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‘Flipping or Flapping?’ Investigating Engineering students’ experience in flipped classrooms

Purpose: This study has explored the flipped classroom model in a private university in Malaysia. It presents a flipped classroom intervention for engineering education innovation.

Design / Approach: The research (1) revisited prominent educational theories for a flipping or flapping pedagogy, (2) implemented and explored the flipped classroom experiences in one engineering subject; using the action inquiry method with thematic analysis and (3) reflectively evaluated both students’ and educators’ ‘flipping or flapping experience’.

Findings: The responses of the research participants are analysed and used to develop the Flipping or Flapping Classroom Principles and an Ideal Flipped Classroom Model. From passive lectures to active learning with collaborative discourse and reflective communication, flipping the classroom can offer a seamless learning experience.

Research Limitations / Implications: The Flipped Classroom Model can provide good reference for other educational researchers who intended to conduct flipped classroom. However, the small sample size with qualitative method and thematic analysis employed led to considerable theoretical development, but it may not achieve the validity standards to generalise the findings. Further empirical investigation with systematic controlled group is recommended for future work across disciplines for extrapolation.

Keywords: Flipped classroom, Technology Enhanced Learning, Blended Learning

Introduction and Background

The term ‘flipped classroom’ or ‘flipped-mode teaching’ has gained considerable currency in the past few years to depict innovative forms of flipping the traditional education model, by providing more interactive and engaging face-to-face learning activities. Students are required to study pre-class learning materials (with the aid of educational technologies) before attending the flipped classroom, where conventional

in-class lectures are replaced with collaborative activities, application discussion or hands-on projects (Tucker, 2012; Chen, Wang, Kinshuk, & Chen, 2014).

The development of the flipped classroom is increasingly being discussed and explored in higher educational institutions across disciplines and continents in the past few years (Herreid, & Schiller, 2013; Kengwee, Onchwari, & Oigara, 2014; Khan Academy, 2015; McCrea, 2016). Educational researchers and practitioners have investigated and debated the rationale and both the positive and negative experiences of flipping the classroom. Schools that support this emerging 'flipped' model stress that it promotes active learning and enhances student engagement (Hussey, Fleck & Richmond, 2014; Gilboy, Heinerichs, & Pazzaglia, 2015). In addition, a flipped classroom offers greater opportunity for in-depth peer discussion in classes and problem solving among students (Youngkin, 2014). Thus, this further interaction facilitates substantial development in critical thinking skills and cognitive development in the subject matter (Kong, 2014). Students prepare prior to the actual class, i.e., watch pre-recorded videos and take online quizzes; taking more responsibility for their own learning (Gecer & Dag, 2012). Flumerfelt and Green, (2013) assert that a flipped classroom has an impact on learning across all academic levels and ages, whereas Boyer (2013) claims that a flipped model is a 'pedagogical shift in the use of class time' (pp.29).

Conversely, the flipped model could be viewed as a 'flapping' experience without moving forward nor improvements experienced in learning while too much effort is being put in. Some academics complain that there is a substantial amount of additional workload on educators such as pre-recording video lectures, designing flipped classroom activities and approaches to motivate students for the 'extra'

preparatory work to engage in the flipped classroom (Acedo, 2013). From students' perspectives, the time spent on the self- and pre-studying can be overwhelming. For instance, in a traditional classroom setting, students need to attend 4 hours of lectures and tutorials. With the flipped classroom model, students are required to conduct 2-3 hours of self-studying prior to classes in preparation for pre-class quizzes, plus 3-4 hours of in-class activities for in-depth discussions and collaborative activities. The expectations of how far the blend of technologies and IT infrastructure supports the flipped classroom in meeting students' expectation are yet to be explored (Hiew and Chew, 2016). Hence, this paper aims to discuss the 'flipping or flapping' experience from students' perspective. It summarises an action research with reflective discussion of the 'flipping or flapping' classroom principles.

Research Method and Theoretical Ground

The action inquiry method is a research approach that conducts action and inquiry concurrently as a disciplined leadership practice that may increase the effectiveness of the proposed actions (Torbert, 2001). There are 4 phases in the action inquiry method (Meyer, 2003): (a) Visioning; (b) Strategizing; (c) Performing; and (d) Assessing which are adapted as follows:

A. Visioning

In this paper, we explore the motivations and educational theories that underpin the flipped classroom practice; what possible pedagogical challenges and approaches need to be worked around? The consequences of not being able to flip the classroom seamlessly would be the 'flapping' circumstances, which lead to a disruptive learning

and teaching experiences compared to an ideal 'flipped' classroom. This paper attempts to respond to these questions by (1) revisiting prominent educational theories for a flipping or flapping pedagogy, (2) exploring the flipped classroom in one Engineering subject and (3) reflectively evaluating both students' and educators' 'flipping or flapping' experience.

