
5E Flipped Learning Environment Enhanced Classroom Learning Capability Among Medical Assistant Students

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Abstract

This is an exploration study on learning experiences of medical assistant students in a 5E flipped learning environment of Pre-Hospital Trauma Care (PHTC) course at a private college in Malaysia. In this study, students were required to participate in a 5E-flipped learning environment with both learning activities on an online platform and participation in face-to-face classes. A case study research approach was adopted with 12 undergraduate students who enrolled in a 7-week PHTC 5E flipped classroom course. Qualitative data were generated through participants' learning diaries, classroom observations, online non-participant observations, student focus group discussions, and individual student interviews on their learning experience. Thematic data analysis was used to code, identify patterns, and developed themes within the data. The findings showed, students had enhanced classroom learning capability in 5E flipped learning environment. In conclusion, they felt this instructional approach improved their learning capability and engagement in this learning environment.

Keywords: *5E flipped learning, Learning experiences, Medical assistant students, Integrated learning environment*

1.0 Introduction

Over the past decade, education standards have emphasized the value of student-centred learning, in which students are responsible for their own learning and actively participate in higher-level tasks and cognitive standards (Islam, Sarker & Islam, 2022; Mubarak, Wibowo, Rahamathulla, Yang, & Schönert, 2022; Nerland, 2020). This requires the use of active learning approaches in the classroom that encourage students to present their work, solve problems, and engage in self and peer assessment, group work, and discussion (Bond, 2020). However, creating such engaging based learning environments remains a challenge, as educators are either untrained or lack the confidence to apply, orchestrate, and address the difficulties of this new student-centered pedagogy (Gezim & Xhomara, 2020; Komatsu, Rappleye & Silova, 2021). An example is the limited classroom time available for teaching new materials and using active learning methods (Al-Samarraie, Shamsuddin & Alzahrani , 2020).

Contemporary instructional strategies, typically using technology as the main tool of delivery, aim to relieve this tension and enable effective student-centred strategies. A majority of lecturers strive to adopt innovative methods to foster learner autonomy, while still ensuring content coverage within the time span of the curriculum (Zheng, Ward & Stanulis, 2020). Now that educational technologies are increasingly being made available online, lecturers in various disciplines have provided students with access to various course contents (typically via video lectures) outside the classroom, and practical activities inside the classroom; namely, “classroom flip” (Kang & Kim,2021). Flipped classroom (FC) models have attempted to address these issues by providing more classroom time for active and student-led learning and using advanced technology to support a blended learning approach. A typical FC methodology provides students with access to online video lectures/tutorials (flips) prior to in-person sessions so that they are prepared to participate in more interactive, collaborative, and overarching activities such as research, debate, problem-solving, and discussion i.e engaging based learning methodology (Al-Samarraie et al., 2020; Kang & Kim,2021; Marshall & Kostka, 2020; Zhao & Su,2021). Students benefit from this pre-class exposure to materials and events outside of the classroom, as they can adjust their pace of study to suit their individual learning styles and understanding. During classroom sessions, students have the opportunity to engage in classroom activities through group work, rather than passively listening (i.e., lecturing) to the lecturer. Lecturers, in turn, can spend classroom time facilitating, monitoring

student performance, and providing adaptive feedback to individual students or groups of students (Marshall & Kostka, 2020; Zhao & Su,2021).

This approach has attracted attention from academia as research results show that a more dynamic learning environment is being created via this instruction (Halasa et al., 2020; Kang & Kim,2021; Martínez-Jiménez & Ruiz-Jiménez, 2020). However, the implementation of this approach in medical education training is scarce, especially in the medical assistant setting. In short, a novel flipped learning environment approach with a detailed instructional design has been developed and implemented in a medical assistant program with the expectation of achieving a more engaging and interactive learning environment.

Many proponents of active, student-centred learning suggest that flipped learning environment activities should be well designed to maximise the opportunities for students to construct meaningful personal knowledge and cultivate a higher level of cognitive skills (such as applying, analyzing, and evaluating) (Diningrat, Setyosari, Ulfa & Widiati , 2020) or higher-order thinking abilities (Hwang, Yin & Chu, 2021). As such, students can determine whether they understood the course content and are able to relate it to their prior knowledge, making it their own by being able to question it in their own words (Zheng & Zhang,2020). Systematically designed activities have been proven as an effective approach that could stimulate students into higher thinking and engage conceptual understanding in the learning process (Sya'Roni, Inawati & Guswanto, 2020). When students are engaged and involved actively in the learning process, it allows them to better understand the subject matter (Hoshang, Hilal & Hilal, 2021). Sya'Roni et al. (2020) further pointed out that students need to engage actively in the learning activities; they need to participate in the learning environment whether there are any parts of the activities that seem important, but which they do not comprehend, in addition to how the core concepts can be understood. This process triggers many metacognitive processes, thus aiding learning, with students becoming more intellectually active and engaged in the learning process (Sya'Roni et al., 2020). Moreover, Baptist, Utami, Subali and Aloysius (2020) indicated that step-by-step learning cycles engage students with the learning topic, thereby increasing their understanding and promoting their interactions.

