare means were used to obtain the importance level of e-Learning for ODE. The outcomes will be used to carry out the 2nd phase of the study which seeks to improve the quality of Mathematics e-Learning at the Faculty of Engineering and Built Environment, UKM.

RESULTS AND DISCUSSION

Respondent profiles: The tabulation of respondents by race indicates that Malay students constitute 49.0% of the total followed by Chinese (47.75%), Indian (2.1%) and other race (1.3%) students as shown in Fig. 2.

UKM students mainly comprise Malay, Chinese and Indian ethnicities. Other races represent international students and native students. The classification of respondents by department shows that the Department of Mechanical and Materials Engineering has the highest percentage of respondents (29.3%) followed by the Department of Chemical and Process Engineering (28.5%), Department of Civil and Structural Engineering (27.6%) and Department of Electrical, Electronic and Systems Engineering (14.6%) as shown in Fig. 3. Figure 4 shows the results of the survey: about 81.2% of the students are aware of the existing of e-Learning and 69.0% of them have used it. About 65.7% of respondents learned Mathematics through e-Learning. However, only 63.2% are satisfied with SPIN. Moreover, only 40.2% know the purpose of providing e-Learning Methods in the teaching and learning process. This implies that engineering students are aware of the existence of e-Learning and SPIN. Moreover, the students used the e-Learning programme for learning purposes even though >50% of them did not know the purpose of e-Learning. Faculty need to engage in consistent and aggressive

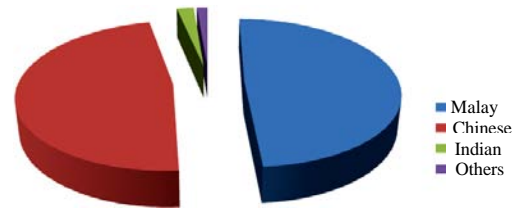


Fig. 2: Distribution of respondents by race

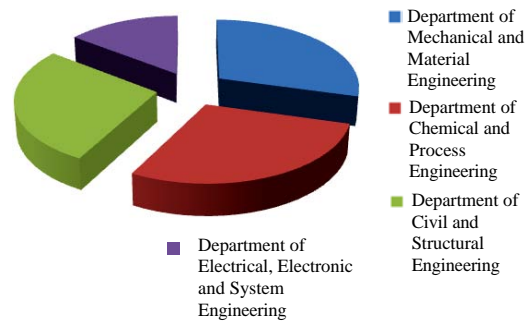


Fig. 3: Distribution of respondents by department

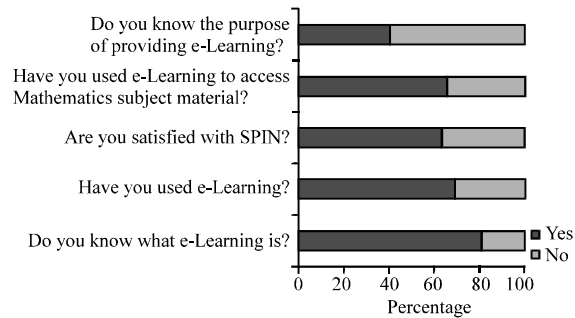


Fig. 4: Awareness of e-Learning and SPIN for Mathematics

promotion to encourage students to use SPIN. The faculty may need to require all academic staff to promote SPIN in their classes by making it compulsory for students to obtain their notes and exercises from SPIN. In addition, the SPIN forum can be used as a venue for interaction between students and their lecturer. Hopefully, this will increase awareness and usage of SPIN among engineering students. To increase students' learning of Mathematics through the e-Learning programme, Mathematics lecturers need to be actively involved in SPIN. For example, lecturers can require their students to access SPIN by posting notes, exercises, announcement, assignments or online quizzes.

Perception of e-Learning in Engineering Mathematics:

Table 1 shows that the perceived importance levels

for all e-Learning elements are >4 (out of a possible score of 5). The value indicates that Engineering Mathematics e-Learning for ODE is very important. Out of 11 elements, element 1 learning materials and element 2 allowed to download learning materials are very important with mean scores of 4.6. Meanwhile, element 3 easy to download and element 4 upload learning material on time obtained scores of 4.5. The other elements have slightly different (lower) scores. However, only element 9 e-Learning website is attractive scored <4 indicating that the website is not attractive enough for students to use the facility.

