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Blended Learning in Process Control Course for Undergraduate Students

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ABSTRACT

Research shows that perceived academic control, a person's belief in his or her influence on the success or failure of performance outcomes, has been the important aspect that builds the confidence among students, especially undergraduate students paving their way through university. Good academic control can come from a good learning experience. Out of many ways to improve the students' academic control, blended learning can be one of the good candidates to be explored. This paper shares about blended learning implementation for Process Control Course, a course perceived as difficult course among the students. The finding shows that implementation of blended learning does have a positive impact on students' performance.

Keywords:

Blended Learning; process control courses; undergraduate; Chemical Engineering

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1. Introduction

An excellent student during high school does not guarantee to become successful during university life too. In contradictory, there are many cases when bright, enthusiastic high school students fail after entering university. The two main factors attributable to these unfortunate events are perceived academic control and action control respectively as mentioned in Perry *et al.*, [1]. It is important that we minimize the impact of these failures by equipping the syllabus with a tool that can restore students' interest and faith that it can be done.

Rafiqul *et al.*, [2] defines chemical engineering as a cross-sectoral profession, a blend of different engineering augmented with competencies from computer science as well as mathematics. As such, chemical engineering relies on a firm technical and scientific foundation that remains largely unchanged. The ability to understand complex systems is at the heart of current and future challenges for improving life on the planet. By nature, these challenges are ones that require engineering of innovative solutions as per highlighted by Ian *et al.*, [3]. One of the available ways is via conducting blended learning to facilitate the student understanding. This paper presents a brief explanation on blended learning implementation for Process Instrumentation and Control course.

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This course is currently offered to second year third semester undergraduate students and has commenced its first blended learning structure in September 2022 semester. This paper will touch on the important aspects of the blended learning structure and provide observable impact that it has upon the students' performance.

1.1 Research Question

Our blended learning approach aims to aid the student understanding for this usually considered as killer course in Chemical Engineering Syllabus structure, the Process Control. Hence our main research question is:

“How can we integrate blended learning into the course to increase the undergraduates understanding?”

1.2 Research Objectives

The objectives of this study are:

1. To provide an overview of how the blended learning is structured into the course.
2. To analyze the effects of blended learning and its relationship to students' performance.

2. Methodology

2.1 Blended Learning Framework

The term blended learning is used to describe as solution that combines several delivery methods and also used to describe learning that mixes various evident-based activities. The evident-based activities include face-to-face classroom, e-learning activities and self-paced learning as per mentioned in Purnima [4]. Blended learning has also captured a lot of attention since the COVID-19 pandemic hits the world in 2020. A study by Batubara *et al.*, [5] focuses on implementing blended learning to undergraduates students in Indonesia and has concluded that blended learning does bring positive impact towards students' performance. Although there is no one definite way that guarantees learning, blended learning can be seen as an emerging potential approach to improve students' learning experience. This is supported by several continuity research that focus on studying the effect of blended learning on students' performance as per presented in Maulida *et al.*, [6], Li *et al.*, [7] and Suryono *et al.*, [8].

As every lesson should go, construction of blended learning starts with the lesson plan. In our approach, Week 8 is selected for Blended Learning implementation after having 7 weeks of physical class approach. This lesson plan is important to segregate the activity and hours spent accordingly. This lesson plan should have been constructed by taking into consideration two main things which are the complexity of the course and E-learning platform capability.

Table 1

The hours breakdown for Blended Learning Lesson Plan

Lesson Details	Students Learning Time (SLT)
Video lecture / lecture complimentary notes / suggested reading materials	8 hours
Self-check activities through suitable online media	6 hours
Assessment/ Scaffolding	4 hours

Week 8 has been chosen for blended learning for this Process Control Course because it is during this part of the syllabus students are introduced to the real concept of process control. This chapter is called Feedback Control System, and it holds the most important part in Process Control Course that students need to grasp and hopefully truly understand. The complexity requires some tweak and improvement from normal physical class in order to increase students' interest and understanding. Hence blended learning is deemed suitable to be implemented at this stage of the syllabus. This is because on both sides, students and lecturers have more flexibility to learn and produce materials according to their time and pace.