Rafon and Mistades (2020) posit that the regular and systematic use of the 5E instructional model could make the flipped learning environment unique. Some instant, learning cycles, such as 5E instructional cycles, can be regarded as educational facilitators because it provides not only a step-by-step learning approach for students, but the activities made also support stronger communication, sharing and socializing (Gillies & Rafter,2020;

Rafon & Mistades,2020; Siwawetkul & Koraneekij,2020). The 5E instructional model can increase students' participation in the learning process, which can be summarized simultaneously as engagement with the learning environment (Siwawetkul & Koraneekij,2020). This means, every student in the 5E instructional learning environment can interact and participate actively, and the teacher can get a rough picture of student learning progress (Lam, Hew & Jia,2022). In recent years, numerous studies have examined the effects of the 5E instructional model in education and have reported positive learning outcomes (Bahtaji, 2021; Gillies & Rafter,2020; Lam et al., 2022; Rafon & Mistades, 2020).

Tasks and activities incorporated in higher education teaching are based on pedagogies and supported technologies that might increase student engagement and improve their attitudes toward learning. Based on the above-cited work, this study chooses flipped learning and the 5E instructional model as the major pedagogical approaches. This paper proposes that, if university students have more opportunities to become involved in a flipped learning environment and are encouraged to enhance their own learning capability and to engage in deep thinking and discussion supported by using 5E instructional cycles, curricula might be constructed differently. As Lo and Hew (2020) mentioned, there are only a few conceptual frameworks that can elicit a 'how-to' list-associated approach with the design of an effective flipped learning environment, and exactly how this approach is contributing to learning. Solutions to the issue require an understanding of what design approach entices student engagement in the flipped classroom environment. Therefore, this study created an innovative flipped learning environment that incorporated 5E instructional cycles and explored their learning experience; thus, contributing to the growing line of research literature in the field.

2.0 Methodology

2.1 Research Design

This is a qualitative case study to explore the learning experiences of university undergraduate medical assistant students with a 5E-flipped learning environment on emergency course module.

2.2 Research Subjects

This study was delimited to undergraduate students from medical education, especially to medical assistant disciplines at one of the private universities in Malaysia. University undergraduate (Diploma in Medical Assistant Studies Programs) students were selected to participate in this study. It adopted convenience purposive sampling procedure. There were 12 students participated in this study. These students were required to attend a 7-week pre-hospital trauma care course which was designed with a 5E-flipped learning approach.

2.3 Sources of Data Collection

It was a qualitative case study carried out for eliciting the learning experiences of the respondents on practices of 5E flipped learning approach. A total of 12 learning dairies, seven classroom observations, two focus group discussions, and four individual interviews to be used as research tools to collected data. All these research tools were prepared after the literature review and in the light of nature and research questions of the study. Expert opinion helped the researcher in finalizing the tools. The main question was to explore what is the learning experiences of medical assistant students in 5E flipped learning environment. In this study, a pilot study was conducted to test data-generation instruments, especially the participant learning diary, focus group discussion protocol, and individual interview protocol. Two students from year two medical assistant program were selected to go through and provide feedback on the quality and understanding of the participant learning diary content, focus group discussion protocol and individual interview protocol. The feedback from them were used to make improvement of the data collection tools.

2.4 Data Collection Techniques

The researcher first obtained approval from the university administration and the course leader. Follow by this, a meeting was arranged at week 1 with the students. This meeting was held to introduce the researcher and explained about the study. The researcher had explained the study process and their task trought out the course. The researcher also clarified any questions from the students. In addition, during the meeting, students' consent was obtained through a consent form. At week two the first part of course was started with online and classroom sessions. The first round of participant learning dairies and classroom observations were collected from week two to week four. Then at week five the second part course was continued with online and classroom sessions. At the week nine, second round of participant

learning diaries and classroom observations were collected. At week 10, two focus group discussions were conducted, followed by four individual student interviews at week 11.

2.5 Data Management Procedures

Data collected from participant learning diaries and classroom observations were transferred into the form of documents and focus group discussions and individual interviews were transferred into the form of interview transcriptions. For answering the study purpose of this study, the researcher had used thematic analysis approach for data analysis. In this study, participant learning diaries, the focus group discussions and interview transcriptions have been analysed by following Braun and Clarke (2020) thematic analysis with six stages. Themes or patterns in thematic analysis can be identified in an inductive or 'bottom-up', or deductive or 'top-down' manner. In the inductive approach, data is analysed with little or no predetermined theory or framework, resulting in data-driven analysis. An inductive thematic analysis method was used in this study (Braun & Clarke, 2012). To elaborate, themes are identified based on what is contained in the data. Furthermore, the data is used to investigate specific theoretical concepts (Braun & Clarke, 2012).

