Blended Learning Module for a Course in Statistics

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ABSTRACT

Instructors for mathematical and statistical courses generally feel that it is quite impossible to have an effective teaching and learning process if the blended learning teaching style were to be adopted. The traditional teaching instruction of 'chalk and talk' still has many proponents. To find out the truth of this conjecture, we experimented with 298 students who had enrolled for Introduction to Statistics course at a public university in Malaysia. We had enrolled the course as Blended Learning with the Institute of Learning and Quality Management (ILQAM) at the beginning of the semester (May-October 2014). A video power point for each chapter of the course syllabus was developed and a detailed blended learning scheme of work was outlined to the students. Students were assessed using online quizzes, written quizzes, written tests, and final examination. Two hours of the total four contact hours per week was allocated to students' Self-Learning while the other two hours was allocated to Assisted-Learning sessions. Results from t-test showed that examination marks scored by students instructed with blended learning were not significantly different from examination marks scored by students instructed using traditional teaching. Results of students' perceptions on the blended learning module were also presented. In conclusion, blended learning is feasible for statistics courses and is beneficial to both students and instructors.

Keywords: Hybrid Learning, e-content, statistics, module dimension, t-test, student perception

INTRODUCTION

Determining how students learn most efficiently is one of the leading goals of research in education. For the last 30 years, many researchers and educators revolutionized the area of statistics education in an effort to be more equipped with the growing population of students across a wide range of practice that are required to complete coursework in statistics (Moore, 1997; Roiter & Petocz, 1996; Yilmaz, 1996). Many students have little interest in learning mathematics and even less interest in learning statistics. In order to attract students' attention, teachers use computer technology in statistics classroom together with other reformed efforts in statistics education (Garfield, 1995; Ben-Zvi, 2000; desNicholls, 2001; Mills, 2002). Until recently, most of the traditional learnings are instructor-led approach where students have access to the experts, engage in questions and discussion, open to social interaction and have the opportunity to learn from others. However, with the improvement of technology it is possible to regenerate the way people learn and to present the information to them (Cobb, 1992; Moore, 1997; Garfield, 1995; Rosling, 2007; Garfield & Ben-Zvi, 2007). Being exposed to social networks such as Facebook and instant messaging technologies such as WhatsApp and Telegram, the present generation of students prefers an individualized or less structured environment in teaching and learning process. In other words, they need self-paced learning material. Hence, educators are now facing with the challenges of combining traditional and emerging technology to balance different students learning styles (Felder, 1988).

Statistics is considered as a mathematical subject that requires students to do a lot of exercises in order to acquire the problem solving skills meted out in the subject's syllabus (Ahmad, Shafie & Janier, 2008). Instructors are naturally expected to demonstrate in front of students the different ways of solving statistical problems in class sessions. Students find Statistics and Mathematics to be difficult subjects because not only they have to understand theories, but also memorize formulae as well as visualizing the practical application of some of the theories. Hence, the acceptable practice is to have mathematic instructors present in person to offer an effective learning mode. As such there is a general opinion among statistics and mathematic instructors that it is quite impossible to have an effective teaching and learning process if the blended learning method was adopted for statistical and mathematical courses.

In considering to the problem described in the above paragraph, a blended learning module was developed for a statistics course coded QMT181 (Introduction to Statistics). The module was applied for one semester (four months) at a public university. The primary objective of this paper is to evaluate the module by comparing final examination scores of students undergoing Blended Learning module with scores by students who followed the traditional teaching approach. The other objective was to discover students' perceptions on the module. The main research hypotheses for this study were formulated as follows:

H_0: Examination scores by students instructed with Blended Learning are not significantly different from examination scores by students instructed using traditional teaching.

H_1: Examination scores by students instructed with Blended Learning are significantly different from examination scores by students instructed using traditional teaching.

