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MODERN OR TRADITIONAL TEACHING STRATEGY IN LEARNING ENGINEERING MATHEMATICS COURSE

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Abstract

First-year engineering students of the Faculty of Engineering and Built Environment, UKM are in the process of transition in the way they learn mathematics from pre-university level to the undergraduate level. It is essential for good engineers to have the ability to unfold mathematical problems in an efficient way. Thus, this research is done to investigate students preference in learning KKKQ1123 Engineering Mathematics I (Vector Calculus (VC)) course; either individually or in a team; using modern (e-learning) or traditional (cooperative-learning) teaching strategy. Questionnaires are given to the first year Chemical and Process Engineering students from academic year 2015/2016 and the results were analysed. Based on the finding, the students believed that the physical educators or teachers play an important role and that they have slightest preference in the traditional teaching strategy to learn engineering mathematics course.

Keywords: E-learning; Teaching strategies; Cooperative-learning; Vector calculus.

1. Introduction

Mathematics is a crucial subject and act as an indicator of the student's ability not only in engineering but also in other fields. It is one of the core subjects that has been assessed since primary school up until the university level. A research was done by [1, 2] and shown that students who are excellent in mathematics proved to be excellent in other subjects too. Nopiah et al. [3] shown that there is a relationship between student grade point average in Mathematics at the pre-university and in their Vector Calculus results at UKM. Although the result is not significant, and the pre-university results do not indicate the actual performance of the students in the university, but it does give some intuition of the expected outcomes. Kamal et al. [4] discussed the relationships between pre-university education and mathematics achievement with performance in engineering subject. The results show that mathematics grades relate to students' performance in engineering courses. In Faculty of Engineering and Built Environment, (FKAB) UKM there is seven compulsory engineering mathematics subject that the students have to take in their first and second year of study. The courses are Vector Calculus, Linear Algebra, Differential Equation, Engineering Statistics and two compulsory subjects for students from the department of Electrical, Electronic and System which is Complex Analysis and Numerical Methods. However, students entering engineering courses in university struggle in the first year mathematics [5-7].

There have been numerous strategies in mitigating the mathematical knowledge gap in students. One of it is the integration of modern and traditional teaching strategy also known as blended learning to fulfil the students need. The modern teaching strategies which are technology-driven is quite convincing [8-10]. In FKAB, UKM the modern tools that has been used in educating and transmitting information to students are I-folio and Wiley-Plus®. These are the tools that the students can use as an aid in learning the subject individually. I-folio is an online learning system which was developed and patterned by UKM. The teacher can virtually discuss with the students, upload lecture notes and tutorial questions. However, there are some constraints in I-folio where the lecturer themselves have to create their own notes and questions to be published in I-folio. Thus, Wiley-Plus® is introduced to assist and complement the use of Ifolio. Wiley-Plus® is a web-based application which integrated the whole textbook in the website. Students are not only able to access the full text through Wiley-Plus® but also additional reading materials including videos and animations. Apart from that, Wiley-Plus® helps the teacher in simplifying and automating important tasks such as making assignments, scoring student work, keeping grades, and more. It allows students to complete their homework online and receive instant feedback on their work. Research by Razali et al. [11] shown that engineering students in academic year 2010/2011 who first using Wiley-Plus® in Vector Calculus are satisfied with the components of Wiley-Plus®. The modern technology also helps students develop connections with peers. For example, the use of social media such as Facebook, WhatsApp and Forum establish a virtual community of learners.

However, traditional teaching and learning method are still relevant as discussed by Mandic in [12]. A traditional learning style known as cooperative-learning (CL) is introduced in learning Vector Calculus. Zakaria et al. [13] studied the effects of CL on students' mathematics achievement and attitudes toward mathematics. The study revealed that the CL methods have a positive effect on the formation of the attitudes toward mathematics among students. Cooperative learning is a teaching strategy in which students work in a small group, where each member of the group having different levels of ability, use a variety of learning activities to improve their learning understanding [14]. Each member of a group is responsible not only for their own learning but also for helping their teammates learning. It is also an approach to teamwork that minimizes the occurrence of those unpleasant situations and maximizes the learning and satisfaction that result from working on the high-performance team [15]. There are five important elements to CL [16, 17]; which are individual accountability, social skills, face-to-face interaction, positive interdependence and group processing. Consequently, the results of cooperative efforts, each member trying to obtain mutual benefits so that all members of the group;

- gain from each other's efforts
- recognize that all group members share a common fate
- know that one's performance is mutually caused by oneself and one's team members
- feel proud and jointly celebrate when a group member is recognized for achievement.