3.0 Findings

3.1 Demographic Profiles of the Participants

There were 12 students involved in this study. Out of the 12 students, 8 were females while 4 were males, aged between 20 and 22 years. In terms of ethnicity, only one student was Malay, four were local ethnics from Sabah while the other seven were local ethnics from Sarawak. Table 1 provides data on the demographic profiles of the participants involved in this study related to student code, gender, age and ethnicity.

Table 1.*Category of Participants*

Student	Student Code	Gender	Age	Ethnicity
Student 1	S1	Male	21	Iban
Student 2	S2	Female	20	Malay
Student 3	S3	Female	22	Iban
Student 4	S4	Male	21	Kadazan
Student 5	S5	Male	21	Kadazan
Student 6	S6	Male	21	Dusun
Student 7	S7	Female	20	Bidayuh
Student 8	S8	Female	22	Bidayuh
Student 9	S9	Female	21	Dusun
Student 10	S10	Female	21	Bidayuh
Student 11	S11	Female	21	Iban
Student 12	S12	Female	20	Iban

Note: S= Student

3.2 Data Sources

The responses of students collected through participant learning dairies, classroom observatios, focus group discussion and individual interviews were grouped thematically according to purpose of the study. The results were extracted from thematic analyses individually for students respectively. Table 2 shows the summary of data sources.

Table 2.*Summary of data sources*

Research Method	Description	No. of Participants/activities involved
Study Logs with Reflections	Collecting participant learning diaries	12
Classroom Observations	Observing 2-hour classroom activities	7
Student Focus Group Discussions	Conducting focus group discussion with students divided into 2 groups with each group consisted of 6 students	2
Student Individual Interviews	Interviewing selected students	4

3.3 Emerged Theme: Enhance Classroom Learning Capability

The theme emerged from the data analysed was this learning environment enhanced classroom learning capability of students and this theme has five sub-themes. Table 3 shows the summary of findings. All the sub-themes are explained below.

Table 3.*Summary of findings*

Themes	Sub-themes	Codes	Frequency (f)	Total Frequency (f_i)
Enhanced Classroom Learning Capability	Increased In- Class Practice	- Provide more classroom discussion	6	16
		- Provide many various types of classroom activities	4	
		- Provide pre-class quiz at beginning of class	3	
		- Provide classroom discussion than lecture	3	
	Immediate Feedback	- Obtained immediate feedback from teacher in classroom session	5	12
		- Asked question and get immediate answer from the teacher	4	
		- Asked question and get immediate answer from the peers	3	
	Supportive Peer Interaction	- Student actively interact with other student in classroom discussion	4	12
		- Students communicate with each other in classroom discussion	3	

	- Peer helps each other in the discussion session	3	
	- Most of the students actively interact with peer	2	
Providing Platform for In-Depth Learning	- Provide in-depth classroom activities that make the student participate actively	5	14
	- Provide a simulation-based case study approach	4	
	- Instruction used from simple case study to complex case study	3	
	- Scenario used were more challenging	2	
Improved Interaction and Engagement	- Students actively participate in classroom discussion	4	9
	- Students always ask questions in the classroom	3	
	- Students lead the classroom discussion by themselves	2	
Total		63	63

a. Increased In-class Practice

In a traditional classroom, it is usually difficult for students to seek help from their teacher during class, as class time is limited and is often used for teaching in general. In this study, the 5E flipped learning environment ensured that limited class time was devoted to individual case study practice. This was evidenced by student 5 through the excerpt:

“5E flipped classrooms gives me more time to read and practice. But in the traditional classroom, I have less time. The teacher explains for a long time. So, it is very different to understand concepts because the time in the classroom is very short. In the 5E flipped classroom, we got a lot of time to discuss case scenarios step-by-step and think about problem-solving. The 5E flipped classroom is more flexible than a traditional classroom” (FGI S5).