Figure 5 shows the perceived level of importance of the e-Learning method in delivering ODE for study purpose among the four races in the faculty of engineering. The overall average of students' perception of the importance of e-Learning is 4.4 representing very

important. This shows that students now-a-days are very ICT oriented. They love to study and update their knowledge using ICT technology.

Among the four races, Chinese students show the lowest score with a mean of 4.1. This indicates that Chinese students are more likely to favour using the traditional method to learn Mathematics. Malay students scored 4.2 which is 0.1 below the Chinese students' score. They may also favour the traditional method of learning. The Indian and other race students scored >4.5 indicating that they like to use the e-Learning approach in learning ODE and think it is important for them to use the e-Learning Method to enhance their understanding in ODE. However, their high scores may also be attributed to the number of Indian and other race students who participated in the survey.

Table 1: Importance level by race

Respondents' expectations for e-Learning in Mathematics	Importance level				
	Malay	Chinese	Indian	Other	Mean
E1: Learning material, especially for Mathematics (notes, exercises, announcement, etc.) are provide on e-Learning website	4.5	4.3	4.8	5.0	4.6
E2: Students are allowed to download learning materials in e-Learning	4.6	4.4	4.4	5.0	4.6
E3: Easy to download learning materials	4.3	4.2	4.6	5.0	4.5
E4: Lecturers upload learning materials on time	4.2	4.1	4.6	5.0	4.5
E5: e-Learning website is easy to use/consumer friendly	4.0	4.1	4.4	4.3	4.2
Q6: e-Learning is helpful in the education process	4.3	4.1	4.6	4.7	4.4
E7: e-Learning is time efficient	4.1	4.0	4.6	5.0	4.4
E8: Materials in e-Learning are of good quality and effective	4.1	3.9	4.4	4.7	4.3
E9: e-Learning website is attractive	3.9	3.6	4.2	4.0	3.9
E10: e-Learning website can be accessed anywhere, anytime (including out from university's database)	4.2	4.2	4.2	4.7	4.3
E11: e-Learning is cost efficient	4.3	4.1	4.2	5.0	4.4
Overall	4.2	4.1	4.5	4.8	4.4

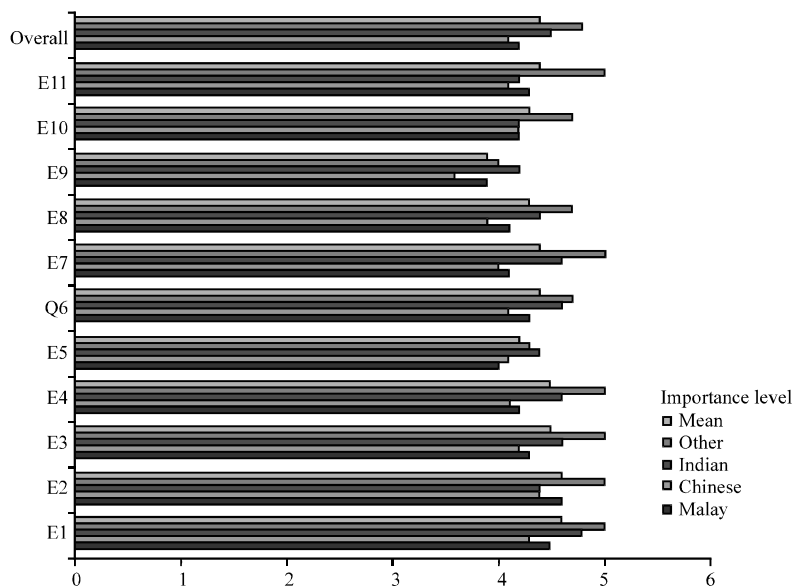


Fig. 5: Importance level by race

CONCLUSION

The results of the study show that the overall importance level of e-Learning as perceived by students is 4.4 out of 5. This implies that students trust that all of the elements studied are important to ensure the effectiveness of e-Learning. The students were satisfied with SPIN's presentation in helping them to study and understand ODE. Consequently, more action is required to assist academic staff in effectively developing and improving knowledge of teaching Engineering Mathematics in e-Learning for students in the Faculty of Engineering and Built Environment as well as other UKM faculties. Further study need to be conducted to determine the performance of the students who utilize SPIN in their studies.

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