

Efficiency in Learning Computer Programming Through Blended Learning Methods

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Abstract

The COVID-19 pandemic has shifted the way education is delivered, leading to a widespread adoption of online learning methods. Online education has adopted many methods of learning, such as synchronous, where teaching is present during instruction, and asynchronous, where pre-recorded video learning is provided for students. In addition, there is also blended learning, where both methods are combined simultaneously. This research compares pure synchronous teaching and blended learning of a computer programming course in the Faculty of Engineering. We collect data by comparing performance between fully synchronous learning and blended learning from two groups of students, with 25-30 students in each group. The method to compare two groups of students is divided into two parts; the first part uses a quantitative approach by using the outcome of the exam. The second part uses a more qualitative approach by collecting feedback from students they have an experience in blended learning. The result of the first approach has shown that students' exam scores using the blended method give a higher median of 5.76% and a higher average score value of 1.59% than those who only participate in a synchronous approach. For the second approach, we found that students prefer blended learning over either only asynchronous or synchronous learning. They believe asynchronous learning can provide flexibility in terms of learning and course revision, while synchronous learning can provide instant feedback and reassurance from the instructors if they have questions and clarifications. The combination of both methods can help students reach the best outcome.

Keywords: Blended Learning, Computer Programming, Online Teaching

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Introduction

Computer programming course is a fundamental course for all engineering students. Students come into the university with various backgrounds, it usually takes a lot of time to ensure all students can reach the same level of understanding of computer programming concepts. Designing a classroom with video sessions can encourage students to have the basic knowledge beforehand so that during their classroom sessions to practice with real problems. Since students with various background can impact their learning experience, through the video sessions, students learn the basic concepts and try to understand different examples in a self-learning environment (Anthia & George, 2016; Delen, 2014; Hughes 2009).

A lot of study shows that with video content, the performance and satisfaction of students significantly increases with better knowledge transfer and memory. (Desai & Kulkarni, 2022; Dilani & Arezou, 2018; Greenberg & Zenetis, 2012; Bravo, et al. 2011). Moreover, another main advantage in using video is it can provide flexible time and place that may suitable each individual student (Henderson, et al, 2017). However, using series of videos with linear content alone cannot achieve the best learning outcomes. Many studies have suggested that interactive activities are useful in encouraging students to focus more and promote active learning rather than the passive one (Dilani & Arezou, 2018). Questions and quizzes are one of interactive activities during and after watching the video to get more student attention and to emphasise the key contents where students should be focusing (Anthia & George, 2016; Wouters et al., 2007). There combining both video and questions can provide interactive activities during the self-learning without the aide from the instructor.

However, a lot of previous research shows that students are more content with face-to-face interaction, even in an online environment (Barbara & Flowers, 2020). Moreover, using only video sessions cannot fully facilitate students as much as teacher interaction and attention. Blended learning can be essential to encourage the most student involvement especially in the online learning environment (Moorhouse & Wong, 2022; Mukminatus, Z & Maskhurin, 2022). There are quite a few of studies have been conducted on primary and secondary school not many studies have been conducted on engineering subjects (Moorhouse & Wong, 2022; Mukminatus, Z & Maskhurin, 2022, Desai & Kulkarni, 2022; Barbara & Flowers, 2020).

Therefore, the author experimented by adopting a blended learning method where students can study using the instructional video before the live session as a method of blended learning which is include the synchronous learning mode where students use the video session for basic theory and examples and asynchronous mode where students will meet with instructor face-to-face and focus more on example and practical sessions.

In this study, there are two groups of students. The first group is using fully synchronous mode and the second group is using blended learning mode. There are two measurements used in this paper, which are:

1. Student Performance's assessment
2. Questionnaire Feedback

Student Performance's Assessment

The final exam scores are used to evaluate students' performance in two groups. Students in the first group use a fully synchronous method, where the instructor is present during the teaching period. The second group uses blended learning, where the pre-recorded video is used before the synchronous teaching is performed. We compared the data for two groups of students using a simple statistical method which are average, mean, and standard variation values, based on their scores.