It was agreed by most student participants that the 5E flipped learning environment and the traditional classroom were not the same. One of the main differences was that the 5E flipped learning environment gave them more time to watch, read and practice. Student 1 said:

“The 5E flipped classrooms and traditional classrooms are not the same. I prefer the 5E flipped classroom because I can still learn even though I am not in the classroom. I do more activities in the 5E flipped classroom as compared to the traditional classroom. I interact with my classmates differently too. In the 5E flipped classroom, we have a chance to work with others so I know how they solve the problem. In a traditional classroom, I have less time to do these activities” (IS1).

b. Immediate Feedback

80% of students in their interviews mentioned that the 5E flipped learning environment increased student-teacher interaction and gave them more opportunities to receive immediate feedback from the instructor. They commented positively about the teacher’s feedback in a 5E flipped classroom, stating that their teacher knew their strengths and weaknesses and was able to point out to them the areas that they need to improve. Student 9 stated:

“In a 5E flipped classroom, the teacher understands what we need or what we are good and not good at and I can know immediately, don't need to wait. In the traditional classroom, teachers take two to three days to mark. Then, I already don't remember what I answered” (IS9).

Getting feedback from peers in the classroom is also an important aspect of learning. Student 11 valued the immediate feedback from her classmates as described below:

“While we were doing the classroom discussion, the teacher walked around to give feedback to the students. The immediate feedback helps. I also like the immediate feedback from friends” (FG1 S11).

For seven students out of the 12 students, there was a difference between the traditional classroom and the 5E flipped classroom in terms of feedback. Student 9 stated:

“In the traditional classroom, the teacher just teaches in the class and then we write. No need to talk. Just write. So, I didn’t feel that I ever learned more in a traditional classroom. But I feel better studying in the 5E flipped classroom because the teacher has taught. I also watched the lecture video before I was in class. We have discussed this before the classroom session, sometimes with the teacher...sometimes with my classmates” (IS9).

In the traditional classroom, feedback was delayed, so the students believed that it was hard for them to improve their understanding. Student 8 said:

“5E flipped classroom helps me think better because I have more chances to discuss and talk. I hate reading before class but now I have become a more confident learner, more independent and more critical thinker” (FG2 S8).

The immediacy of feedback is greatly beneficial for students, especially in learning and understanding, as it helped them with comprehension and in return, students also shared the information via peer feedback. The quality of feedback, which is both personalised and specific, is useful because not all students face the same challenges in learning. Some students might struggle with understanding concepts, while others might need more help with better explanations and organisation.

c. Supportive Peer Interaction

The 5E flipped learning environment also encouraged interaction among the group members, especially among students. Students freely communicated between themselves during the online and face-to-face sessions. They felt this approach to teaching really supported their interaction with their peers. In terms of the topic section arrangement, they commented

that it was helpful in supporting peers' interaction and helped them in sharing their insights. Student 9 stated:

"Yes, this method helps us communicate with friends. With this method, we have to discuss the scenario in class. The instructor will give a case study and we have to discuss it in groups. This encourages us to discuss and communicate. It also made our way of thinking better. When discussing, we can share our insights and come up with ideas and this causes us to be more critical-minded" (FG1 S9).

The above statement was also supported by Student 6:

"I can see that there were forum discussions, small group discussions, and classroom presentations. These all were good activities and they helped the students in understanding the topics. I found the forum helps the students by getting explanations and the same goes for the small group discussion, in small group discussion there was discussion among the peers. This helps the students understand better because they can get clarification from their peers and I felt as if the students were more comfortable getting feedback from a friend. No stress when discussing with my friend" (IS6).

Student 6 was also involved in the online discussion forum as noted in the online non-participant observation:

"The online non-participant found that the students were involved in online discussions" (OBS6).

In addition, the students can work in groups and solve problems. They also discussed and clarified issues to better understand the lesson, especially during the classroom session. Student 1 explained further in his learning diary:

"We had a chance to take part in group discussions in view of the class we had earlier on. We had case scenarios as groups to work on and this further helped us engage our understanding of the topic" (LDS1).

A student has written that group discussions really helped them to reinforce their learning. Student 5 wrote:

"Group discussions were used to reinforce whatever had been learned in class which was very good for me" (LDS5).

d. Provide a Platform for In-depth Learning

Students' active engagement appeared to facilitate in-depth learning during the increased class time spent on sharing, discussion and debates. Being able to elicit comprehensive insights through interaction with classmates and instructors was the most frequently reported gain among students and instructors. The students' comments were as below:

"Everyone has different ideas from watching the same video clip. If a teacher provides a single input in class [as a traditional approach], the thought is usually limited to a single direction ... if we watch the video [at home], and we discuss it in class, we would probably brainstorm new ideas. This is a part of learning" (LD S1).

"I found that I will only have solid ideas to discuss with others after I watch [the video]. ... If I haven't watched it, I would be using my past experience, and my old thoughts to discuss. Then, I don't think I would have learned anything" (IS9).

"We usually analyse things from their literal meaning under the traditional approach. Through real cases, group debates, and case studies under the flipped approach, we could generate clearer ideas on what the meanings are and understand how to implement and apply them when we need to" (FG2 S4).

