



## **Engineering Students' Perceptions and Acceptance of the Online Flipped Classroom for Learning during the COVID-19 Pandemic**

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### **Abstract**

This article reports on the results of an open-response survey sent out to IUM Engineering students to elicit their thoughts and views about learning their courses online via the flipped learning mode. The decision to take academic courses online was brought about by the COVID-19 pandemic which has forced many sectors, including the education sector, to either cease operations or make changes to their approaches. Hence the objective of the survey was to explore Biochemical Engineering students' perceptions and acceptance of online flipped learning during the COVID-19 pandemic. Responses were collected from 80 Year 2, 3 and 4 students of Engineering at the IUM. The results showed an overwhelming acceptance of online flipped learning among the students where only a small percentage of 2.7% completely rejected it as a preferred online learning mode. A majority of the students expressed a reserved acceptance (64.9%) of it, while 27% accepted it unconditionally. A major concern that emerged from the findings was uncurated and poor selection of videos for students to study before class meetings. This suggests that the flipped classroom approach can result in ineffective online learning if it is not designed carefully. The findings have significant implications on the technological skills and pedagogical readiness of university lecturers to design and deliver online flipped learning in an effective manner.

**Keywords:** *Flipped classroom, emergency online learning, students' perceptions of online learning, students' online learning readiness, learning during the pandemic*

## INTRODUCTION

Following the rapid spread of COVID-19, the World Health Organization (WHO) declared the virus as a Public Health Emergency of International Concern (PHEIC) on the 30<sup>th</sup> of January 2020 (COVID-19 Public Health Emergency, 2020). Then on March 11, 2020, WHO declared the COVID-19 outbreak as a global pandemic due its widespread presence affecting over 100 countries within just a few weeks' time (Cucinotta & Vanelli, 2020; Remuzzi & Remuzzi, 2020). COVID-19 is an infectious disease caused by a severe acute respiratory syndrome which originated from the People's Republic of China (Remuzzi & Remuzzi, 2020), the transmission of which occurred through close physical contact and has now resulted in millions of deaths globally (Cucinotta & Vanelli, 2020).

Many countries have chosen to enact a *cordon sanitaire* or quarantine at infected areas, states, or even the whole country as a measure to contain the spread of COVID-19. By definition, a *cordon sanitaire* is the restriction of movement of people into or out of a defined geographical area, such as a community, region, or country implemented by the state or federal government (Misra et al., 2020). The federal government of Malaysia declared the first phase of national quarantine, the Movement Control Order (MCO) on March 18, 2020 to prevent the transmission of the COVID-19 infection (Bunyan, 2020). The MCO was extended to several different phases in 2020 and 2021, where some phases were relaxed while some others were restricted based on the latest number of COVID-19 cases. Consequently, several sectors were forced to either cease operations or make changes in their approaches, including all levels of the education sector, i.e., schools, colleges and universities alike.

### Implementation of Online Teaching and Learning at Malaysian IHLs

In reaction to the MCO directives from the federal government, the Malaysian Ministry of Higher Education (MoHE) immediately issued directives to local higher education institutions, both public and private universities, instructing them to stop all face-to-face classes and take their teaching and learning (T&L) activities online. They were also to ensure that no student was left behind in technology accessibility. Universities were to make sure that all students had access to the Internet and the relevant online learning platforms (e.g., Google Classroom, Padlet, Schoology, etc.). More importantly, the lecturers and the infrastructure must first be ready to deliver and support online learning. Consequently, the public and private universities that did not or could not implement full online T&L were not allowed to continue with their classes to prevent students without technology access from being left behind (COVID-19: Soalan Lazim Kementerian Pengajian Tinggi, 2020).

Later, on March 28, 2020, MoHE issued a recommendation to higher education institutions to postpone their second semester of the 2019/2020 academic session (i.e., Semester II, 2019/2020 Session) to April 27, 2020 or June 1, 2020 the latest ("Pengendalian Program Akademik Di Universiti Awam (UA)," 2020). The reason for the postponement was to give ample time to all parties—students, lecturers, and universities as a whole—to make adequate

preparations for online teaching and learning. As the number of infected cases increased, worsening the pandemic situation, MoHE then on May 27, 2020 directed that higher education institutions were only allowed to conduct their T&L via an online mode until December 31<sup>st</sup> of the same academic year (“Pengendalian Aktiviti Akademik”, 2020; “Advisory Note No. 4/2020,” 2020). The sudden change from face-to-face to the online T&L mode occurred not only in Malaysia, but also worldwide. As described by Crawford et al. (2020), there has been a massive transition from physical classroom teaching to online teaching due to the indefinite shutdown of schools, colleges, and universities. This sudden and unplanned transition resulted in an evolution of teaching methodology as lecturers sought for effective methods to deliver courses online. One of the most sought-after models is the flipped classroom (Khalil, 2020; Tang et al., 2020).

