Author:
Ka Lai, Ng

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A quasi-experimental study of the Flipped Classroom Method in a Hong Kong Associate Degree of Nursing Studies setting

A quasi-experimental study of the Flipped Classroom Method in a Hong Kong Associate Degree of Nursing Studies setting

by

Ng Ka Lai

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Abstract

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There is a call for transformation of pedagogy in nursing education to include an innovative student-centered approach. Developments in technology as well as a realization of the complex clinical environment have caused nurse educators to seek to establish an innovative learning environment which encourages students to engage actively in learning in order to foster their learning outcomes. The flipped classroom method enables students to prepare themselves with the course material prior to class and allows more in-class time for higher learning and higher-order skills. The flipped classroom method of teaching has rapidly gained popularity in Western health professional education, especially in medical education. However, few studies have been conducted to study the flipped classroom method, not only in particular student engagement, but also in Asian nursing education and also associate degree nursing. The uncertainty about the impact of the flipped classroom method on learning in Hong Kong nursing education gave the impetus for this study. At the time of the start of the study, the flipped classroom was not widely practiced in this setting although with the pandemic it has become increasingly practiced. To my knowledge, this study is one of the first studies to explore the impact of this new innovation in the Hong Kong nursing education involving associate degree of nursing studies students.This study was conducted in a first-year associate degree of nursing studies student cohort enrolled in their nursing foundation course at a Hong Kong community college. A total of 271 students from two classes learned under different instructional approaches. One under traditional learning (n=141), and another under flipped learning (n=130). A mixed methods approach was used with quantitative (assignment and final written examination scores, student survey) and qualitative (semi-structured focus group interview) measures taken to investigate different outcomes under each teaching method.

The aims of this study were to investigate the effects of the flipped classroom method on student achievement and engagement in nursing education involving associate degree of nursing studies students in Hong Kong SAR. This study indicated that use of the flipped classroom method yields a positive result on student academic achievement and engagement in the associate degree nursing. There was a significant increase in post-test, assignment and final exam scores for the flipped classroom, all $p < 0.01$, with a medium-to-large ($d = 0.74$), a very large ($d = 2.47$), and a medium-to-large ($d = 0.60$) effect size respectively. The flipped classroom students also demonstrated a significant improvement in their content knowledge across the term compared with the traditional classroom students ($p < 0.05$), with a small effect size $d = 0.32$. A positive correlation was reported between assignment scores and emotional engagement ($\rho=0.3$), cognitive engagement ($\rho=0.3$) and behavioral engagement ($\rho=0.21$). A positive correlation was also found between quiz and behavioral ($\rho=0.26$), cognitive ($\rho=0.23$) and emotional engagement ($\rho=0.25$). Finally, there was also a positive correlation between post-test scores and behavioral ($\rho=0.2$) and cognitive engagement ($\rho=0.2$) with all correlations $p < 0.05$. The benefits that contributed to such a positive student achievement included the flexibility of online learning material, more peer collaboration, more teacher-student interaction, greater application of knowledge and active learning. This study will contribute to a greater understanding of the impact of the flipped classroom method in nursing education.

Dedication and Acknowledgement

First, I thank my Lord for granting me the perseverance needed to accomplish this journey. Then, I would like to acknowledge the efforts of my supervisors, Dr. France Knight, Prof. William Browne, Dr. Janet Orchard. I have received consistent support and expertise from their guidance has been invaluable. All demonstrated a lot of patience and wisdom during this dissertation phase and for that, I am thankful! I would also like to express my appreciation to Prof. William Browne as he has increased my interests in statistics and research. Up and down throughout this journey and life, my son is born, the COVID-19 pandemic has occurred, my supervisor has left the academics……Their encouragement and support during difficult times helped me overcome all obstacles placed before me during the journey. Next, I highly appreciate the institution for allowing me to conduct this study. I would also like to thank the students for participating in this study although they are anonymous. Finally, I would like to show my love and appreciation to my family and friends, especially my husband and my parents. They always encourage and support me. Thank you for being my rock to lean on. With their love and support, I am able to accomplish this dissertation. I am so thankful and grateful for all of you!

Author’s declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's *Regulations and Code of Practice for Research Degree Programmes* and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

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Chapter 1 Introduction

1.1 Introduction and Background

As health care systems have become increasingly complex, nurses are expected to apply knowledge and solve problems critically (Barbour, & Schuessler, 2019). The Institution of Medicine's (2011) The Future of Nursing Report has highlighted such transformations in nursing education, including an innovative student-centered approach to prepare nurses to work effectively and collaboratively in a rapidly changing clinical environment. The traditional education pedagogy of in-class lectures may be inadequate in facilitating students to develop problem-solving skills and higher-order-thinking (Dong et al., 2021; Morrison, 2014).

