The Effectiveness of Blended Learning: A Case Study among Undergraduate Engineering Students in a Private University

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ARTICLE INFO
Article history:
Received 10 December 2015
Accepted 22 January 2016
Available online 30 January 2016

Keywords:
Pinch technique, pinch force, carpal tunnel syndrome.

ABSTRACT
This case study focuses on the effectiveness of the usage of Blended Learning in teaching an undergraduate engineering class in a private university. The subject (Quality Engineering) was selected to be part of the university’s pilot project of introducing the relatively new method of teaching (Blended Learning) to the students. The syllabus and contents of the subject is briefly explained in the Introduction. In addition, there is also a brief literature review on Blended Learning for further understanding. The methodology section explains the role of Outcome-based Education in assessing the effectiveness of the teaching and learning process for Blended Learning. For this selected class, there were 5 Learning Outcomes which the students were expected to achieve. The two Blended Learning methods used were Flipped Classroom and E-Learning. The results of the students’ performance showed improvement in the subject topics that were taught using the Blended Learning techniques. In addition, there was an encouraging improvement in achievement of Learning Outcomes for this subject by the students. In contrast, there were reductions in Learning Outcomes achievement for the topics which were not taught in the Blended Learning techniques.

INTRODUCTION

The increase in usage of Blended Learning worldwide is in itself evidence of its proven effectiveness in improvement of the education process. However, the implementation and usage of Blended Learning in Malaysian universities is still considered at an early stage. For the private university mentioned in this paper, Blended Learning was officially launched and implemented only in June 2015, which was the first trimester of this university’s academic year.

The subjects chosen for this pioneer project were not taught totally in Blended Learning but the lecturers were instructed to limit its percentage between 30-60% of the total lecture hours. One reason for this guidelines was that there was concern that the majority of the students were not given sufficient preparation in taking subjects that were taught in Blended Learning. There was a real concern on the students’ performance in the subject, especially if the students were in their final year of studies. Although there were both undergraduate and postgraduate programs in the university, the selected subjects were from the four-year undergraduate programs.

The subject which is the focus of this paper is a third year engineering subject named Quality Engineering. There was no pre-requisite subject for this particular subject. The subject was not carried out using Blended Learning in previous years. The topics covered in the subject ranged from topics such as Introduction to Total Quality Management (TQM), Six Sigma, Statistical Process Control (SPC) and Acceptance Sampling.
Three out of the subject’s six topics were taught completely using Blended Learning. These three topics allocated lecture hours was 21 hours, which was 52.5% of the total 40 lecture hours for the subject. The Blended Learning topics had both course work and exam assessments which was not combined with the non-Blended Learning topics. In addition, the same topics also had separate assessment tools for the same subject which was conducted for the previous academic year. This scenario would enable us to analyse the data and conclude with useful information later.

**Literature Review:**

Although the origin of the term is uncertain, it is believed that its first use was in 1999 when a computer and software company in Atlanta offered and labelled their online courses coupled with live instruction as blended learning (Friesen, 2012). This definition suggested that blended learning was restricted to only virtual learning without face-to-face intervention, a constraint that has become less true with the later development of blended learning.

Since then, there has been a wide breadth of definitions deposited into current literature on blended learning. Singh and Reed (2001) defined blended learning as a learning program where more than one delivery mode is being used with the objective of optimising the learning outcomes and the cost of the programme delivery.

It is important to make aware of the purpose of blended learning. Apart from improving students’ performance and cost effectiveness, blended learning also aims to be highly personalised for each learner. This has been suggested by Thorne (2003) when he described blended learning as the process of engaging the ordeals of customising learning and development to the necessities of students. In order to meet the objectives of blended learning, social interaction in a traditional classroom is equally as important as the utilisation of an individualised online system.

Many studies concur that blended learning is a hybrid mode of learning which harness both face-to-face learning and online learning (Bersin, 2004; Boyle et al., 2003; Garrison and Vaughan, 2008; Lim and Morris, 2009; Mortera-Gutierrez, 2006). For example, Graham (2006) in the first handbook of blended learning defined blended learning as the combination of two historically separate models of teaching and learning, namely the traditional face-to-face learning systems and distributed learning systems. It is worth noting that the term distributed learning systems is an umbrella term for any technology-led learning. Friesen (2012) clarified the meaning of blended learning by suggesting that blended learning is a prospective learning method that combines the Internet and digital media with conventional classroom structures which necessitates the physical co-presence of the learners and educator.

Due to the difficulty in accessing the vast availability of blended learning programmes and methodologies in the literature, Staker and Horn (2012) attempted to categorise the available blended-learning taxonomy and definitions into four models, namely rotation, flex, enriched-virtual and self-virtual. The student autonomy increases across each model at a point that the self-virtual model was actually coherent with the online courses offered by the computer and software company in Atlanta (Friesen, 2012). Students in a flex model complete their courses online, though the teachers-of-record is on-site to offer scheduled activities such as group projects.

The most popular mode of blended learning by far is the rotation model which allows students to rotate on a schedule between learning modalities, where at least one of which involves online learning. Under the rotation model, the concept of flipped classroom receives greater attention due to the reversal of the learning mode between the classroom and home (McRae, 2015). At home, students are to learn from online videos produced by their educators, whereas at classrooms, they are to deliver, practice and apply what they have learned with their teachers and classmates (Beaver et al., 2014).

Researchers have in general established a positive correlation between conventional and blended learning, particularly in engineering education (Rodriguez et al., 2013; Soler, 2010; Soler et al., 2006; Ubell, 2000). Soler et al. (2006) suggested that the use of technology in blended learning also improved learners’ academic results apart from increasing their motivation in learning. One of the technologies includes applications that can autocorrect mistakes in student assignments, which allows lecturers to recognise and gauge the students’ level of learning (Soler et al., 2006).