### **The Flipped Classroom Method of Teaching**

The initial idea of the flipped classroom was founded in 2007 by Jonathan Bergmann and Aaron Sams, Chemistry teachers at the Woodland Park High School, Colorado (Noonoo, 2012). Since then, the flipped classroom concept has been adopted and adapted by educators worldwide, and has evolved into several different formats as we can see it today. The flipped classroom is a pedagogical classroom that emphasizes video lectures and guided reading as homework. In essence, it prepares students for the learning material before the actual class meeting. Students are required to do the reading and/or watch the assigned video(s) before coming to class and during class itself, with no lecture being given on the content. Instead, class time is spent on addressing questions, clarifying student misunderstanding, solving problems and engaging in in-depth discussions or debates regarding the topic.

Before the pandemic, the prevailing practice of the flipped classroom was one that required students to complete pre-meeting tasks (such as reading an article, watching a screencast tutorial or synthesizing a literature review) before the physical class time. The tasks were to be done by students in their own time and were considered as part of the student learning time (SLT) stipulated in the MQA framework (Code of Practice for Programme Accreditation, 2018). Students were expected to already have an adequate amount of prior knowledge of the subject matter to enable them to engage in a fruitful discussion during class with the lecturer and classmates. However, during the COVID-19 pandemic where social interaction was limited and face-to-face T&L activities were not allowed, the in-class activities for the flipped learning had to be changed and brought to online platforms as well. One great advantage for educators around the globe is that the advancements made in technology offer various platforms and tools that enable live (synchronous) engagements and interaction between educators and students (Ballard, 2009; McBrien et al., 2009) despite the pandemic.

Due to the sudden change in the T&L delivery method, it is important to know if our students are ready with the knowledge, skills, and equipment to accept this new mode of online learning. It is important for us educators to understand how students perceive such learning and whether they are benefiting from it. Platt et al. (2014) suggested that there are two factors that

necessitate a systematic study of students' perceptions. First, we need to document how students' perceptions towards the teaching and learning method in use influence their approach to the course. Second, our understanding of students' perceptions, particularly their acceptance of new teaching and learning methods, enables us to make more informed decisions regarding a course's instructional design by considering those perceptions. These data and insights are particularly crucial for engineering degree courses as they typically require hands-on activities and physical demonstrations of concepts in face-to-face class meetings.

### **Research Objective and Question**

Hence, given the preceding arguments about the necessity of understanding students' perceptions, the study sought to explore engineering students' perceptions and acceptance of online flipped classroom during the COVID-19 pandemic. Our specific interest was in finding out how students would respond to our question regarding online flipped learning. To acquire the data, we sent out an online survey asking the following open-ended question: "*What are your thoughts about online flipped classroom?*" The survey question also constituted our research question. It was set as an open-response inquiry into students' perceptions and acceptance to avoid leading the students into giving answers that would result in biased data.

## **METHODOLOGY**

### **Research Approach and Method**

The nature of our open-response survey question rendered this study as a positivistic qualitative inquiry that explored students' perceptions and acceptance of online flipped learning. The data we obtained from the survey were essentially narrative data that we organized into themes reflecting students' perceptions and acceptance.

### **Participants**

Our participants were 80 students enrolled in two undergraduate engineering courses at the IIUM's Department of Biotechnology Engineering. The courses were Thermodynamics, a second-level course, and Bioprocess Control and Instrumentation, a fourth-level course. The ages of the students who took Thermodynamics ranged from 20 to 21 years old, while those taking Bioprocess Control and Instrumentation were between 22 and 23 years of age. Out of 80 students, 52 were females (62.5%) and 29 were males (37.5%). The students in both courses were a mix of local and international students with approximately 84% Malaysians and 16% international students. The international students were citizens of various countries including Indonesia, Myanmar, Bangladesh, Yemen, Egypt, Jordan, Iraq, Syria, Sudan, Somalia and Burkina Faso. Details of the participants are summarized in Table 1. The undergraduate Engineering programme offered by the department is a four-year degree programme. At the point of data collection, all of the students who participated in the survey were attending online classes for all of their enrolled courses due to the COVID-19 pandemic.