Nursing programs now highlight the needs for students to apply theory into practice and enhance their problem-solving skills (Puetz, 2013; Barbour, & Schuessler, 2019). Nursing education has understood that shifting from a traditional, content-laden approach to a student-centered approach is now necessary (Shellenbarger & Robb, 2015). The role of the instructor shifts from a conveyer of information to a facilitator of learning (Betihavas et al, 2016).

The instructors can employ approaches which engage students in student-centered activities so as to avoid students' passive learning (Barbour, & Schuessler, 2019). The flipped class allows a student-centered approach and employs active learning approaches which can promote higher-order-thinking in nursing education (Missildine et al., 2013). However, the traditional in-class lecture remains the dominant instructional approach in community nursing courses.

Moreover, a large class that greatly relies on a lecture format has become more common in community nursing courses. However, a large lecture-based classroom has encountered concerns such as this approach hindering student engagement in class activities, that may be linked to lower students' academic achievement (Lax et al., 2017). To address these concerns, a flipped classroom is designed to enhance students' interaction, engagement, and academic achievement (Hudson et al., 2014). This thesis will investigate the impact of introducing a flipped classroom instructional approach in nursing education

The remainder of this chapter next describes the flipped classroom method (Section 1.2). The research aims and questions are posed (Section 1.3), and the significance of the study will be highlighted (Section 1.4). Details of the underpinning theoretical framework are elaborated upon (Section 1.5) and finally, the organization of the dissertation is outlined (Section 1.6).

1.2 The Flipped Classroom Method

The flipped classroom method ("FCM") is a pedagogical approach which inverts the traditional lecture-plus-homework formula (Flipped learning network, 2014). In general, the flipped classroom method tries to release in-class time from lectures by presenting the course content through video for students to watch as homework; in-class time is then utilized for active learning where the instructor acts as a facilitator to conduct class activities to deepen students' understanding (Roehl et al., 2013). In the traditional classroom ("TC"), students listen to lectures in class and finish their homework after class. In a flipped classroom ("FC"), students access course material in audio or video format prior to class as well as conducting in-class active learning activities such as exercises, group discussions and projects (DeLozier & Rhodes, 2017; Puppe & Nelson, 2019). FCM has generated interest in higher education because it provides a model of a student-centered approach which has been recognized to enable students to be active and responsible in their learning (Nouri, 2016; Lo et al, 2019). The flipped classroom method may potentially help to engage nursing students in learning (Betihavas et al., 2016).

The FCM was initially common in the United States (Bergmann & Sams, 2014), and it allows students to apply knowledge they have acquired outside the classroom to problems within the classroom and other real-world situations (Flipped learning network, 2014; Roehl et al., 2013; DeLozier & Rhodes, 2017). The instructor provides students with instant feedback throughout in-class activities such as group discussions and projects instead of direct lecturing (DeLozier & Rhodes, 2017). To foster student achievement and engagement, a shift towards a student-centered approach manifests itself through problem-based learning (Puppe & Nelson, 2019) and collaborative learning (O'Flaherty & Phillips, 2015).

Different health professional educators have recently adopted FCM, especially in medical education (Hew & Lo, 2018; Ramnanan & Pound, 2017). Several studies of students' perceptions toward FCM in health professional education (Betihavas et al, 2016; Chen et al., 2017; Hew & Lo, 2018) revealed positive feedback from students under flipped learning. Students have revealed strong satisfaction with the pre-class learning as they can access the pre-recorded video anywhere, anytime and as many times as they want. The question is however does using FCM in nursing education really help students learn better?

There may be limitations to flipped learning and it is vital to know, for example, if positive student perception of the FCM does not necessarily have a positive effect on student performance and engagement of this instructional approach.

1.3 Aims and research questions

This study takes a mixed-method approach to studying flipped learning in the context of a Hong Kong associate degree in nursing studies setting. First, the effects of flipped classroom method are evaluated and compared with some non-flipped learning (e.g., traditional classroom) by equivalent groups of nursing studies students, using objective measures such as academic scores to assess the impact. Second, qualitative methods such as focus groups are used to acquire a deeper and richer understanding of students' flipped learning experiences. The result of students' engagement in the FC are then analyzed and findings identified that can be used to inform future practice, policy-decisions and research in enhancing student engagement on these kinds of programs. Two instructional approaches are compared and evaluated in the main study in this thesis, specifically the traditional classroom and the flipped classroom. The aims of this study are to (1) examine student achievement under these two instructional approaches and (2) investigate students' engagement under the flipped classroom method. The research questions are listed below:

1) How does the flipped classroom method influence students' academic performance compared with the traditional classroom?