LITERATURE REVIEW

The Definition and Concept of Blended Learning

Blended learning can be defined in many ways. The idea comes from the blended term, which is defined as mix, merge, integration or combination. Blended learning is a composition of traditional types of learning and e-Learning (Collis & Moonen, 2001). In addition, hybrid is another term found in most literatures. Hybrid or blended learning can be translated as a combination of traditional learning and online learning (Collis & Moonen, 2001). E-Learning is the learning process aided by computer technology and the internet connection. Even though educators and learners strongly admit that traditional teaching has its important role in teaching function (Mandic, 2010), the development in Information and Communication Technologies (ICT) cannot be averted. Hence, blended learning is becoming more popular in educational system with positive consequences especially to the students. According to Hisham et al. (2006), blended learning represents the integrated combination of traditional learning with web based online approaches, the mix of media and tools expanded in e-Learning environment and the combination of number of

pedagogical approaches. Implementation of blended learning is to merge the strengths and overcome the weaknesses either in traditional method or e-learning (Azizan, 2010).

Learning Styles and Benefits of Blended Learning

Despite the fact that blended learning may appear to be a better chance for education improvement, it may show some significant impediments in terms of application. Learners' individual contrasts, for instance, their learning attributes and learning styles should not be disregarded since individual's characteristics and learning styles in teaching and learning are major factors in effective teaching (Sarasin, 1999). A study by Felder and Silverman (1998) which focused on engineering students found that the failure of knowledge delivery comes from the contradiction between traditional teaching styles versus common learning styles. This gap will create problems such as absenteeism and boredom, causing the students to lose their interest in the subject matter.

Blended learning may offer a solution because in this teaching mode, instructors are no more the sole source of knowledge instead they are expected to be facilitators as well as motivators to students. Rovai and Jordan (2004) define blended learning as a new method of learning that offers flexibility and convenience to the educators and learners. Specifically, this new alternative of learning will help and guide workers who want to pursue their studies while they are working. Several literatures found in Matheos et al. (2012) suggest that this alternative strategy of teaching and learning can intensify better performance in knowledge transfer. Tayebinik and Puteh (2013) investigated the advantages of blended learning over face-to-face teaching and found that blended learning can be viewed as an effective approach in terms of students' learning experience, student-student interaction as well as student instructor interaction, inducing students sense of community and enhance collaborative task.

Success and Failure Factors of Blended Learning

Webster and Hackley (1997) outlined several factors for successful blended learning implementation; they were competency in Information Technology, different teaching styles, and positive attitude and mindset

towards the learning process. In addition, Volery and Lord (2000) put forward that educators should have good knowledge in information technology and use different teaching styles in order to maintain students' or learners' interest. In contrast, a study from Sun et al. (2008) pointed out seven factors that contribute to the failure in implementing blended learning: the learner computer anxiety, poor instructor attitude toward e-Learning, poor e-Learning course flexibility (learners' perception of the efficiency and effects of adopting e-Learning in their working, learning, and commuting hours), poor e-Learning course quality (virtual characteristics of e-Learning such as online interactive discussion and brainstorming, multimedia presentation for course materials, and management of learning processes), low perceived usefulness (degree of work improvement after adoption of a system), low perceived ease of use (users' perception of the ease of adopting a system), and low diversity in assessments. Prior literatures on distant learning studies show varied results. Dellana et al. (2000); Iverson et al. (2005); Sooner (1999); Jones et al. (2005) concluded that distant learning is as powerful as traditional classroom learning while others (Terry et al., 2001; Ponzurick, 2000) observed that graduate students in conventional face to face beat those in web course. In conclusion, to attract, retain, and motivate learners, e-Learning courses should be flexible (Trasler, 2002), have high diversity in assessments as well as students and instructors ability to adapt to ICT (Sun et al., 2008). Means, Tayebinik et al. (2013) concluded that students in a blended learning environment performed better than those receiving face-to-face instruction.