It can be observed that the breakdown for student learning time (SLT) for online lecture and self-check activities are close to each other. This is because in blended learning, these two sections are almost equally important, and at time can be interexchange able following circumstances. Students can utilize both sections to increase their understanding since it can be accessed at their own convenience with no pressure. Physical class self-assessment is the opposite, it takes place at a specific time with limited flexibility. Students who might not be in a good condition during that time will perform below their actual level. This is where blended learning wishes to close the gap, especially during the critical phase of the course syllabus.

Once the hours breakdown has been finalized, the preparation of electronic materials started. It involves recording videos to be posted into the student portal for them to watch and learn about together with the step-by-step explanation alongside the posted video. This is the crucial aspect of blended learning and where the effort of the lecturer implementing this method should be maximum. The videos serve as the '*lecturer substitute*' to convey the lesson. On the advantage side, this process provides the lecturer to reevaluate their understanding of the taught course and to include any additional info they feel necessary. The availability of a conducive E-learning platform will become handy at this stage. Students and lecturers are connected via ULearn e-learning portal to ensure a smooth transfer of information about teaching and learning. This portal enables a seamless integration of blended learning into the readily available normal physical class structure. Lecturers are able to upload videos they have prepared and provide step-by-step information alongside them. The information includes what the students should focus on, complimentary materials to aid the videos and even personal tips from the lecturers. All of these can be uploaded to the portal in an organized manner which the students can access with ease. It is important for the lecturer to fully explore the capabilities of the E-learning platform in order to maximize the usage and provide optimum study environments for the students throughout the blended learning duration. The ULearn portal is also equipped with embedded H5P, an authoring tool that allows the creation of interactive exercises to aid the self-assessment stage of blended learning.

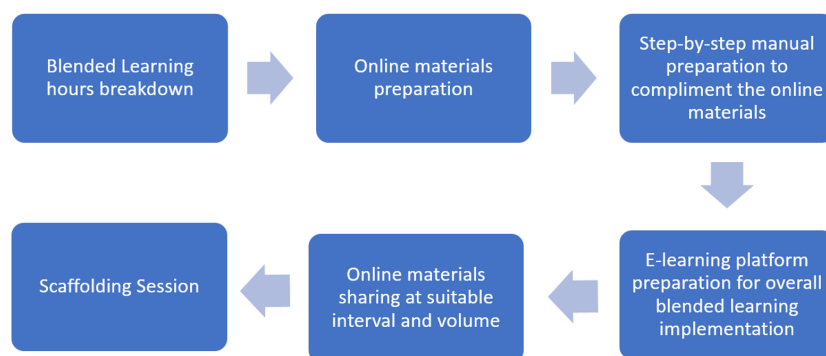


Fig. 1. Summary of blended learning implementation steps

The volume of the materials posted online should also be closely monitored. It is preferable to share shorter videos instead of a long 2-hour lecture. In the case of long videos are unavoidable, those videos can be posted part by part leveraged by a more comprehensive complimentary material. Towards the end of the blended learning week, a scaffolding session is conducted to assess the students' understanding through quizzes. The quiz questions should be carefully designed to ensure they ask about the most important part of the syllabus. The quiz answers will then be discussed during a face-to-face session once the blended learning is completed. Figure 1 summarizes the important steps during blended learning implementation.

3. Results and Discussions

This section discusses the observable improvement on students' performance for their Test marks before and after the blended learning implementation. The data shows the marks of 67 undergraduate students taking Process Control Course during January 2023 semester.