Besides that, computer-based assessment (CBA) platforms have also been established by the computerisation of each teaching and learning feature (Soler, 2010). Using CBA, researchers discovered that a significant interaction was present between the educator and learners across the entire assessment process (Soler, 2010; Soler et al., 2006). During this process, the assignments, corrections and feedbacks were delivered automatically by the system. Artificial intelligence (AI) techniques have also been incorporated in blended learning for engineering laboratory practices in order to cultivate an educator-cognitive system combination (Rodríguez et al., 2013).

Technology-oriented blended learning activities have been supported extensively in education (Al-Busaidi, 2013; Islam, 2016; Sumak et al., 2011). Researchers have also discussed the appropriateness of blended learning to improve the achievement of learning outcomes (Shih et al., 2008). It was reported that the intent to use blended
learning significantly correlated with the efficacy of blended learning (Liaw, 2008). The voluntary contribution of educators and positive anticipations set up before the start of the course also significantly affects the acceptance of blended learning in a course (Hrtonová et al., 2015).

**Methodology:**

Outcome-based Education has been practised in the university over the past 5 years. Outcome-based Education (OBE) is a measurement of the effectiveness of a learning process by evaluating the outcome. For this particular subject, there were 5 Learning Outcomes (LO). Two LOs were mapped to the 3 topics taught using Blended Learning. The usage of LOs is useful since the outcomes were measured in percentages of achievement. Having a measurable outcome is beneficial as it would be a justified and scientific method of comparing performances.

One of the main differences in how the subject was taught was that the selected topics were not delivered in the traditional lecture classroom environment. The lecturer did not have to conduct lecture classes and discuss the lecture notes (powerpoint slides) with the students. Instead as part of the Blended Learning initiative, the lecturer made a powerpoint slideshow with voice-over narration for the selected Blended Learning topics. The file was then converted into a video format (mp4) which was then uploaded in the lecturer’s YouTube video channel and shared with the students. Students were instructed to view the video and prepare a carefully designed assignment with the purpose of assessing the students understanding of the topic. In addition, to further improve the students soft skills, students had to work together as groups of either three or four students.

The assignment required the students to further search for more relevant information which was related to the Blended Learning topic and share their findings during their presentations in class. The assessment method is relatively new in the university as in most subjects, the assessment methods used would be the more traditional methods of written quizzes and tests.

In the written examination for the subject which was held at the end of the trimester, the Blended Learning topics had separate exam questions from the non-Blended Learning topics. The questions were designed to assess the students from the perspective of the cognitive domain of the Bloom’s Taxonomy. Questions assessed students’ ability to apply the principles they had learned from the Blended Learning topics when answering the exam questions.

**Findings And Discussion:**

The number of students in this academic year (2015) was 62 where else the previous academic year (2014) had 32 students.

Comparing the passing rate of the academic years, more students passed the subject as the overall subject failure rate reduced from 6.1% (2014) to 3.2% (2015). In terms of failure rate, it reduced by 2.8% in the 2015 academic year.

In addition, the overall average marks for the subject increased by 4.7% from 62.7% in 2014 to 67.4% in 2015. This was an improvement of 7.5% for this subject.

As mentioned earlier, the 3 Blended Learning topic were mapped to 2 Learning Outcomes (LO#2 and LO#5). For this university, a student is assessed as achieved (or passed) a certain Learning Outcome when the percentage of achievement is at least 50%.

The LO#2 achievement in 2014 was only 82%. In 2015, the percentage of achievement increased to 98%. This is an improvement by 19.5% compared to the previous year when the topics were not taught using Blended Learning.

Comparing the LO#5 achievement for 2014 and 2015, it was found that the same positive effect of Blended Learning had occurred. The previous year only had an achievement of 76%. However, after the introduction of Blended Learning in 2015, the LO#5 achievement rose to 97%. A high percentage of improvement by 27.6% was indeed unexpected.

The 5 Learning Outcomes for the subject Quality Engineering were mapped to only 1 Program Outcome (PO#5). This mapping was the same for both the academic years being analysed in this paper.
For comparison purposes, in order to analyse the performance of the topics and the related LO achievements, the data for the Learning Outcomes which mapped to the topics taught using traditional methods is analysed. The data is shown in the following 3 charts, respectively LO#1, LO#3 and LO#4.

From the 3 charts shown above, which is for the topics not taught using Blended Learning, there were no improvements in the LO achievement. It can be seen from the charts that for LO#1 and LO#3, both had reduced LO achievement. The achievement for LO#1 dropped from 82% to 65% and for LO#3 it also dropped from 88%
to 66%. The achievement for LO#4 maintained for the 2 comparison years. Its achievement was 100% in 2014, and it was the same achievement in 2015.

![Graph showing learning outcomes for LO#4 in 2014 and 2015](image)

### Conclusion:

The objective of this paper was to study the implementation of Blended Learning to an undergraduate engineering subject in a private university. The achievement of the students in the subject by the end of the trimester is analysed to understand the effect of implementation of Blended Learning.

From the findings and discussion, it was found that Blended Learning had a positive effect on the performance of students in the Quality Engineering subject in 2015. This was shown from the improvements in both the subject failure rate and average marks of the students as compared to the previous year.

In addition, there were significant improvements in the achievements on the Blended Learning related Learning Outcomes.

With this positive results in this pilot project, more subjects have been identified for the implementation of Blended Learning in the private university.

### REFERENCES