Perception and Attitude towards Blended Learning

Tanveer (2011) studied students' attitudes towards integrating e-learning in classroom language teaching and found that the majority of students preferred blended learning. Similarly, a study on Palestinian university students was carried out by Adas and Abu Shmais (2011) showed that the majority of learners expressed their positive attitudes towards blended learning. Moreover, Hirata and Hirata (2008) conducted a study about attitudes of Japanese students towards hybrid learning and found that most of the students thought that blended learning was more effective whilst few students preferred traditional learning. In addition, a study from Ahmad, Shafie, and Janier (2008) revealed that the student perceptions towards blended learning were positive. These findings indicate that current

learners are ready for the interactive teaching and learning as long as the educator or instructor prepares quality online materials. However Grandzol (2004) discovered uncertain evidence about learning outcomes as measured by examination scores for an MBA statistics course. Grandzol found those students' perceptions in terms of enthusiasm; preparation, grading, and clarity of instruction were identical for both conventional and blended learning. Držid, Seljan, Džigunovid, and Lasid-Lazid (2012) conducted a study on university students in Zagreb learning English for special purposes. The results showed that students' communication with their instructors was better in traditional learning whereas a few students who were taught with blended learning obtained better marks over those of traditional learning, but with no significant difference.

Dimensions of Blended Learning

In 2012, Matheos et al., produced a paper discussing the impacts of different dimensions of blended learning for the success of educational environment. Ahmad et al., (2008) applied a blended learning approach with three dimensions, face to face lecture, face to face tutorial sessions, and Self-Paced learning based on website materials. Valiathan (2002) introduced three approaches for blended learning which were Skill Driven, Behaviour Driven and Attitude Driven. Ahmad, Shafie and Janier (2008) choose Behaviour Driven (BD) approach in Engineering Mathematics subject in order to motivate and assist the students to understand the subject. Behaviour Driven can be defined as a learning approach to develop specific attitudes and behaviours among learners. This approach blends collaborative learning events through instructor-led classroom sessions (lecture face to face, instructor-led, coaching, and some feedback activities), tutorials (face to face interaction, simulation using developed courseware and interaction with material or the exercises discussed in the class and some feedback activities), and web based activities (interactions and discussions facilitated through technology). Web-based activities offered flexibility learning in time and place in order to access and study the material on e-Learning.

Carman (2002) provided five key ingredients as important elements of a blended learning process: i) live events (synchronous, instructor-led learning events in which all learners participate at the same time, such as in a live "virtual classroom"), ii) online content (learning experiences that

the learner completes individually, at his own speed and on his own time, such as interactive, internet-based or CD-ROM training), iii) collaboration (environments in which learners communicate with others, for example, e-mail, threaded discussions and online chat), iv) assessment (a measure of learners' knowledge. Pre-assessments can come before self-paced events to determine prior knowledge, and post-assessments can occur following scheduled or online learning events, to measure learning transfer), and v) reference materials (on-the-job reference materials that enhance learning retention and transfer, including PDA downloads, and PDFs).

Delialioglu and Yildirim (2007) conducted a study on students' perceptions of the effective dimensions of interactive learning by Computer Networks and Communication students. The findings of the study showed that the way instructivist (knowledge flows from instructor to the student) and constructivist (knowledge is a construct in the mind of learner) elements are blended, the need for metacognitive support (supporting learners by helping them monitor and regulate their own learning process), authentic learning activities, collaboration (learners work in pairs or small groups to accomplish goals), source of motivation (extrinsic and intrinsic motivation), individualized learning, and access to the internet played important roles in students' learning in the hybrid course. In conclusion, the dimensions of blended learning discussed in literatures boil down to three basic approaches, assisted or guided learning, self-learning, and assessments. These dimensions were applied in this study's blended learning module.

Dimensions of Blended Learning Module

The blended learning module consists of three dimensions namely Self-Learning, Assisted Learning, and Assessments. Self-Learning comprises i) an audio video PowerPoint slide which provides lectures and interactive quizzes for all the chapters in the syllabus, ii) notes, texts and reference books for further reading, iii) online quizzes, and iv) a detailed blended learning scheme of work, provided to every student as a schedule guiding students and lecturers throughout the semester. Assisted Learning comprises; i) face to face tutorial and discussion classroom sessions, ii) instant messages using an instant messaging tool such as WhatsApp, and iii) a forum made available on i-learn. Assessments comprises i) online and written quizzes, ii) written tests, and iii) final examination. These three

dimensions were consecutively applied throughout the semester following the blended scheme of work. The blended learning module dimensions are depicted in Figure 1.