B. Strategizing

We briefly review the educational theories underpinning flipped practices. Locke began with the *tabula rasa* concept: (1) students are in a blank state, and the educator is similar to parents who instil knowledge into the students' blank state, and (2) students are submissive and subservient, receiving knowledge passively from the educator who has more authority (Locke, 1995; Huyler, 1997). However, Freire 'flipped' the traditional 'oppressed pedagogy' through the elimination of the authoritative instructions and knowledge instilling from the educator; instead, educators are to create an autonomous and constructive learning environment for students to learn from active reasoning and collaborative discourse (Freire, 1970; Johnston, 1996; Glass, 2001). Dewey extends the educational paradigm to emphasize 'learn by doing'; the educator creates a praxis environment. Reflections are introduced, which requires constructive dialogue, reflective learning activities and communication with more opportunities for self-learning (Dewey, 1960; Simpson, 2001).

In this paper, we explore the impact of a flipped classroom implementation. Purposive sampling is used to glean knowledge from individuals that have particular expertise (Bryman, 2012; Daniel, 2011). The selected research participants were staff and students who pioneered a flipped classroom learning subject in an Australian University

campus located in Malaysia. These experiences during the first exploratory phase would highlight potential new areas of interest or disruption, while opening doors to other future educational practitioners for flipped classroom implementation in the University.

C. Performing

A traditional lecture in the University is typically held in a large hall with lecture slides projected on a screen, wherein the lecturer provides a detailed explanation of the topics covered and students work through problem solving exercises in their own time. The flipped classroom instead allows more face-to-face discussion on problem solving because lecture content and quizzes have been converted to pre-class activities as described in Table 1.

Table 1. Typical Sequence in Flipped Classroom Approach

Week No.	Activity	Marks
1	Pre-Class: Watch several short video lectures (10-15 mins each, total duration is 1-1.5 h) uploaded on Moodle/YouTube. Complete a 20-min online quiz consisting, typically True or False and Multiple Choice Questions	~0.5% per Quiz for a total of 8%
2	Flipped Classroom: Students gather in the lecture hall to work through several worksheets in small groups and facilitated by the lecturer based on topics covered in video lectures and online quizzes before the start of this session.	
3	Tutorial: Lecturer or tutor stamp completed worksheets and provide simple verbal feedback on a one-to-one basis. Students are encouraged to practice on additional exercises from the recommended textbook and ask questions during this session.	~0.5% per Worksheet for a total of 8%

D. Assessing

A total of 136 students were surveyed in Semester 1 and 2 using an anonymous online survey (SurveyMonkey, 2014), and a total of 91 students responded (67%). The lecturer, tutors and students were interviewed by a project investigator who does not

teach the subject. The online survey and interviews were used to explore the flipped classroom perception and assess students' and educators' 'flipping or flapping' experiences by observing the provision of online documents, learning materials, and assessment methods. All responses were analysed using thematic analysis (Greg, 2012) with open coding followed by axial coding approach (Strauss & Corbin, 1998) in which the educational theories discussed above represent the responses and explore how and why they are related. The data analysed in this research are depicted in Table 2, Figure 6 and 7 in four dimensions.

Results and Discussion

General Discussion

Comparing the results depicted in Figures 1, 2 and 3, this implementation of the flipped classroom shows the learning experience shift from the traditional culture of 'listening to lectures' and 'copying knowledge from lectures' to actively and repeatedly engaging with the online quizzes, worksheets and peers / lecturers at their own pace.