In this paper, we investigate the teaching strategies of students from the Department of Chemical and Process Engineering in learning Vector Calculus either individually or in a team; using modern or traditional teaching strategy. We evaluate the mean score of different teaching strategies according to the level or importance and agreement. Finally we show the analysis of their grade obtained for Vector Calculus.

2. Methodology

There are 80 students from the Department of Chemical and Process Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia from Semester 1, academic session 2015/2016. However, only 50 participants responded and involved in this survey.

An online survey was given to the students to gather some information on their pre-university background and also their experience using the internet. The questions are using 1 to 5 range of Likert Scale. The participants are dominated by a female with 62% while 38% are male. Almost half of the participants (46%) live in urban area, 32% in the suburb and 22% in rural area. In terms of experience using the internet, 88% have more than 4 years of experience, 10% with 2-4 years of experience and only 2% with less than 2 years of experience.

3. Results

Figure 1 shows the percentage of student who choose to learn individually, in group or both according to modern or traditional teaching strategy. Based on the figure, more than 80% of students choose to learn individually either using modern (82%) or traditional teaching strategy (88%). While 62% students choose to traditionally learn in a group and 68% choose to learn in a group using modern tools for example through a forum, Facebook and WhatsApp.

Table 1 shows the mean score for level of importance and agreement towards teaching strategy. Lecturer/tutor has the highest mean score with 4.56 and 4.44 for the level of importance and agreement respectively. Followed by Wiley-Plus® and I-folio with mean score 4.02 and 3.88 for the level of importance and 3.98 and 3.74 for the level of agreement. Finally, the score for e-learning is the same as I-folio for the level of importance with 3.88 scores and the lowest mean score for level of agreement with 3.72.

Figure 2 shows the grade percentage comparison for first year students of Department of Chemical and Process Engineering in academic session 2009/2010 and the current students in academic session 2015/2016. These are two different set of students who being taught by the same lecturer. However, the students in academic session 2009/2010 have not used Wiley-Plus® in Vector Calculus. According to the figure, we see multiplication of students who got A's in 2015/2016 compared to the year 2009/2010. There is also increment of 6% of students who got B in 2015/2016. However, we also observed that around 1-3% students got D+ and D in year 2015/2016 compared to none in 2009/2010.

Although mathematics is hard (60% of students agree and strongly agree with this statement based on Fig. 3, but they agree that Vector Calculus is an interesting subject with 74% of the students agree and strongly agree with this statement as shown in Fig. 4.

4. Discussion

The results from this survey suggesting that the intervention of modern teaching strategies with Wiley-Plus®, Ifolio, Facebook, WhatsApp and forum creates a positive learning experience for both students and lecturer. The students are familiar with the technology, hence there are no issues regarding the implementation of the modern technology in learning mathematics. The learning style is equally rated and the students prefer to study alone rather than in the group with either modern or traditional teaching strategies. Despite the familiarity with the technology, the students believe that the lecturer and tutor play an important role. There was an increased in academic performance of students who got A's in 2015/2016 compared to the students in year 2009/2010. However, this finding does not indicate the actual performance since there are other factors such as the difficulty level of the exam questions, the background of the students and the entry requirement from the pre-university level that might contribute to the increment.

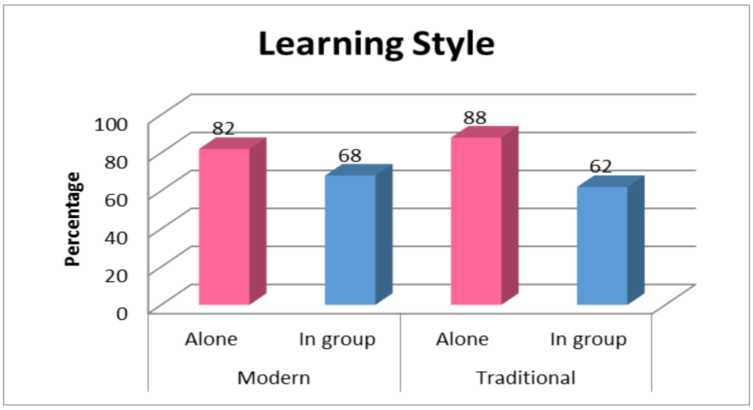

Fig. 1. Percentage of students according to their teaching strategy either modern or traditional; alone or in group.

Table 1. Level of importance and agreement towards learning style.