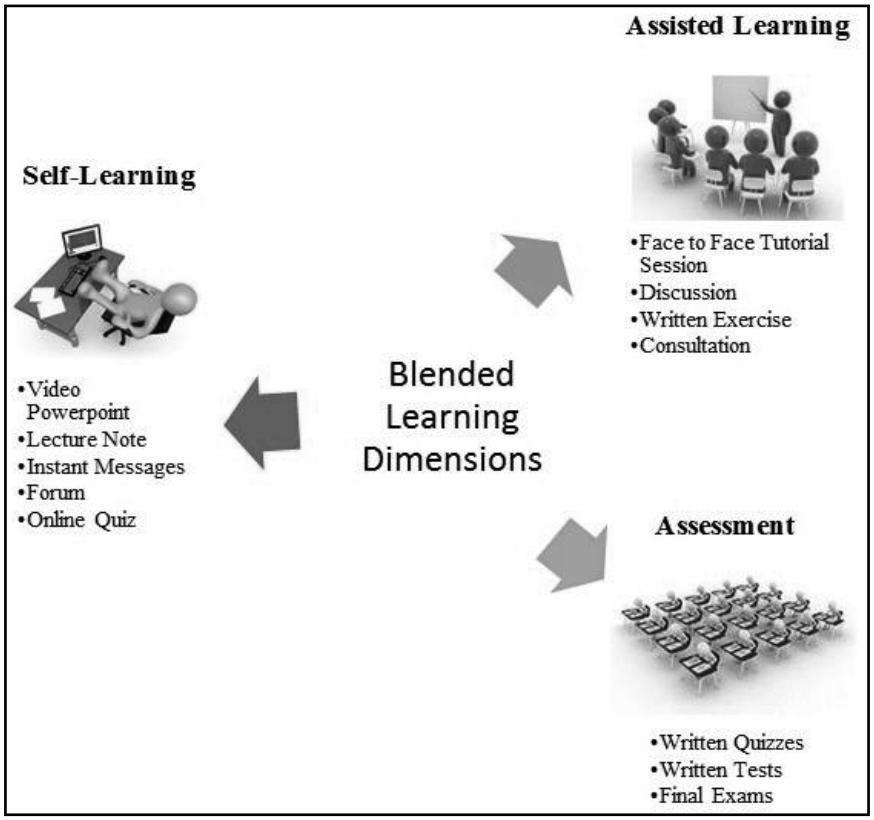

Figure 1: Dimensions of Blended Learning

RESEARCH METHODOLOGY

A total of 298 parts two, three and four Diploma students (semester May-October 2014) took an introduction to statistics course (QMT181) instructed by four lecturers. Two lecturers (190 students grouped into seven classes) opted to apply blended learning module in conducting their lectures while two others applied the traditional approach (108 students grouped into three classes).

During the lecturers' first meetings with students, lecturers who opted to use the blended learning module provided students with audio video PowerPoint for all the chapters in the syllabus and explained the blended learning scheme of work. Traditionally, the course consisted of four hours per week of face to face lectures and tutorials but with blended learning module, it was reduced to two hours Assisted Learning while the other two hours were allocated to Self-Learning. During Self-Learning sessions, students were expected to listen to audio video PowerPoint's, read notes and textbooks after which they were expected to do online quizzes. Every chapter has at least one online quiz. During Assisted Learning, the lecturers conduct tutorial sessions where exercises and tutorial questions are discussed. In these sessions students can ask whatever questions they have about the topic and clarify any misunderstandings. Even though two of the four contact hours were allocated to Self-Learning, for topics that are more difficult and need more assistance, all four contact hours may be utilized to give more time for problem solving exercises.