1. Scores collected during midterm exams
2. Score collected during final exam

The scores during the midterm exam can be difficult to compare because it is based on a different settings. Students in synchronous mode took the exam in person with a closed-book option. While the second group of students took the exam online with an open-book option. Both groups have a time limit of three hours.

The scores during the final exam are in the same environment, which is in an online mode with an open-book option and with a time limit of three hours.

Questionnaire Feedback

A questionnaire is collected, blinded-folded through an online platform. Students who have experience in the blended learning are asked to provide feedbacks. There are 5 main categories in the questionnaire.

Analysis Students' Performance

Table 1 shows the score summary of the midterm exam in two groups of students. Group A is the first group of students who study in a fully synchronous method. In comparison Group B is a group with blended learning. There are 28 students in Group A and 25 students in Group B. The results can be difficult to interpret as it has been mentioned since Group A took the exam in person with a closed book while Group B took it online. The result shows that the average, median, minimum, and maximum score of Group B is higher with a slightly higher standard deviation value. Group B, with the advantage of open book can get much better scores during their midterm exam.

Teaching Mode	Group A	Group B
Average Score	34.03	70.47
Median Score	32.5	73.71
Minimum Score	0	24.29
Maximum Score	80.5	100
Standard deviation	15.26	19.41

Table 1: Midterm exam score

Figure 1 shows the distribution of scores in both student's groups using a histogram. The x-axis denotes the score, while the y-axis represents the number of students within that range. The distribution of Group A is significantly lower, and only one student receives a score of more than 80. Most students in Group B receive a better score than group A.

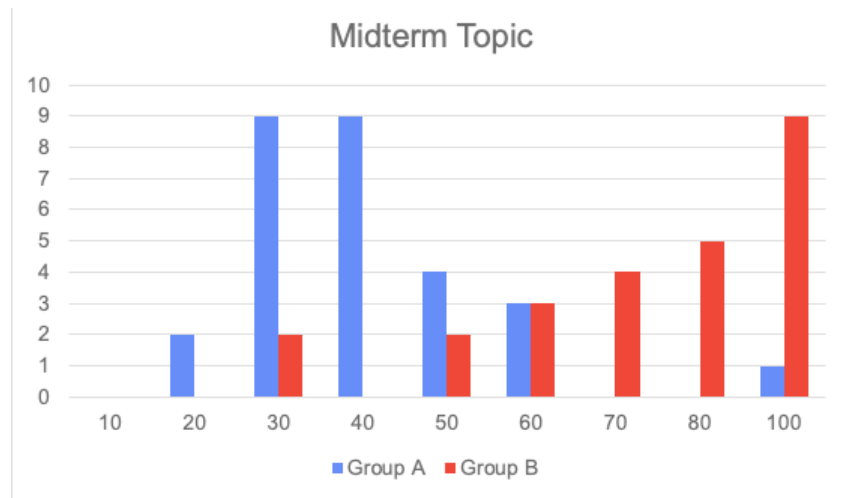


Figure 1: Histogram Distribution of midterm score from students in two different modes of study during the midterm exam, using midterm topic

Table 2 shows the score summary of the final exams. In this exam both groups are taken exam in the same environment which is online and open book setting. The results show that the average, median, and maximum scores of Group B are 1.59%, 5.76% and 4.25% higher than Group A respectively. However, the minimum score in Group B is 9.71% lower than Group A. The fluctuation in scores of Group B makes the standard deviation of Group B higher.

Teaching Mode	Group A	Group B
Average Score	58.23	59.82
Median Score	60.83	66.59
Minimum Score	20.24	10.53
Maximum Score	83.33	87.58
Standard deviation	16.80	23.17

Table 2: Final exam score

Figure 2 shows the distribution of scores in both student groups in a histogram. So, it can be seen that a few students from Group B get low scores than Group A. However, most of Group B students tend to have higher score than those in Group A. It shows that students in blended learning environment can perform slightly better than students in synchronous learning only.