"In the 5E flipped approach, there was more time for discussion and presentation ... I felt that their homework was of higher quality. That's just my general impression after marking them. Their lesson plans and classroom discussion materials were more insightful and meaningful than before i.e. using the traditional approach" (FG1 S5).

Content analysis from the learning diaries was compared to the focus group data to confirm the participants' perceptions and experiences. Students noted that the 5E flipped classroom approach contributed to a more profound understanding of the content. They perceived that the 5E flipped learning environment helped them to do complex tasks. Students reported that the 5E flipped learning environment is an avenue that provided the opportunity to think deeply about their tasks, which is a component in scientific inquiries. They reported that they understood the process of scientific investigations after the course. They also noted that the 5E flipped learning environment created an avenue for synthesising information to make meaning. Some of the students noted that the 5E flipped learning environment enabled them to synthesise information to develop new knowledge as they go through the active learning activities on their own at their convenience. The findings revealed that 5E flipped

learning environments fostered a deeper understanding of concepts and contributed to more profound learning by the respondents. The students perceived the 5E flipped learning environment as helping them to complete difficult tasks and to think deeply about the tasks. Student 6 in his individual interview commented:

“Learning in the 5E flipped classroom encouraged and motivated me to master knowledge searching skills, which will help me connect with other aspects of my life. The use of in-class time for deliberations on the problem-solving questions made students master the skills to perform difficult tasks” (IS6).

Understanding scientific inquiries is one of the advantages of the 5E flipped learning environment, where students can engage in active learning. Students understood the process of scientific investigations after being exposed to the 5E flipped learning environment. Student 1 noted:

“As we engaged in inquiry, learning enabled us to process information to construct knowledge by creating new ideas, which provide the opportunity to increase my understanding of the topics” (IS1).

The findings showed that the 5E flipped learning environment has created an avenue for synthesising information to make meaning. Some of the students explained that the 5E flipped learning environment enabled them to synthesise information to develop new knowledge as they go through the active learning activities on their own at their convenience and classroom activities with their peers. Student 8 in her focus group interview noted that:

“I find it much more beneficial because it helped us gather new information since the activities were arranged in the form of step-by-step” (FG2 S8).

e. Improve Interaction and Engagement

Another sub-theme that emerged explained the preference that 5E flipped learning was more engaged and active by letting the students to take on a more participatory role in the class rather than being passive learners. Student 6 commented:

“In traditional classrooms...we spend lots of time listening to the lecturer explaining and we don't have time to work together. In the 5E flipped classroom, we have time to work together for 2 hours. In the classroom instead, we can ask our friends and lecturer” (IS6).

Student 4 also shared student 6's opinion, stating that he had a chance to interact with his teacher and friends before and after the 5E flipped classes.

"5E flipped classroom encourages learning with friends either online or in the classroom. Learning online can be enough information and there are also forum sessions. After following the online session, especially the videos, we were able to chat with friends as well. During the discussion through the forum, we were able to share information and understanding. Here we get a clearer explanation. During our classroom sessions, there was the opportunity to discuss with friends and share opinions. In this way, we can deepen our understanding. So, student-centred learning and collaborative learning can be practiced" (IS4).

Unlike in the traditional classes where students would just sit and listen during class time with little or no opportunity to engage in active learning or interact with others, most student participants in the 5E flipped learning environment valued the discussion time with their classmates and their lecturer. Student 10 explained:

"In the traditional classroom, the teacher always gives lectures on PowerPoint and we just copy them down. Then he explained again and clarified some words. We just do the same thing in every classroom and just listen. The 5E flipped classroom is more useful and interactive". (FG2 S10)

The opportunity to co-construct their knowledge through interaction with their classmates and instructor was highlighted as important by 50% of the students. Student 4 expressed his interest in doing class activities, placing focus on communication in his learning diary:

"I really like the class activities and case study discussions in pairs or in the group in the 5E flipped classroom. I like to work together. It's more interesting because, for the in-class activities, we can discuss together. When we have a problem, we can always ask each other" (LD S4).

There were 80% of the participants believed that interaction and engagement in the classroom are important in learning. They were pleased with the fact that they had more opportunities to interact among themselves, with their instructor and with the content. Students commented that they were able to take control of their own learning and felt a sense of

ownership compared to their learning in a traditional classroom where the teacher dictates the pace. Student 7 in her learning diary voiced similar views:

“When he said the lecturer is usually the one who contributes to the classroom learning while students just sit quietly and listen, unlike in the 5E flipped classroom where students can contribute and discuss their ideas” (LDS7).

The responses showed that the use of in-class time for deliberations on the problem-solving questions enabled the students to master skills to perform problem-solving. The students were optimistic that interacting and collaborating with peers provided an opportunity to solve challenging tasks during their group work. Student 4 stated:

“Working with peers helped me finish the tasks on time and fostered effective peer teaching as we share ideas among ourselves” (IS4).