Students were assessed by online quizzes (which constitute 5% of total final mark), written quizzes for chosen chapters (5% of final mark), written tests (30% of final mark), and final examination (60%). Online quizzes were posted on I-learn, which is the university's e-Learning application. The online quizzes were made available for repeated trials; the main intention was to encourage students to make an effort at trying to understand and memorize certain facts after they had listened to the video PowerPoint slides. Thus, 5% was allocated to the total marks students scored for all the quizzes. Hopefully this would be a motivation for them to earn as much scores as they could. However, students could repeat doing the quizzes within the limited time the quizzes were made available.

One of the worries of mathematics or statistics lecturers in implementing blended learning is how to assess students' solving method. This is because mathematics and statistics involve not only understanding factual knowledge but also the process or procedures in arriving solution to problems. The lecturers insist that they should go through manually students' methods in solving problems so that they know students are using the correct method to get the solution. Thus, online quizzes alone would be insufficient. In this module, we complemented online quizzes with written quizzes and written tests. In this way, students were also assessed manually to see whether they were using correct methods in solving problems.

In order to find out whether blended learning module is at least as effective as traditional method, an independent t-test analysis was conducted to compare the means of final exam scores across the blended learning status. A survey of students' perception on the blended learning module was also conducted to gauge students' experience taking a statistics course offered in blended learning mode.

ANALYSIS AND FINDINGS

Comparison of Means

Comparison of means was conducted using Independent Sample T-Test in SPSS version 21. It is known that one weakness of the 'mean' is that it is influenced by extreme values. Thus, measures have to be taken to make sure that comparison using 'mean' is valid. One way is to verify that groups involved in comparison have almost the same dispersion among their scores. Hence, before we compare the group mean scores, dispersion of scores for each group was first calculated using the Coefficient of Variation (CV). CV is a relative dispersion to the mean which is the standard deviation expressed as a percentage of the mean (shown in Table 1).

Table 1: Descriptive Measures and Coefficient of Variation of Scores for Each Group

Group	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		**Coefficient of variation (%)**
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	
A (BL)	25	37.00	87.50	64.8200	14.17074	-.268	.464	**22**
B (BL)	33	25.50	90.50	55.3333	17.35190	-.203	.409	**31**
C (BL)	27	22.00	87.50	56.5556	18.55000	-.292	.448	**33**
D (BL)	34	22.00	89.50	61.5882	18.75297	-.328	.403	**30**
E (BL)	38	23.00	79.50	49.1053	13.13143	.128	.383	**27**
F (BL)	15	39.00	86.50	55.9000	14.08038	1.081	.580	**25**
G	30	30.50	86.00	62.4000	16.80538	-.685	.427	**27**
H (BL)	19	33.00	93.50	65.1053	18.84187	-.404	.524	**29**
J	37	20.50	90.00	58.2568	18.60355	.011	.388	**32**
K	41	23.00	85.50	52.6220	15.26056	.333	.369	**29**

*Groups A, B, C, D, E, F and H were instructed using blended learning module
*Groups G, J and K were instructed using traditional teaching

There were two groups (A with CV = 22% and F with CV = 25%) with dispersion markedly different from the rest. The other eight groups can be considered to have similar dispersion. To illustrate diagrammatically, CV for each group was plotted against their frequencies as shown in Figure 2.

Marked different dispersion					Marked similar dispersion						
					x		x				
x			x		x		x	x	x	x	x
22	23	24	25	26	27	28	29	30	31	32	33

Figure 2: Distribution of CV for Each Group

The two groups (A and F) were separated from the other eight groups that have almost the same CV. Five groups (151 students) were instructed using blended learning module, while the other three groups (108 students) were instructed using traditional approach. The independent t-test was conducted to compare the means of final examination marks between teaching approaches, Blended Learning vs Non Blended Learning. Table 2 shows the result of the independent T-Test.