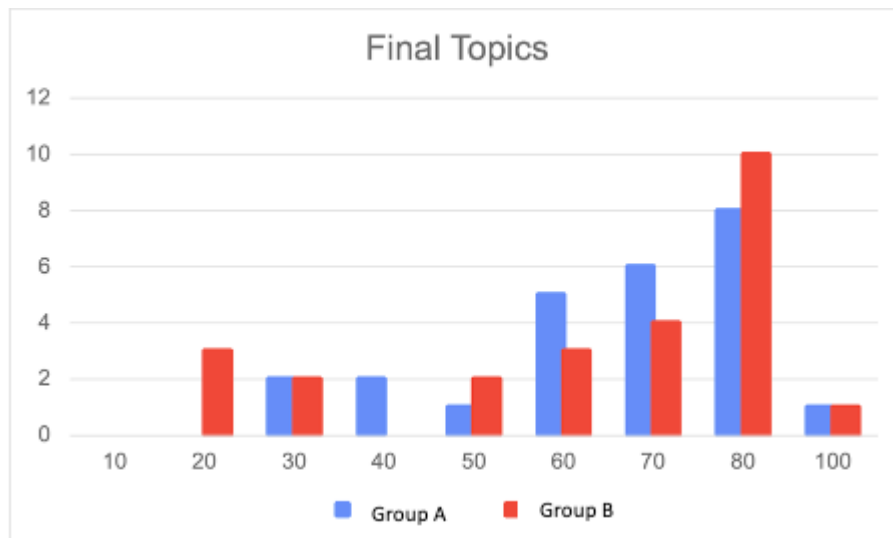


Figure 2: Histogram Distribution of the final exam scores from students in two different modes of study during the final exam, using final topic

Analysis of Questionnaire Feedback

A questionnaire is conducted in voluntarily manner for students in Group B who have experience in blended learning. All students are requested to answer different type of questions in 5 categories. There are 15 students who participated in providing the feedback to this questionnaire.

Each section contains a set of questions, with different scaling questions and questions that ask for their opinion in each topic. For the scaling questions, a scale of 1-5 is used to evaluate their satisfaction and agreement with the question. Scale 5 indicates that the student agrees with the question and scale 1 refers to student who completely disagrees with the statement.

The 3 main sections are as follow:

1. Perception of learning through video recording
2. Perception of learning of live online learning
3. Perception of learning of blended learning

All sections focused on modes of learning: asynchronous, synchronous, and blended learning.

In the first section, there are five scaling questions, which are:

Question 1: How much does watching videos help develop your programming skill?

Question 2: Does watching videos improve your understanding?

Question 3: Does doing interactive quizzes while watching the video helps you understand the topic better?

Question 4: How much do you think doing quizzes helps you learn compared to not having quizzes?

Question 5: Does doing more exercises after all asynchronous and synchronous teaching help improve your understanding?

Question	Average	Standard deviation
Question 1	3.47	0.62
Question 2	3.26	0.85
Question 3	3.73	0.68
Question 4	3.53	0.62
Question 5	4.07	0.77
Average	3.61	

Table 3: The average score of each question in the topic perception of learning through video recording

The average and standard deviation score results for each question are shown in Table 3. The results show that students are slightly satisfied with asynchronous learning with an overall average score of 3.61 out of 5. The first two questions are about watching videos; the average of satisfaction score of watching the video is 3.36. The following two questions are about doing quizzes during the video session, which give a better average score of 3.63. This indicates that doing quizzes along with video watching can improve students' understanding and learning. The last question emphasises the additional exercise after class which give the highest score of 4.07. In almost all the questions there are barely any students who have given score lower than 3, besides one student who gave a score value of 1 in Question 2. As a result, the average score of Question 2 is slightly lower than the other questions.

Additionally, for non-scaling questions, the questionnaire asks students about their opinion on benefits and obstacles in engaging asynchronous learning. Table 4 and Table 5 show the results of students' responses to the benefit and obstacle respectively. Both tables show the most frequently answered. Each student allows to have multiple comments.

The most common benefits that all students agree are that the video can be rewatched easily and almost everyone (86.7%) agrees that the video allow flexible time for them to study at their own pace. About half believe that the content can be understood easily by the instructors in the video.