In addition, student 9 in focus group one noted:

“The 5E flipped classroom is good because we can share ideas with peers, which enhanced our understanding of the concept better when working with peers than a teacher teaching us” (FG1 S9).

One essential element of the 5E flipped learning environment is teacher-student interactions. Students perceived the 5E flipped classroom approach as effective since they had a better chance to receive constructive feedback from instructors. They had the opportunity to meet the instructor in class for discussions and reflections on the videos, reading materials, and other incidental tasks. This helped boost their understanding of the concepts since the instructor used that free time to provide feedback, explain concepts students find difficult, and clarify their misconceptions. These experiences encouraged students to go through the various stages of finding answers to the assigned problems, thus enhancing their understanding of scientific inquiry. Some students expressed their positive experiences in collaborating with peers:

“During the out-of-class session, we were encouraged to share ideas during the discussion with peers to clear any misconceptions we had” (FG1 S5).

“The tutor’s presence made me feel comfortable as he helped to discuss our questions to understand the topic better” (FG2 S8).

“We were able to discuss our problems we did not understand with the teacher who explained to us and sometimes corrected our misconceptions” (IS4).

Another learning outcome the students mentioned was meeting their course expectations through active collaboration activities. Some of the students felt more comfortable working with peers in the group to build their confidence to learn. In addition, the engagement enhanced interpersonal interaction, and the group activities helped students become more open-minded as they shared ideas, discussed, reflected, and came to common conclusions. Consequently, students were of the view that the 5E flipped learning environment fosters effective peer teaching as they were able to share ideas. The students preferred this approach since it promoted their interaction and their communication skills. Student 5 in the focus group interview stated:

“Working with other students helped us learn the concepts. Through the discussions, we can ask our peers for clarification and communication to better understand the concept” (FG1 S5).

Another participant reiterated that:

“Because the interactions with our teacher and other students are cordial such to an extent, we don’t feel unwilling to answer and ask questions in the class” (IS1).

Furthermore, student 4 in his interview noted that:

“The 5E flipped classroom creates opportunities for us to be more interactive as we collaborate and discuss to bring out different ideas and views to be shared. Through the collaboration, we understand the concept well” (IS4).

Student 4 again in his learning diary added:

“Our expectations increased when collaborating with peers through the class discussion. We could come to a common agreement regarding presenting results in our group project” (LD S4).

4.0 Discussion

a. Increase In-class Practice

Once students have a foundation and prior knowledge of the key concept, the in-class learning activity is devoted to a student-centred and active-learning environment. Since the major goal of in-class learning activity is “construct knowledge in active-learning ways”, the potential learning theory that relates to this learning activity is constructivism (Muhajirah, 2020). He also mentioned that the Constructivist learning theory sees learning as an active process of constructing instead of acquiring knowledge. Therefore, the main goal of an engaging instructional design is how to design an in-class learning strategy that facilitates individual knowledge construction by helping students engage in a meaningful way. The main idea of flipping the classroom with the 5E learning cycles stages was that it gives the students opportunity to actively engage in class time through a systematic and active learning activity. Thus, teachers should have more time to give direct feedback during the active learning session. When the students actively construct and organise the knowledge into their meaningful learning ability, the active learning will possibly happen. Santos and Serpa (2020) argued that active learning experience typically involves one or more of the following features: discussion and application of the content, practice to solving the problems, reflection about what has been learned, and consolidation activity through collaboration activity as well as presenting the solution and ownership of the learning. The active learning comes in various forms and the researcher mainly prefers the active-learning activities such as problem-solving and collaborative group work (Olaniyi, 2020). Regarding in-class learning activities, a previous study revealed that active learning are the key contributions of the flipped classroom model and it might be the most influential elements for positive learning outcomes in classroom sessions (Mojtahedi, Kamardeen, Rahmat & Ryan, 2020).

Due to the learning activity and active-learning approach being an important element in the in-class stage, it plays a central role in the success of learning in the 5E flipped learning environment. Studies have shown that students found positive attitudes by integrating case-based instruction and were not only being motivated to solve the ill-structured problem, but also had high self-efficacy (McWhirter & Shealy, 2020). Consistent with this study, the combination of flipped learning environments with 5E learning cycle stages was effective in helping students whose performance is low (Schallert, Lavicza & Vandervieren, 2022). Hence,

this study's finding suggested that teachers should integrate the 5E learning cycle stages in class time to motivate students to engage in solving real problems and increase in-class practice. A similar research showed engagement in problem solving has increased the students' in-class practice and achievement (Kevser, 2020). In addition, the 5E learning cycle stages in flipped learning environments provide positive contributions to the students' self-regulated skills (Lam et al., 2022). Thus, designing high-quality learning environments, especially considering activities that increase in-class interaction are the key success factor and driving force for increased students' learning ability.