Table 2: Results of Independent T-Test

t-value	Degree of Freedom	Significance (2-tailed)	Std. Error Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-0.453	258	0.651	-1.01852	2.24672	3.40572

*Equal variances assumed

The result from the t-test shows that there is no significant difference between the final examination marks scored by students undertaking blended learning module and the final examination marks scored by students instructed with traditional teaching method. Thus, the null hypothesis was not rejected.

Students' Perception on Blended Learning

To capture students' perceptions on the blended learning module, a short questionnaire was developed and distributed to the students. Students were asked if they had heard of blended learning before starting the module. Only 40.8% of the students were familiar with it, while the rest (59.2%) were not (Table 3). 68.3% were clueless on what blended learning is, 12.7% thought that blended learning might be scary and only 19% thought that blended learning would be fun (Figure 3).

Table 3: Students Awareness towards Blended Learning

	Heard of Blended Learning
Yes	40.8
No	59.2

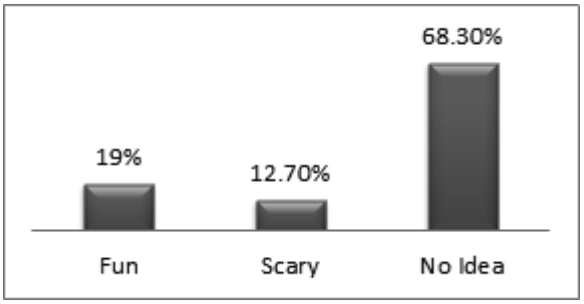

Figure 3: Opinion on Blended Learning before the Module Starts

Students were also asked if they would prefer other mathematical subjects to be conducted as blended learning as well. 21.1% said yes while the rest (78.9%) did not prefer other mathematical subjects to be offered in blended learning mode (Table 4).

Table 4: Students Preference to apply Blended Learning to other Subjects

	Prefer blended learning for other mathematical subjects
Yes	21.1
No	78.9

There were three components in Self-Learning and Assisted-Learning dimensions that contributed to the highest percentage of students who confessed to have problems. The components were video PowerPoint (69.7%), online quizzes (50%), and class tutorials (9%) (Figure 4). On the other hand, the component that best helped the students to understand the subject was classroom tutorials as shown in Figure 5.

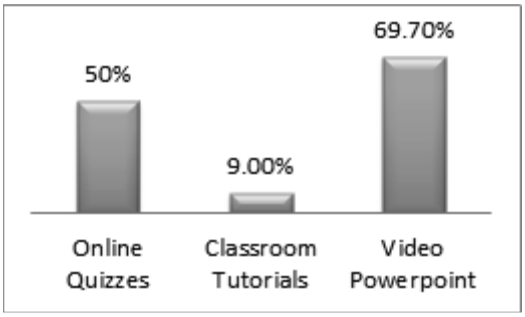

Figure 4: Components with Highest Percentage of Students who Face Problems

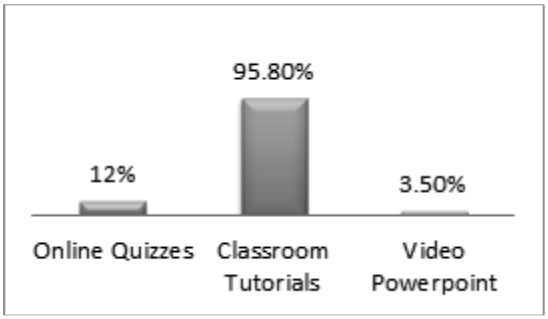

Figure 5: Components that Best Helped Students' Understanding

LIMITATION OF STUDY

One of the limitations of this study is that there were different lecturers teaching different groups of students. This may prompt different teaching styles among different lecturers that may have different influence on students' learning gain. We tried to overcome this limitation by using final examination marks as comparison instead of the final graded scores. In this university, the final graded scores consist of the continuous assessment marks (quizzes and tests) which were handled by the lecturers individually plus the final examination marks. Except for tests' questions, the quizzes and assignments (if any) were not standardized across all groups of students. However, the final examination questions as well as the marking scheme

were standardized. Furthermore, most lecturers also practised common marking (a lecturer marks the same questions for all students) which further enhanced standardization in marking questions. There is also a time lapse of about three weeks between the last lecture and the final exam date. During this time the students were left totally on their own to prepare for the final examination. Hopefully this time lapse and standardization will diminish if not nullify the impact of different teaching styles conducted by the different lecturers.