Benefits	Number of students	Percentage of respondent
The video can be rewatched easily	15	100.0%
Flexible time	13	86.7%
Easier to understand the content	6	53.3%
Many instructors make the content more understandable	5	33.3%

Table 4: Benefit of online asynchronous learning

Obstacles	Number of students	Percentage of respondent
Poor internet connection	11	78.6%
Difficult to access lecturer	7	50%
Personal device is not good enough	6	42.9%
Watchings video wasting ore time	4	28.6%

Table 5: Obstacle online Asynchronous learning

On the contrary, students find that their personal device with their poor home internet connection is the greatest obstacle to accessing online asynchronous learning. About a half of students believe that they cannot easily reach the lecturer during the asynchronous session because they do not have a face-to-face experience with the instructor. A few of them believe they must watch the video before class as a wasteful of time.

The second section is about students' perception of learning of live online learning or during synchronous learning sessions. There are 3 scaling questions as follows:

Question 1: Does “instructor-led” learning help improve overall learning?

Question 2: If learning with fully asynchronous, without an instructor present, how well do you understand the contents?

Question 3: How much do doing exercises during synchronous class useful for learning?

The average and standard deviation scores for each question are shown in Table 6.

Question	Average	Standard deviation
Question 1	4.13	0.62
Question 2	2.99	1.18
Question 3	4.00	0.63

Table 6: The average score of each question on the topic of students' perception of learning of synchronous learning

In this section, each question asks students in different aspects, so the average score across all questions is not calculated. Question 1 and question 3 ask about students' preferences for synchronous learning, while question 2 focuses more on the asynchronous approach. Question 1 and 3 have received a lot better response compared to Question 2. Figure3 shows the histogram distribution of answer to all three questions. In Question 1 and 3, the minimum score is on a scale of 3(Neutral). But in Question 2, the distribution of answer is very diverse.

There are 7 out of 15 students disagree that that without the synchronous session, they can still understand the content in the same way that they do with the blended learning. They believe that synchronous learning is essential for them. However, there are still 4 out of 15 students believe that they can understand the content in the same way by using only asynchronous learning.

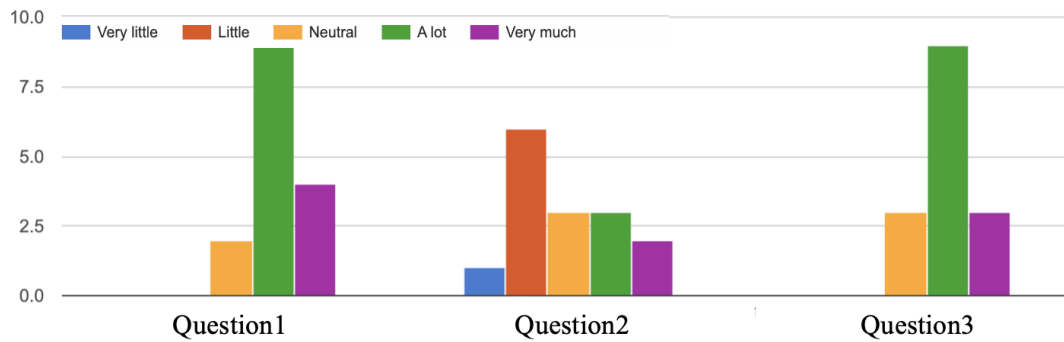


Figure 3: Histogram distribution of students responding to the questions regarding to perception to synchronous learning

For non-scaling questions, the questionnaire asks students about their opinion on benefits and obstacles of engaging synchronous learning. Table 7 and Table 8 show the results of students' responses to the benefit and obstacle respectively.

Benefits	Number of students	Percentage of respondent
Understand the content instantly	11	78.6 %
Receive immediate comment during exercises	10	71.4%
Ability to discuss with instructor easily	10	71.4%
Ability to access using personal device easily	2	14.3%

Table 7: Benefit of online synchronous learning

Obstacles	Number of students	Percentage of respondent
Poor internet connection	8	57.1%
Personal device is not good enough	7	50 %
Difficult to access the lecturer	5	35.7%

Table 8: Obstacle online synchronous learning

Most answers regarding the benefit of synchronous learning indicate that they can access to the instructor easily and instantly without delay. If further discussion is required, the instructor is available to give students feedback and clarification immediately. Unlike asynchronous learning where students feel that they cannot communicate with the instructor

easily even though there are many communication channels available for students. Some students may have queries, but they prefer to wait until they meet with the instructor during the synchronous session. Additionally, the internet connection and personal device are still the main issues during online learning which is similarly to asynchronous learning. This means that some students find it difficult to access the online classroom. However, a few more people, complain about their internet connection more during asynchronous learning, it may be the result from some students feel that they require to use their internet connection unnecessarily during asynchronous learning.