### **Procedures of Data Collection**

At the beginning of the first semester of 2019/2020, during the first class meeting, we briefed students in the two courses on the concept and nature of the flipped classroom/flipped learning and how it differed from the traditional physical classroom. We informed them that we wanted to know their thoughts and perceptions of such a learning structure if it was brought online and that we would be giving out a survey for this purpose. The students were informed that their responses would not be made anonymous because the findings had to be used for continuous quality improvement (CQI) of the teaching and learning process of both courses. There was a mutual understanding between the lecturers and students that their responses would not have any bearing on their grades. An infographic of our explanation on the flipped classroom along with the survey question were posted on the courses' Google Classrooms after the first class meeting. The students were asked to respond to the survey within a week.

### **Data Analysis**

Due to the nature of the responses, the data obtained through our online survey was first screened and categorised into three themes, namely "Unconditional Acceptance", "Reserved Acceptance", and "Rejection". These themes were identified based on the combination of the words listed and key-words-in-context technique (Ryan & Bernard, 2003) and the logic of a Boolean operator "OR". The word lists and key-words-in-context technique looked for the frequencies of unique words appearing in the students' testimonies and the list of words was then used to derive the themes of the study. The Boolean logic is a form of algebra that utilizes three simple words, 'OR', 'AND', and 'NOT'. These three words are known as Boolean operators and are usually used in search engines. The Boolean operator 'OR' is used to express that as long as one of two or more conditions are satisfied, then the value of a specified query is true. The Boolean operator 'AND' will return true for a query when all specified conditions are satisfied, while the 'NOT' Boolean operator is used to exclude certain terms.

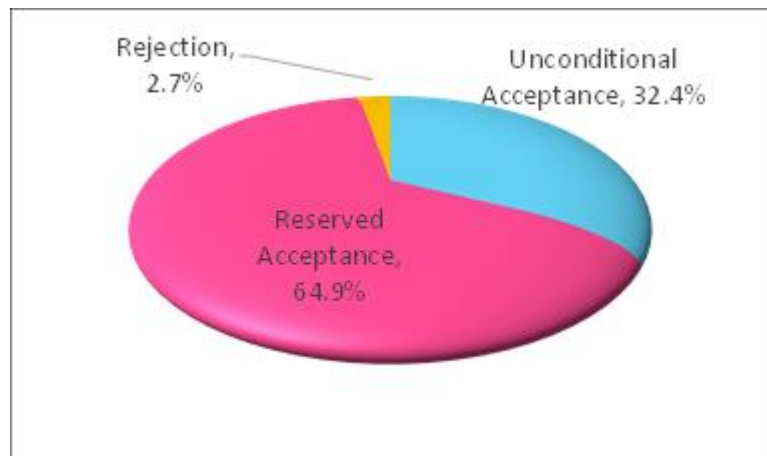
Our review of the responses found a lot of occurrences of words such as "like", "OK", "but", "balance", "not effective", and "many tasks". Hence these words were selected as the keywords to determine the themes of the responses. The combination with a Boolean operator "OR" allowed us to group like responses together although they did not have the same keywords. For example, the keywords "like" 'OR' "OK" were used to separate the responses that contained these words, which we subsequently categorised under the theme "Unconditional Acceptance."

## FINDINGS AND DISCUSSION

Our research examined undergraduate engineering students' perceptions and acceptance of online flipped learning to replace the traditional physical classroom during the COVID-19 pandemic. Our analysis of the survey data identified three underlying themes: (1) Unconditional Acceptance, (2) Reserved Acceptance, and (3) Rejection. Each of these three categories was associated with certain keywords. The percentage distributions of the three categories are shown in Figure 1. The results show that more than 90% appeared to accept the idea of flipped learning. Close to 65% of the students were actually open to having their courses taught as an online flipped classroom provided that the video lectures and reading assignments were carefully curated. Surprisingly, a significantly low percentage of the students' responses, i.e., less than 3%, rejected having online flipped classroom as a replacement for traditional learning.

**Figure 1**

*Engineering Students' Acceptance of Online Flipped Learning*



Our close reading of the responses revealed that students' perceptions and acceptance of T&L modes seemed to be influenced by their prior experiences with other courses. Students were less likely to accept the flipped classroom method if they had had a negative learning experience with it before in other courses. Table 1 shows the keywords and sample responses for each extracted theme.