The second limitation of this study is the difference in students' abilities and efforts that may cause different variances in distribution of marks across the 10 groups of students. We tried to overcome this limitation by conducting Independent T-Test for groups having almost the same dispersion in final examination marks only. By doing this we hope to be able to avoid making erroneous conclusion. We did not make comparison based on failure rate per group because making comparison based on failure rate per group would not enable us to overcome this limitation as the failure rates will only tell us the number of weak students per group whereas blended learning module was meant for every student in the groups. Furthermore a group that has more weak students would be expected to have higher failure rate irrespective of whether they had undergone blended learning module or not.

DISCUSSION AND CONCLUSION

During Self-learning, students had abundance of materials to browse as well as to work on. With video PowerPoint slides explaining the theoretical part of each chapter as well as demonstrating worked examples, lecturers had more time to discuss problems and more problems could be attempted during classroom sessions. However, lecturers must be well versed with the subject in order to provide a summary of the chapter to stimulate further understanding and to be able to guide the students through all the tutorial questions. The video lectures also helped to overcome insufficient number of class sessions to finish the syllabus due to classes being cancelled because of public holidays or programs that either lecturers or students were required to attend.

Class sessions became more interesting because no one fell asleep when classes were interactive discussions and problem solving sessions; students took active part in question and answer activities because having read the textbooks, notes, and watched the video lectures they could contribute to the discussion. Personally, as lecturers we looked forward to classes whereby we were able to attract students' attention to our subject without having to stick to one way traffic' flow of information that usually caused students to fall asleep or trying hard to keep awake.

Results from this study showed that there was no significant difference in final examination marks scored by students who undergone blended learning module and final examination marks scored by students under traditional approach. This can be taken as evidence that blended learning module is as effective as traditional approach as far as examination scores are concerned. In fact during the time lapse before examination date students under blended learning module had the advantage of going through lectures for every chapter (via listening to video PowerPoint) repeatedly as well as personally consulted lecturers through WhatsApp, Telegram and forum application in I-learn. This was a great help in increasing their learning gain.

While many students were keen and excited about this mix method of teaching and learning, there were students who were i) too lazy to listen to video power point slides, ii) couldn't care less about their marks thus not enthusiastic in obtaining as much as they could in online quizzes, and iii) not matured enough to be able to want to gain the most out of available learning opportunities. Students who participated in this study were Part 2 and Part 3 Diploma students, where just a year ago they were attending secondary schools. Hence they were still familiar with the traditional style of 'chalk and talk' delivery which made them very dependent on their teachers as their source of knowledge. Therefore some of them found it very difficult to do independent study by listening to educational videos and tried the exercises presented in the slides as well as reading notes or textbooks on their own. We found that as lecturers, we also had to act as motivators and facilitators. Good students performed very well, but poor students mostly could not keep their patience and concentration long enough to finish listening to the videos.

In general, the results from the survey of students' perceptions on blended learning module were not very encouraging. We think that this was expected as students were no longer 'spoon fed' but had to be more independent in searching of knowledge. There was quite a big change in the teaching and learning process from traditional to blended learning. Thus, it will need a lot of adjustments in the student's attitude to achieve confidence and comfort.

In conclusion, blended learning is possible for conducting statistics courses and is beneficial to both students and instructors. Their performance in final examination showed that students who were instructed using blended learning module were not at a disadvantage compared to students who were instructed with traditional method. In fact, during Self-Learning dimension in blended learning module, the students experienced numerous benefits intrinsically such as time management, self-discipline, patience as well as self-motivation. These are valuable experiences in intellectual training needed by every university student in this decade.

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