The third section of the questionnaire is about the student’s perception of blended learning. There are three scaling questions which include:

Question 1: You prefer blended learning more than purely asynchronous learning.

Question 2: You prefer blended learning more than purely synchronous learning.

The average and standard deviation scores for each question are shown in Table 9. The average score of both questions in this section is the same, which is 3.73. The results indicate that students prefer blended learning more than either asynchronous or synchronous learning.

Question	Average	Standard deviation
Question 1	3.73	0.68
Question 2	3.73	0.77

Table 9: The average score of each question on the topic perception of learning through a blended method

A histogram distribution for each question is shown in Figure4. Even though the average scores of both questions are the same, there is slightly different distributions. Question 2 gives a slightly higher standard deviation. Overall, all students give a score of at least 3 out of 5 however more than half of the students give a score of 4 and 5 which indicates a preference toward blended learning.

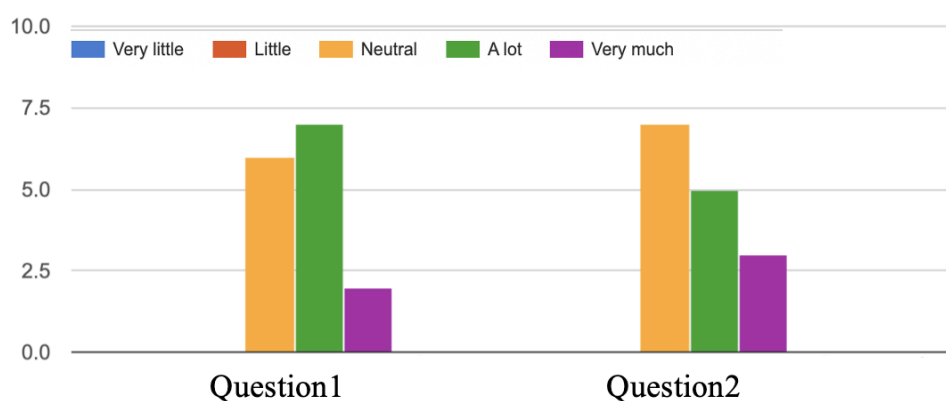


Figure 4: Histogram distribution of students responding to the questions regarding perception of blended learning

Furthermore, with the questions regarding obstacle to blended learning, the list of responses is shown in Table 10. Some students feel they require to spend more time watching videos which may waste their time and need a lot of time to understand the content better since it may not be clear at first. Some students feel they must wait until the online session to make some content clearer, which they feel it's a waste of time.

	Number of Students	Percentage of respondent
Spend more time to understand	6	60.0%
Waste more time to watch video	5	50 %
More internet expenses	2	20.0%
The content is already clear during the video.		
Instructor may not be necessary.	1	6.7%

Table 10: Obstacle of online blended learning

Conclusion

Our study shows that using blended learning between synchronous learning and asynchronous learning, in terms of scores, students with blended learning get higher average and median score better score compared to student using fully synchronous learning.

Asynchronous learning is useful that it provides students flexibility in terms of time, place, and pace of study. A few students tend to prefer video watching, even more than synchronous learning because of its flexibility and ability to repeat the video for revision.

However, most of them still believe synchronous learning is useful. They believe with the instructor present, they can get more clarification if they have questions, there is someone who responses to their questions and queries instantly. Therefore, classroom interaction is important for students to engage and develop better.

One of the main problems students raise about online learning is internet connectivity. Instructors must be aware of students' devices and connectivity, especially during online synchronous learning where students must participate fully using their own devices. Therefore, the main contents of the lecture should be provided during the video sessions for fair treatment of all students.

It can be concluded from this study; blended learning is useful. Asynchronous learning provides guidelines and flexibilities, for learning and revision. The synchronous session is also essential, especially to provide better guidelines to students and give reassurance for skill development to all students.

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