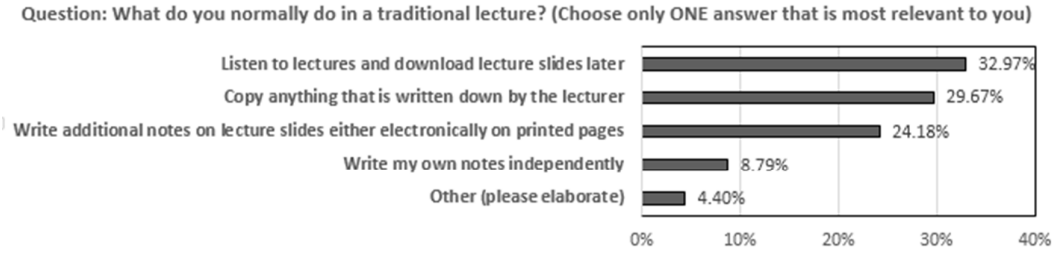

Figure 1. Before Flipped Classroom

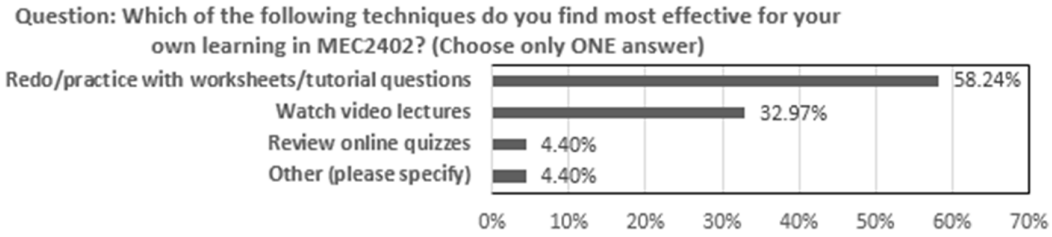

Figure 2. After Flipped Classroom

Before the implementation of the flipped classroom, Figure 1 reflects that students engage with traditional classroom learning in a passive manner: listen to the lecture notes, copy anything that is written by the lecturers and write additional notes on the lecture notes. Of the students, 8.8% would learn independently by writing their own notes. However, after implementation, students tend to engage with the learning actively by practising on worksheets or tutorial questions and watching the video lectures repeatedly at their own pace (refer to Figures 2, 3, Table 2, Tutor-048 comment).

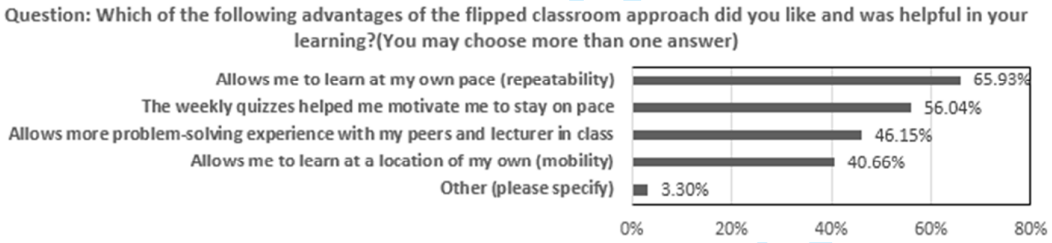

Figure 3. After Flipped Classroom II

Based on the educational theories discussed above, we categorise the participants' responses based on thematic analyses as follows:

Table 2. Summary of Participants' Response

Theme 1:
From *tabula rasa* (theory instilling) to learn by doing and reflective individual

learning activities at their own pace or in a groups (Locke, 1995; Huyler, 1997; Glass, 2001; Gecer & Dag, 2012)

Responses:

"If you compare primary school, the teachers spoon-feed you everything. I mean at this level, you should **take the initiative and learn beforehand** and get to study everything first... to **be prepared** before the class," ~Student-086

"We can learn **at any time we want**." ~Student-116

"**The quizzes** are great ways to keep the students in touch with the video lectures- ensure that **you do the work**" ~Student-116

"With the flipped learning, it opened up more time for student involvement and having more face-to-face hours, **doing hands-on learning** in their labs, programming and having more guidance in their CAD skills." ~Lecturer

"The positive experience about this flipped classroom thing is that it helps me to **get ready** and helps me **keep consistent in pace** of what is happening throughout the whole semester" ~Student-058

"It does train the student to be more **independent**…instead of us having to explain to them you need to do this do that." ~Tutor-048

Theme 2:

From passive lectures to active learning with collaborative discourse and reflective communication (Simpson, 2001; Ray & Powell, 2014; Youngkin, 2014)

Responses:

"Flipped classroom is like you go into the class, you **understand** the **background** and if there is any **question you can ask**...it is better." ~Student-086

"With the flipped classroom, you have a better interaction with the lecturer. Students highlight certain things that they are not clear about, then the lecturer can pinpoint it." ~Student-090

"I wanted to spend more face-to-face time with my students by demonstrating my thought process in solving engineering-based problem and **getting them to do it with me, rather than making them sit together to watch me talk for at least 1 to 2h**…and having a laid-back attitude if they were to go through a traditional lecture in this decade". ~Lecturer

Theme 3:

Seamless learning in a relaxed and uninterupted manner (Hiew & Chew 2016)
Responses:
"The traditional way is very time consuming. And if you don't know then you have to raise your hand and ask, **that'd just stop the lecture**, so it's not that efficient" ~Student-086
"Flipped classroom does give us more freedom **to do what we can do** to really help on those really **genuine questions, those really complicated ones**." ~Tutor-048
"In a typical classroom experience is that you forget things by the end of the semester...But students in flipped model can go back and see what the lecturer said in the beginning because it is **video recorded so they don't miss anything**. In that sense, I think it's a very big advantage especially in the **resources** part." ~Tutor-048
"It's more relaxed, you don't have to be nervous… when the lecturer asks questions from us." ~Student-116

Flipping or Flapping the Classroom?

Addressing the gap between didactic education and hands on performance, Hawks (2014) suggest that the flipped classroom model is a unique integration of behaviourism and constructivism in a learning context. The implementation of the flipped classroom in this study clearly echoes the claim. Table 2 shows a summary of the combination of independent learning experiences and collaborative 'learn by doing' activities, which resonates the lecturer's voice:

> "I truly believe that the majority of students would have achieved more if they experienced learning by watching, imitating, listening and by doing it themselves." ~Lecturer

It is interesting to determine that the flipped classroom contributed to a seamless learning experience in which (1) students self-study in a relaxed and less restricted manner at their own space and pace, without 'stressful moments' when a lecturer asks a question in the traditional class setting; (2) ideally, students are well-prepared prior to the class and are confident to answer lecturers' questions; and (3) more in-depth and

complicated questions can be asked in the flipped classroom without spending effort on the fundamental concepts that can be self-studied. This seamless learning aspect is a significant contribution to address more reserved cultures, where students may be too shy to ask or to be asked questions in the classroom, afraid of responding to a question with a 'wrong' answer and not wanting to waste other students' time or being annoyed by individuals' 'silly' questions (see Table 2). Such focused and maximised use of the flipped classroom is a worthwhile experience.

Conversely, Figure 4 depicts the 'flapping' responses for a flipped classroom. Limited feedback and feed forward in the video lectures are one of the largest frustrations. Students do not receive spontaneous feedback from the lecturer when studying the pre-recorded video lectures. This is agreed by the interview participant:

> "In the video lectures, there are some points that we cannot understand and then we do not have the lecturer with us to ask the questions of. Therefore, we have to wait another day or get an appointment to ask questions, and that's a bit troublesome." ~Student-116

Second, excessive effort in the pre-self-study is also a challenge. Students need to spend much more effort and pre-study times on independent learning prior to the flipped classroom compared to the traditional delivery:

> "The top negative thing [for flipped classroom pre-study]: you have to do it every time. Sometimes, you really don't have time and you still have to do it just for the few marks… you still need to allocate some times to do it." ~Student-058
>
> "...it does require a certain degree of independence from the students. We have some tutorials that are not marked which they're supposed to go back to do it by themselves. Some do it; very few actually do the weekly tutorials." ~Tutor-048

Third, the concerns of the digital gap and the constraints of the technologies are raised. Mobile friendly learning content and speedy bandwidth are becoming basic requirements for students in the 21st century:

> "Moodle is not quite mobile friendly as well. That's true. A lot of students have to watch from their mobiles. But more importantly, Moodle is slow, very slow....it'd take forever to download. The video files are not small. They're really big, and you're really bandwidth-constricted." ~Tutor-048

Although there are 'flapping' experiences as discussed, more than 85.56% students remain positive and recommend that flipped classroom should be implemented to other subject units. This is a very positive sign for flipping, not 'flapping' in the learning experiences.

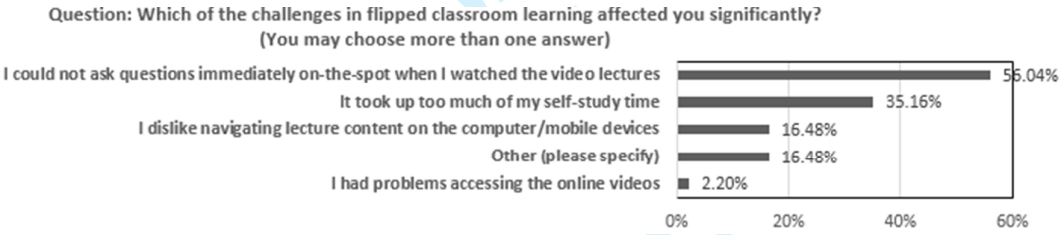

Figure 4. 'Flapping' Experiences

Recommendations and Reflections

Student respondents suggest that students should be provided a forum for feedback during the independent study sessions if there are any questions. A forum type option for each video lecture is preferred:

> "After each video lecture, there should be a questions page which appears, which asks any questions we have…like a forum." ~Student-116

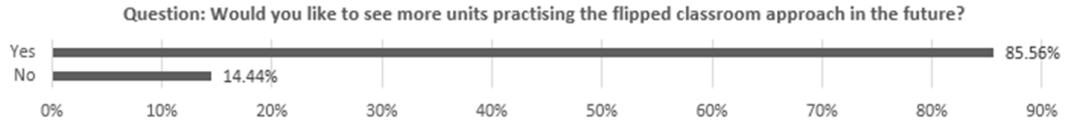

Figure 5. Implementation of Flipped Classroom to other subject units

Figure 5 shows that majority would like to see more units practising the flipped model. It is also recommended to conduct a pre-workshop for the flipped classroom to motivate students' mind-set and prepare or manage students' expectations with regards to the future flipped model:

> "I think mind-set is the priority in life. It depends on your mind-set, like what you want in life everything… can provide some workshop or anything… pre-workshop for flipped classroom? Practice your mind-set." ~Student-086

Based on Table 2 and the flipping or flapping experience of this research, we would propose flipping or flapping classroom principles depicted as:

Seamless learning in a relaxed and free way.

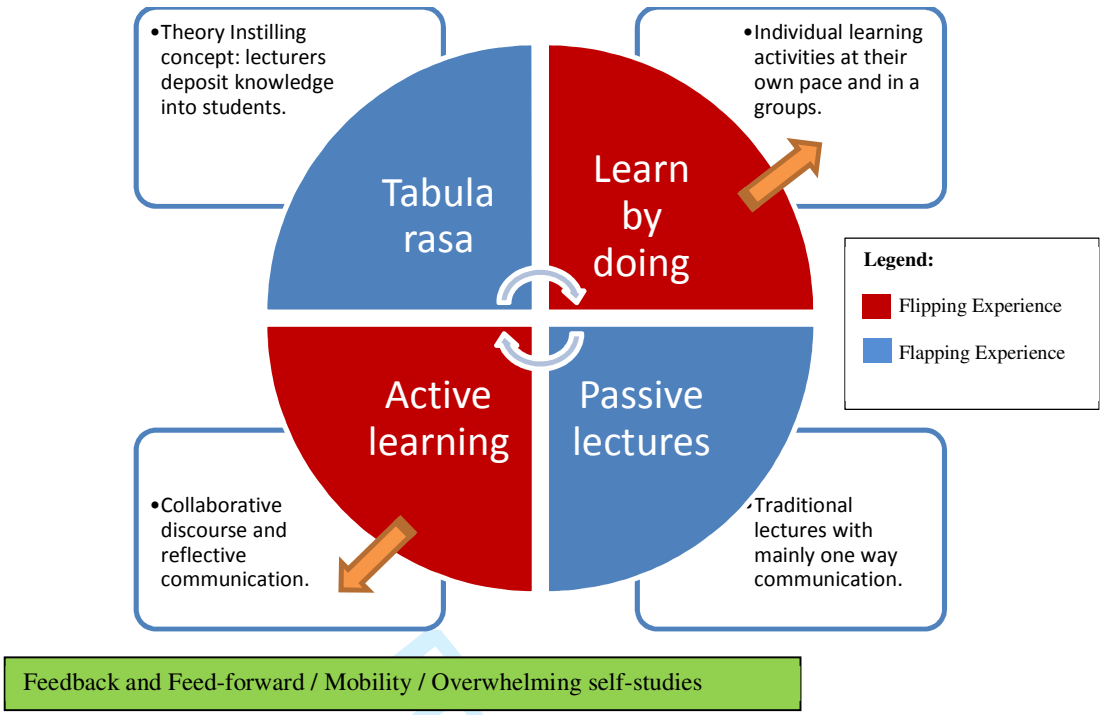

Figure 6. Flipping or Flapping Classroom Principles

The principles shown in Figure 6 attempt to describe what a flipped classroom does with the shift of pedagogy. The columns in green represents the aspects of how a flipped classroom can be further improved or strengthened. In a fully flipped classroom, ideally, the elements of *tabula rasa* and passive lectures are much smaller and are flipped to 'learn by doing' and active learning. This is a recommended seamless learning experience.