2) How does the flipped classroom method influence students' engagement?

1.4 Significance

FC is widespread in the education of health professional education in the western world, especially in medical education. Studies have shown a positive impact of FC on learning outcome (Chen et al., 2017; Hew & Lo, 2018). Betihavas et al. (2016) carried out a systematic review of FCM in nursing education. They found that there was a lack of evidence on the impact of FCM in nursing education compared to other health professions. Most of such studies were conducted with undergraduate students. Thus, the approach was not broadly generalizable to other levels of study. Therefore, the findings of this review may not apply to associate degree nursing students. Given that an instructional approach which is effective in particular levels and disciplines of students may not necessarily be as effective in another discipline. There is therefore a gap in the literature here. In the meantime, student engagement of FC is still underexplored in nursing education. Student engagement is a key concept of student's learning processes. Furthermore, most studies published have been carried out in the United States. Thus, they may not capture the impact of FC on Asian students because the

education system differs and that might prompt different responses to FC. The gap existing in the recent literature relating to FC warrants a quasi-experimental study. It makes room to find out if FC in nursing education can enhance student learning in Hong Kong nursing education. The findings of this study may therefore enhance our understanding of such students' academic performance and engagement in the FCM involving Asian associate degree nursing students.

1.5 Theoretical framework

Adult learning theory (Knowles et al., 2005) and the concept of student engagement (Fredricks et al., 2004) are the two main theoretical frameworks that support this study.

1.5.1 Adult Learning theory

Malcolm Knowles (1972) indicated that adults learn differently from children and made the term "andragogy" well-known in public. Knowles' adult learning theory was based upon the principles of andragogy, a set of learning principles which apply to adult learners (Knowles et al., 2005). Andragogy includes six principles the instructor should consider that are related to adult learners and student-centered learning. First, adult learners need to understand why learning is good for them. The instructor should present the course content in a way that enables adult learners to understand the reason to learn the content. Second, adult learning is more self-directed because adult learners have self-concept. Adults have different self-concepts than children because adults are more responsible for their decisions. The instructors play a crucial role in supporting adults to shift from being a dependent learner as children to an independent leaner as adult.

Third, adult learners have more life experiences which impacts upon their learning. Adults bring these life experiences into the classroom, that can either promote or hinder learning. The instructor can utilize students' experience to bring diversity into the classroom and encourage students to use their knowledge to teach one another. Fourth, considering the adult learners' readiness to learn. Children are developmentally unable to understand "concepts" as they have not yet experienced life, while adults are capable of learning more complex concepts when these concepts are applied directly to their real-life situation. If the adult learners have not developed the appropriate readiness, the instructors can apply different strategies such as simulations or models to motivate their learning experience.

Fifth, adult learners desire to learn when it is directly relevant and applicable to their lives. Adults are motivated to learn when it enables them to improve their circumstances by bringing

self-fulfillment or by advancing their career. Sixth, adult learners learn better with intrinsic versus extrinsic motivators. Adults are motivated to learn basically due to a desire to improve quality of life and job satisfaction, while children learn as they are required to do so.

Adult learning theory supports learning approaches which employ problem-based and collaborative learning activities to engage the adults to learn (Knowles et al., 2005). Higher education instructors can vary their techniques to meet the diverse needs of adult learner as well as motivate and engage them (Shellenbarger & Robb, 2015). Both Bergmann and Sams (2012) and Peisachovich et al. (2016) asserted that students today are of a generation who prefer utilizing technology than sitting in a TC. The FCM fulfills their preferences by utilizing technology to help learning, moving the lecture outside the classroom, and applying active learning approaches during class time (Bergmann and Sams, 2012; Ward et al., 2018).

Learning activities should be custom designed to address the diverse needs of students, establishing a student-centered environment where students can be more proactive in the classroom, as opposed to passively listening to the instructor (Schwartz, 2014; Hew & Lo, 2018). The FCM gives this chance by releasing class time for more student-centered learning (Bergmann and Sams, 2014; Ramnanan & Pound, 2017).

Active learning is about any instructional approach which engages learners in the learning process (Prince, 2004). Active learning attempts to change teacher-centered approach to student-centered approach through students' participation in different learning activities, as opposed to passively listening to a lecture. It highlights higher-order-thinking by completing task through active engagement with learning materials and often involves group work (Freeman et al., 2014).