**Table 1***Themes of Students' Acceptance of the Online Flipped Classroom*

Theme	Keywords	Sample Responses	% of Acceptance
Unconditional Acceptance	<ul style="list-style-type: none"> <li>• Like</li> <li>• OK</li> </ul>	<p><i>"I think flipped classroom is a very reasonable way of teaching during this pandemic. It helps the student to understand the subject when it is... discuss[ed] in the formal online meetings. It also widens students' perspective on the topic so that they will be more enthusiastic when [the] lecturer is teaching in online meetings and have questions to ask."</i></p> <p><b><i>"I like flipped classroom. Reading ahead or knowing about the topics to be discussed [in advance] helps the content last longer in memory."</i></b></p> <p><i>I'm OK with it because we can study it first and the lecture periods consist [of] problem solving and discussion which I can familiarize more with question[s] and practice.</i></p>	32.4%
Reserved Acceptance	<ul style="list-style-type: none"> <li>• But</li> <li>• Balance</li> </ul>	<p><i>"I think most lecturers are using this method currently because it has more advantages than drawbacks. <b>But if this learning technique [does] not work as expected, students are the most affected.</b>"</i></p> <p><i>"I think this <b>method can be a bit burdening</b> when students happen to <b>watch videos</b> about a topic that can be <b>unrelated to our course outline</b> because students do not quite know which video they are supposed to watch in order to cover that certain topic."</i></p> <p><i>"It does <b>require discipline from the students to watch the video or study the material.</b> But I believe flipped teaching allows the instructor to give more value to the students. <b>But a balance has to be made to ensure that the instructor can give better insights during class.</b>"</i></p> <p><i>"I'm scared that if I have to find videos myself, <b>the content of the videos [may not be] not suitable with the syllabus</b> in this course <b>and makes me feel more "lost"</b>. Aside [from] that, I think flipped classroom is the most suitable and effective method [for] online teaching as it helps both students and lecturers. Thank you for considering my thought."</i></p>	64.9%

**Table 1** (continued)

Theme	Keywords	Sample Responses	% of Acceptance
<i>Rejection</i>	<ul style="list-style-type: none"> <li>• <i>not</i></li> <li>• <i>many tasks</i></li> </ul>	<p><i>“For me personally, I experienced this method before with other lecturers and I think it is <b>not effective enough</b> for me and I struggled to keep track [of the class] since we [had] <b>a lot of tasks to do before each class.</b>”</i></p> <p><i>“I do not really prefer this learning method as I already experienced this method before with other lecturers. In my observation, this kind of approach [was] <b>not effective</b> in helping me in my studies before since we [were] <b>burdened with many tasks, including watching long lecture videos.</b> The time for us to prepare for the class also was limited as [the] <b>lecturer tend to post the material late because more preparation time was needed.</b>”</i></p>	2.7%

A closer analysis of the data shows that the percentages of *Rejection* responses came from Level 4 students who had a negative previous experience with flipped learning in other courses. Their unfavorable prior experience had led to their perceiving flipped learning negatively, hence resulting in their rejection of it as a learning option. Meanwhile for *Unconditional Acceptance*, a high percentage of support—constituting 24% out of the overall 32.4%—came from Level 2 students. Those who supported and fully accepted the flipped classroom idea believed it would widen their perspectives and understanding of course content.

On the other hand, a majority of Level 4 students expressed a *Reserved Acceptance* of flipped learning. Based on their responses, their reservation was mostly due to unfavorable experiences with previous online learning. They had the perception that online flipped learning was burdensome, only made them feel more lost in learning, and wasted their time searching for materials which ended up being unrelated to the syllabus. This unfortunate perspective could have been the result of a classroom malpractice because the pre-class reading materials for a flipped learning session should be carefully selected by the lecturer and then assigned to students. As such, there should be no issue of “content unrelatedness” in the materials selected. If students are asked to find the materials themselves, we can expect them to end up with a wide range of irrelevant videos and articles that have little connection to the topic being learned.



## **CONCLUSION**

The current study investigated Engineering students' perceptions and acceptance of the online flipped classroom. The findings highlight that a carefully curated selection of video lectures and reading materials is key to the successful execution of flipped online learning, and this can only be achieved through a meticulously planned instructional design. The current study also demonstrates the importance of introducing the pedagogical approach to students in a systematic manner rather than diving into it straight away at the beginning of the semester. Lecturers should also be cautious about their classroom practices as any malpractice will lead to students' developing various misperceptions about teaching and learning—online or offline.

This study has a few limitations that create opportunities for future research. For further exploration and a more comprehensive view of the issue of flipped learning, two aspects are worth considering. First, it is recommended that future research respondents include all levels of undergraduate students, especially those at the matriculation centre whose courses of learning are deeply affected by the pandemic. Second, it is also worthwhile to study the effects of implementing a flipped online classroom on students' learning process and learning loss.

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