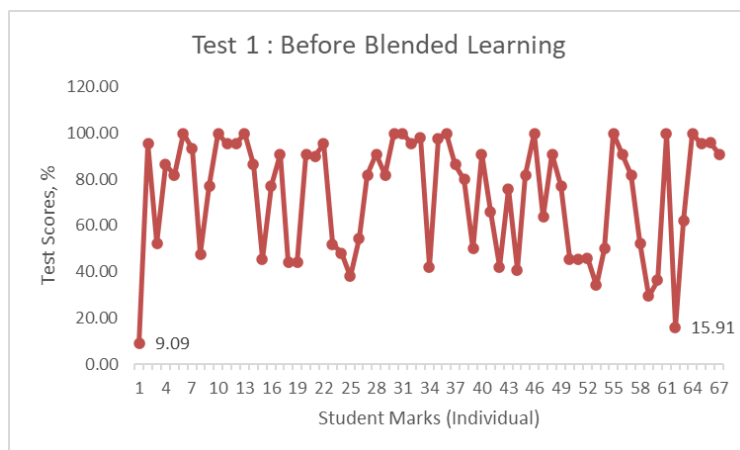


Fig. 2. Test 1 marks (Before Blended Learning)

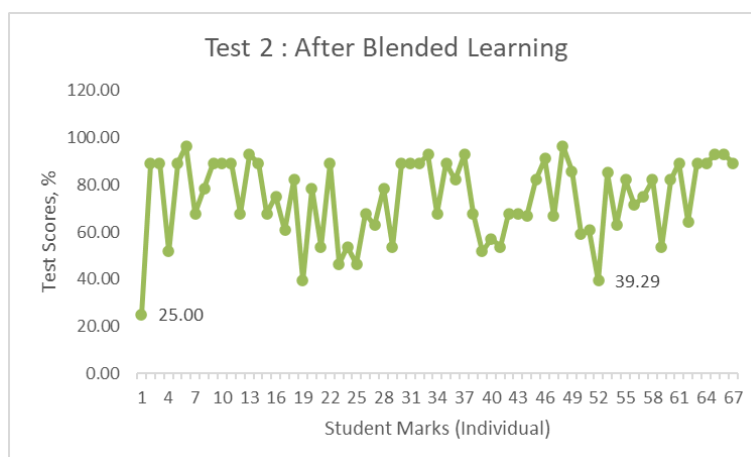


Fig. 3. Test 2 marks (After Blended Learning)

Figure 2 depicts the line chart of the individual marks of the students during Test 1. Test 1 is conducted upon the completion of Week 6. The two points with values are the two-lowest marks

obtain by the student during the test, they are 9% and 16% respectively with the average marks being 73.09%.

Figure 3 shows the Test 2 marks for the 67 students individually. Test 2 was conducted after the completion of Week 10, which means after the blended learning has been conducted in Week 8. An improvement can be observed on the lowest mark obtained by the students during Test 2. The two-lowest marks are now 25% and 40% respectively with the average mark being 74.18%.

This tangible improvement can be attributed to the help of blended learning nature as per discussed previously. The flexibility that blended learning offers has been helpful for students to learn at their own pace and preferred time. The time when they are fully ready to absorb the knowledge, be critical and explore more. The lecture videos can also be replayed to their discretion to capture any relevant information that they are not be able to grasp the first time. On a different side, the blended learning also provides the lecturers with opportunities to enhance and sharpen their understanding towards the course. This happens during the materials preparation, of which might involve transforming readily available materials into interactive videos. As this process takes place, there will be some adjustments needed here and there. Thus, it can be also stated that blended indirectly led to the production of better teaching materials.

4. Conclusions

The important steps in blended learning implemented for Process Control Course offered to undergraduate students of Universiti Teknologi PETRONAS has been successfully shared. The analysis on students' marks during Test before and after the blended learning implementation shows observable increment indicating that blended learning does have positive impact on students' learning experience. has been portrayed to show the impact it has on students' performance. However, it is also important to note that, the success of blended learning is very subjective to various factors such as the campus facility, study and teaching preferences, the lecturers and student's computer literacy and not to forget the internet connection stability. It is important for the above-mentioned factors to be improved together with our eagerness to shift to blended learning thorough implementation. This to ensure the blended learning model is sustainable and beneficial in the long term.

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