Regarding student engagement in learning, the instructors should establish an environment that encourages students to participate within the classroom. However, such an environment is impossible in traditional lecture-based classrooms (Schwartz, 2014). Most importantly, the FC can only succeed when an active learning approach is appropriately applied (Tomas et al., 2019). In the FCM, students are expected to complete the pre-class work. In class, students can conduct active learning activities such as group work and problem-solving activities. During class time students gain feedback from both their classmates and teachers and perform tasks that require them to develop skills of application, analysis, synthesis and evaluation (Ramnanan & Pound, 2017; Greenwood & Mosca, 2017).

Taking an active part in learning allows adult learners to gain an in-depth understanding of subject matter (Simpson & Richards, 2015), increase retention, apply knowledge to practice and feel much more confident about the subject (DeLozier & Rhodes, 2017; Ward, et al., 2018).

Active student engagement may increase productivity of the future workforce. They can be equipped with effective problem-solving skills, collaborative skills and practical application of knowledge (Bernard, 2015; Brame, 2013; DeLozier & Rhodes, 2017).

To prepare nurses with all round competence is a key objective of nursing education. Nurses must be able to demonstrate teamwork and clinical judgment in a rapidly changing clinical settings (Peisachovich et al., 2016). Students become engaged in learning and thus become more pro-active in achieving their learning goals (Ghilay & Ghilay, 2015). The FC may give such a chance for student engagement (Presti, 2016; Post et al., 2015), that in turn fosters students' learning outcomes (Greenwood & Mosca, 2017).

1.5.2 Conceptualization of student engagement

Student engagement was defined by Fredricks et al. (2004) as a multi-dimensional construct including behavioral, emotional and cognitive engagement. First, behavioral engagement represents students' behavior, such as the absence of disruptive behavior, completion of schoolwork and contribution to discussion. Second, cognitive engagement refers to students' willingness to show effort in learning and meeting academic requirements. Third, emotional engagement is about students' interest in and feelings toward class attendance.

In conclusion, adult learning theory describes that adults are self-directed, self-motivated, and active learners. As the FC supports adult learning theory, it has the potential to be a valuable instructional approach in higher education (Barbour & Schuessler, 2019). Three components of engagement are considered, namely behavioral engagement, emotional engagement, and cognitive engagement. The FC enhances student-centered learning and employs active learning approaches that may promote student engagement (Presti, 2016; Tomas et al., 2019).

1.6 Organization of the dissertation

This dissertation contains seven chapters. Chapter 2 provides a literature review summarizing the previous findings of the flipped classroom method in the nursing domain. Chapter 3 describes the research methods used in the studies in this thesis. Chapter 4 presents the findings from a pilot study and its implication to the main study. Chapter 5 then presents the results of the main study. Chapter 6 discusses the research findings and proposes a set of design principles for the flipped classroom. Finally, Chapter 7 presents the conclusions, limitations, and implications of the study and recommendations for future research.

Chapter 2 Literature Review

2.1 Introduction

In this chapter the relevant existing literature related to the proposed study, in which the impact of the flipped classroom method on learning in Hong Kong nursing education is considered, is reviewed. The review focuses on those studies regarding flipped classroom method (FCM), nursing education and student engagement in active learning found in different kinds of nursing programs and published in peer-reviewed English journals. By limiting the review to the nursing domain in higher education, studies that encompassed the flipped classroom method in non-nursing setting or primary and secondary education setting are excluded as are studies not in English.

2.2 Study characteristics

The majority of studies have been carried out in the United States. Chung et al. (2019) conducted an integrated review of 33 published papers related to flipped nursing education from 2010 to 2017. They found that the top two countries publishing in English-language journals on the FCM in nursing educations are the United States and Australia with most studies adopting quantitative methods, followed by mixed methods and qualitative methods. The quantifiable measures used in the reviewed studies included quizzes, online test scores and final examinations. Overall, use of FCM yields neutral or positive results on the measures considered compared to the traditional classroom (TC).

2.3 Current practices in flipped nursing education

The FCM has three stages of learning activities (Puppe & Nelson, 2019; Barbour & Schuessler, 2019; Youhasan et al., 2021): 1. Pre-class activities, 2. In-class activities and 3. After-class activities.