b. Immediate Feedback

The consideration of constructivist approaches in a 5E flipped learning environment for learners who are not accustomed to taking responsibility for learning is difficult. The instructor must truly believe in this theory in order to continue this effort because of the barriers encountered by various constituencies. The 5E flipped learning environment followed in this study impacted students individually and educationally. From the individual point of view, this method encouraged discovery learning due to its problem-based nature. It enhanced students' self-efficiency, communication skills, motivation, engagement with the learning process, and responsibility for learning. All of these cases were self-reported by the students via completing individual interviews, focused group discussion and learning diary data. The researcher also verified the interaction between the lecturer and the students or between the students by looking at the online and classroom observations. Receiving feedback from the lecturer and peers in the 5E flipped learning environment may develop self-efficacy. Bond (2020) reported that the discussion environment with immediate feedback availability in the flipped classroom through the online forum was pleasant and less stressful for students. However, it puts further responsibility on students for their learning.

One of the main findings of this study was that students considered the learning support in general to be helpful because it gave them the opportunity to study, practice and revise concepts learnt and obtain immediate feedback from teachers in the online and classroom at their own pace and convenience. The fact that some students took the initiative to make use of the 5E flipped learning environment to ensure that they understood what they learnt both online and in class suggests that they were interested in the subject. In this study, students expressed their concern about the importance of the face-to-face tutorials with 5E learning cycles because this provided student-lecturer interaction which allowed students to ask questions and obtain

answers in real time and also gave the lecturer the opportunity to explain concepts thoroughly. A number of studies into students' perceptions of flipped learning have reported that although students favoured the online components of flipped learning (Lindeiner-Stráský, Stickler & Winchester, 2022; Mujtaba Asad, Athar Ali, Churi & Moreno-Guerrero, 2022; Xiao, Thor & Zheng, 2021) they also valued face-to-face interaction as an important part of learning. The reason being, in face-to-face interaction, instruction is clearer (Mujtaba Asad et al., 2022) and they are given the opportunity to ask questions and receive immediate feedback (Jia, Hew, Bai & Huang, 2022). Giving students immediate feedback is considered to be one of the seven principles of good practice in undergraduate education (Chickering & Gamson, 1987) as it (i) improves students' self-awareness and confidence, (ii) assists lecturers to monitor individual progression, and (iii) helps "reduce the gap between current and desired understanding" for students' learning (Younas, Liu, Khalid & Bakar , 2020).

c. Supportive Peer Interaction

Students were found actively participating in peer-to-peer interactions and group discussions in a flipped learning environment to discuss matters and solve problems together during in-class writing activities (Lestari, 2021). Hence, this study finding was consistent with the results of some previous studies on peer instruction (Borda et al., 2020; Finkelstein & Winer, 2020; Rafon & Mistades, 2020). For instance, Rafon and Mistades (2020) conducted a mixed method study to determine the effectiveness of using a flipped classroom approach and the 5E instructional model in teaching a physics topic, namely Rotational Motion among Grade 12 students under the Science, Technology, Engineering, and Math (STEM) track. The finding showed that students developed a sense of responsibility, participated in the discussion, and followed instructions as a result of the highly positive and highly interactive learning environment. They overcame the challenges that they faced during the learning process such as the need for guidance/assistance to learn, difficulty in coping with the lesson, lack of Internet access, incomplete homework, and lack of confidence in taking part in the discussion. Most importantly, the students performed very well across several formative assessments. In their study, they highlighted that the 5E flipped learning environment transformed the classrooms into interactive and dynamic places where students were allowed to have synchronous interactions between themselves. In another study, Lai (2021) also stated that the flipped learning approach emphasised the interaction between learners through completing tasks and

projects, including communicative and collaborative tasks. Turan and Akdag-Cimen (2020) confirmed that one advantage of the flipped learning environment was to enhance peer interactions in learning.

The study finding showed that peer interaction allowed the students to actively engage with the discussion list by giving suggestions and asking questions. Similarly, in this study, students expressed their enriched learning experiences with the 5E flipped learning environment approach which naturally allowed extra time for application and interaction facilities in both learning environments; online and the classroom. The affordances of the 5E flipped learning environment allowed the active involvement of learners in the learning process. Such an environment helped to boost confidence in developing students' abilities in a course and made them feel encouraged to participate in further learning. The findings from this study revealed that the 5E flipped learning environment approach enhanced students' learning through their interaction and communication with each other as they learned to do things together.

d. Provide a Platform for In-depth Learning

The 5E flipped learning instructional approach has the potential to shift from teacher-centred to student-centred learning environment. Besides, according to He (2020) almost 96% of the 83% respondents who chose flipped learning environments emphasised that this pedagogical technique underpins the development of 21st century skills. Furthermore, an importance of the flipped learning environment approach is found to be an increase in learner self-study capacity and deeper learning ability through the generation of curiosity and involvement in research, inquiry, in-class questioning and meaningful peer interactions that tend to increase the preparation level of students (Cho, Zhao, Lee, Runshe & Krousgrill, 2021). Additionally, this approach encourages independent learning with active listening and proactive collaboration, complex communication, spontaneity and creative dialogue through deployment of group activities, quizzes, discussions and problem solving (Bloomberg, 2022).