Learning style	Level of Importance	Level of Agreement
E-learning (website)	3.88	3.72
Wiley-Plus	4.02	3.98
I-folio	3.88	3.74
Lecturer/Tutor	4.56	4.44

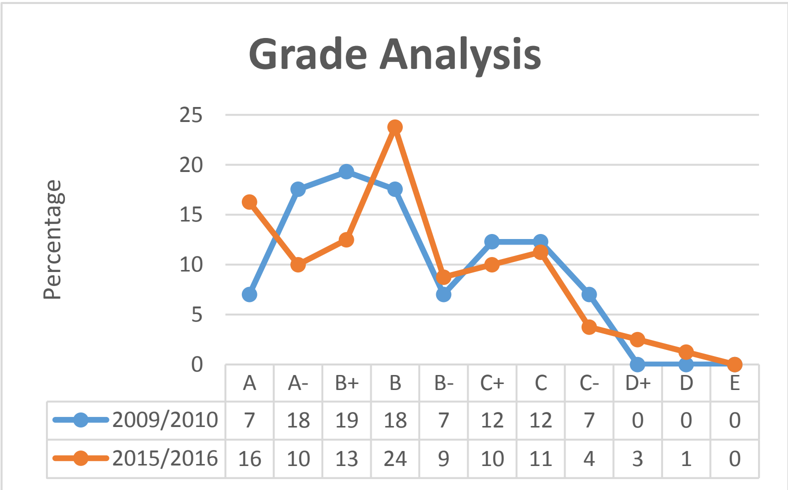

Fig. 2. Vector Calculus grade for first year students of Department of Chemical and Process Engineering academic session 2009/2010 and 2015/2016.

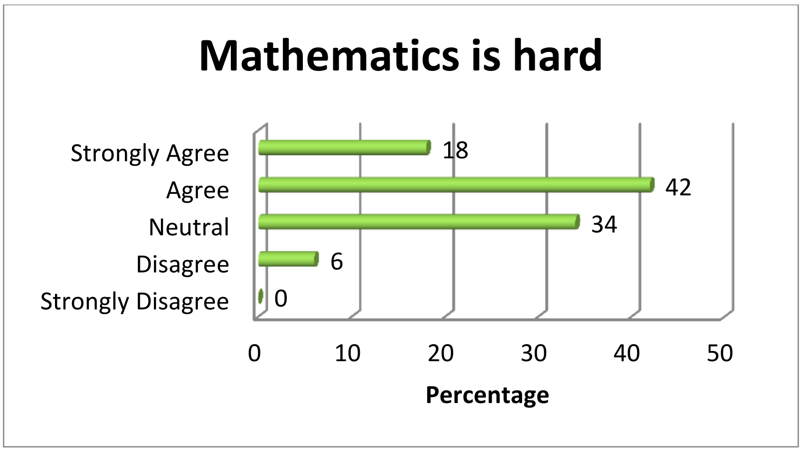

Fig. 3. Student's opinion on mathematics.

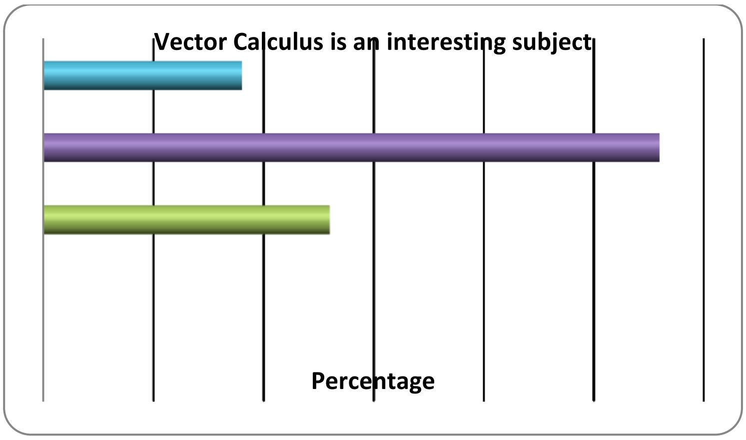

Fig. 4. Student's opinion on vector calculus.

5. Conclusions

The majority of students from the department of Chemical and Process Engineering have experienced using the internet and shown to be able to adapt to the modern and traditional teaching strategies that have been conducted in the university. The e-learning or modern methods are expected to be prominent for the students; however the results indicate the slightest preference in traditional teaching strategy compared to modern teaching strategy in learning Vector Calculus. Lecturers or tutors are the most important reference for the students. It is of interest to observe their learning style especially in engineering mathematics courses as they enter the second year of study and become more self-reliant.

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