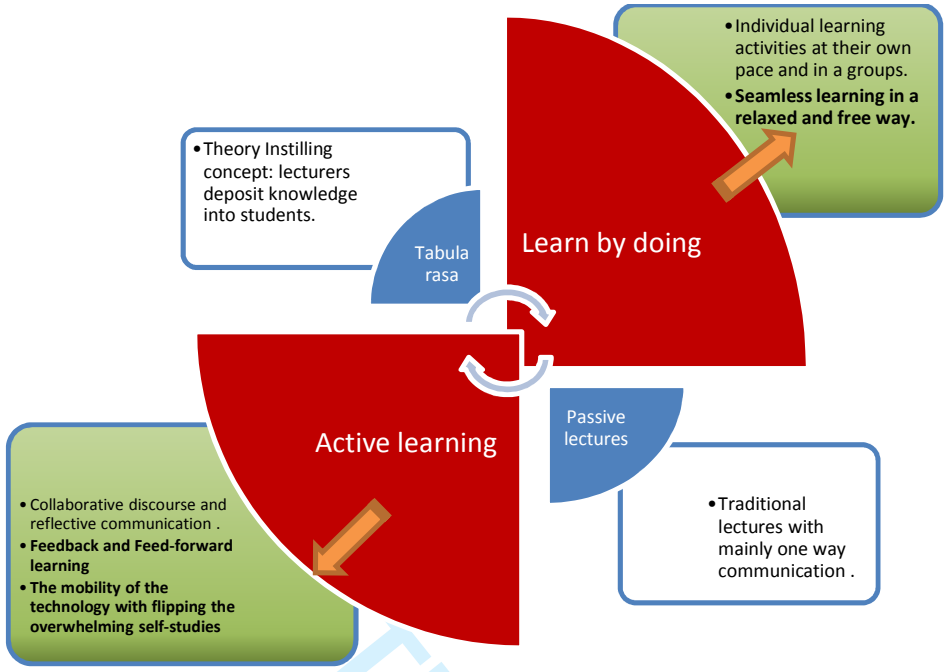

Figure 7. Ideal Flipped Classroom Model

The ideal Flipped Classroom Model as depicted in Figure 7 can be extrapolated across disciplines to add value in implementing the flipped classroom. The model can be generalised by further and larger scale of empirical testing with various disciplines in future work.

Conclusion, Limitation and Future work

This study has explored the flipped classroom model in an engineering subject unit in a private university in Malaysia. The emerging 'flipped' classroom model is pervasive across disciplines and continents because it evolved from a theory instilling delivery method to learning by doing and reflecting individual learning activities at their own pace or in groups. From passive lectures to active learning with collaborative discourse and reflective communication, flipping the classroom can offer a seamless learning

experience. Conversely, the significant effort required to develop the pre-lecture independent learning materials and the provision of spontaneous feedback and feed forward in the pre-recording video lectures are the current challenges. Technological constraints such as lack of content and data mobility have yet to be resolved efficiently.

In this investigation, the small sample size with qualitative method and thematic analysis employed led to considerable theoretical development (Gill, 1995; Rist, 1997) but may not achieve the validity standards to generalise the findings as required. Further empirical investigation with systematic controlled group is recommended for future work across disciplines for extrapolation.

In summary, consider the enhanced and disruptive learning and teaching experiences of the flipped classroom:

> "I think that, in this level, we **should be responsible for our education**. **We must be proactive and have the initiative**. It is my responsibility to learn first. Then, if I don't know anything, I would ask the lecturer" ~Student-086

> "With this system, I find that students were more willing to write, sketch, draw and to do something during the crucial time spent with their lecturer in class. So, they fill out worksheets together with me, and it seems that they could retain more skills while they use their eyes, ears, brain and hands to have a better learning experience.' ~Lecturer

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Responses:

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Theme 3:

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"The traditional way is very time consuming. And if you don't know then you have to raise your hand and ask, **that'd just stop the lecture**, so it's not that efficient" ~Student-086

"Flipped classroom does give us more freedom **to do what we can do** to really help on those really **genuine questions, those really complicated ones**." ~Tutor-048

"In a typical classroom experience is that you forget things by the end of the semester...But students in flipped model can go back and see what the lecturer said in the beginning because it is **video recorded so they don't miss anything**. In that sense, I think it's a very big advantage especially in the **resources** part." ~Tutor-048

"It's more relaxed, you don't have to be nervous… when the lecturer asks questions from us." ~Student-116