Moreover, Louhab et al. (2020) contended that 'learning' is at the heart of flipped pedagogy, thus allowing more time and space for students to not only create and present their own content but also to test their 'learning'. They also emphasised that during the learning in this approach, students tend to engage with each other more and develop the aptitude in working as a team. The implementation of the 5E flipped learning environment technique has

let students work together to achieve the same goals that constitute an integral part of 21st century learning. The various types of activities in 5E flipped learning environment such as video lecture, online activities, teamwork, learning with and through peers and cooperation provide the students with in-depth learning situations. These supportive findings elements of the 5E flipped learning environment were consistent with the finding of the study that peer collaboration and more constructive in-class activities are the key elements to provide a platform for in-depth learning.

e. Improve Interaction and Engagement

The flipped classroom method is centred on the idea that students do not need an instructor present when listening to lectures passively, which saves classroom time for more individualised instruction and small group work (Hussain, Jamwal, Munir & Zuyeva, 2020). Based on the analysis of the interview and learning diary data, this study's participants collectively had very positive perceptions in regards to learning in a 5E flipped learning environment. Students were able to take charge of their own learning more effectively and were more confident in their knowledge when participating in this learning environment. They felt more interaction and engagement in this instructional approach. The students who were typically not willing to ask their teacher to repeat information or provide further clarification were able to have their needs more appropriately met in this setting. Collectively, the data from this study provided three distinct conclusions: students felt an increased sense of ownership in their own learning, the format allowed for more effective use of class time, and students felt more connected to their instructor.

In order for students to take more ownership of their learning, they must understand that success does not come without some struggle (Dias & Victor, 2022). Data from this study showed that students enrolled in this 5E flipped learning environment were more willing to learn difficult topics during class time, because they had the safety net of their instructor and their peers to help them. This approach allowed them to access the content at home, and provide feedback to their teacher in the form of clarifying questions, or responses to teacher-generated questions, and gave them a sense that they were directing the learning process. As they became more familiar and comfortable with the format, students became more and more engaged, as they knew that the more they participated, the more the instructor supported their individual needs. In a traditional classroom setting, students are less likely to ask their teacher to repeat topics or explain in different terms. In a 5E flipped learning environment, however, students

have access to content in multiple forms, and can access information in ways that are better suited to their needs, making them more active participants in their own learning.

As participants in this study indicated, they felt an increased sense of ownership of their learning, and this led to a common sentiment that class time was used more effectively. The typical 5E flipped learning format for this class included the use of an online platform in which the instructor has posted lecture videos with embedded questions to determine the student's level of understanding. The responses to these questions were then used to design the activities in class the following day, focusing on the students' specific needs, as indicated by their responses. The responses to the interview indicated that the participants felt the class time was used more effectively for two reasons. First, the time in class was specifically utilised to focus on the areas in which they were struggling the most, not wasting time on things that they had already mastered. Second, respondents stated that they benefited from the increased peer-to-peer collaboration time that the 5E flipped learning environment design provided. In this setting, the entire class time was dedicated to furthering the students' level of understanding, not just the delivery of content. The most frequently mentioned interview data to the open-ended questions were indicative of an increased ability to interact with the teacher and ask more questions. The students in this study indicated that the format of this learning environment not only allowed them to more readily ask questions to their instructor, but also to have greater opportunities to interact during class time. Throughout the responses to open-ended questions, students repeatedly mentioned how the 5E flipped learning environment not only allowed for more questions to be asked, but it actively encouraged them in learning. Students who would otherwise be reticent to ask questions in a traditional classroom setting felt more comfortable asking questions while engaging in both learning environment activities. Moreover, the in-person portion of the class allowed the instructor to focus on the topics that students had the most difficulty in grasping. Thus, when the students were actually in class, the lack of time spent on lecturing allowed the instructor to spend more time in interacting one-on-one with the students that provided them a more personalised and focused learning experience.

5.0 Conclusion

In conclusion, an overwhelming number of students reported that they were more confident in their ability to understand lessons after attending the 5E flipped learning environment. They believed that they had made good progress in the development of knowledge and practice. The improvements in self-efficacy with regard to independent learning showed that the 5E flipped classroom approach may be appropriate for preparing students for tertiary studies.

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