2.3.1 Pre-class activities

The pre-class activities should benefit students by supporting them to easily connect the knowledge they acquire to the in-class learning (Crtiz & Knight, 2013; Hanson, 2016). In pre-

class activities, often direct lectures are delivered through pre-recorded lectures that are delivered in various formats including voiceover PowerPoints and videos (Plicher, 2019; Ward et al., 2018). The majority of learning methods used outside the classroom in nursing education are instructional video, assigned reading and online follow-up low-stakes quizzes (Chung et al., 2019; Ward et al., 2018) (Table 2.1).

Table 2.1 Major Pre-class activities in flipped nursing education

Learning method	Description
Instructional video	Instructional video is a common form of pre-class learning materials (Chung et al., 2019). Often short videos of 20 to 25 minutes segments are used. A series of shorter videos instead of one longer presentation is often preferred with one recording per topic (Critz & Knight 2013; Smith & McDonald, 2013; Youhasan et al., 2021).
Assigned reading	The assigned reading is primarily fundamental level knowledge that the students can review and understand the contents by themselves (Chung et al., 2019).
Online follow-up low-stakes quiz	Students complete a low-stakes assessment as a means to assure compliance with the pre-class work (Bristol, 2014; Ratta, 2015).

In the aforementioned study of Chung et al. (2019), the majority of instructors delivered lectures utilizing pre-class instructional videos. The videos are uploaded to the Learning Management System at least one week before the face-to-face class (Youhasan et al., 2021). More importantly, the video content, and length should be considered in the video production (Njie-Carr et al., 2017). First, most instructional videos are developed by the instructors and some instructors also use Youtube videos (Ward 2018). Nonetheless, it is not appropriate to simply make a video and upload it online. For the video content, rather than 'nice-to-know' information, it should include largely 'need-to-know' information and should concentrate on information that students will need to facilitate them to meet the desired outcome (Pilcher 2019).

Because students' online attention span is short, teachers should use a purposively segmented video and create one recording per topic (Smith & McDonald, 2013). Mikkelsen (2015) found that short videos can be of important value for nursing students. To maintain student interest and promote content retention, the whole length of all combined videos segments for each lecture should be limited to 20-25 minutes (Critz & Knight 2013; Smith &

McDonald, 2013; Youhasan et al., 2021). The meta-analysis study of Hew & Lo (2018), which looked at multiple non-health professional education-related FC studies showed the majority of students spent up to 20-25 min on watching pre-class video. For example, the online activity record indicated that the majority of students in a flipped economics class (n=1771) spent 10-25 minutes on the pre-class video (Vazquez & Chiang, 2015). Besides, survey results indicated that 31 students in a flipped calculus class on average spent 21 minutes on the pre-class video (Mcgivney-Burelle, & Xue, 2013).

Second, Bergmann & Sams (2014) emphasized that videos are not the only possible form of pre-class preparation. Assigning some text-based reading covering basic level knowledge also allows student to read and understand the concepts by themselves (Chung et al., 2019). To avoid overloading students**,** Critz & Knight (2013) suggested to limit the reading of articles to no more than four per week.

Third, online low-stakes quizzes can be embedded after the video. Assigning a grade to pre-class activities addresses the needs of adult learners as they will more likely value this activity (Barbour & Schuessler, 2019). Support for this comes from a flipped pharmacy study which reported that the use of a quiz before class would enhance student preparation (Patanwala et al., 2017). One hundred students participated in a flipped pharmacy study in the USA, the median video view time (out of 100 minutes) was greater when answering a quiz was required (80 minutes versus 69 minutes, $p < 0.001$). 74 students had ≥75% video view time in session 1 when a quiz was required and this decreased to 53 students for session 2 when no quiz was required. Students are often required to bring the follow-up assessment to the face-to-face class to enhance student accountability and motivate in-class participation (Gilboy et al., 2015).

More importantly, the follow-up assessment can validate if students viewed the materials and assessed how well the content is understood (Smith & McDonald, 2013). Not only do such assessments give students the opportunity to apply what they learn in pre-class video, but also the assessment results explain their readiness for in-class learning. Instructors can determine if it is necessary to review or even re-teach the video content and modify in-class activities. Furthermore, students could use the computerized feedback on their responses to online questions for their self-evaluation.

In the FC, students are held accountable for completion of pre-class work. To continue monitoring, the instructors can track students' time spend on pre-class learning materials in the course level analytics in the Learning Management System (Gilboy et al., 2015).

2.3.2 In-class activities

The FCM is an instructional approach that promotes critical thinking and application of knowledge learned outside the classroom to real-world situations in the classroom (Barbour & Schuessler, 2019, Chan et al., 2021). The possible in-class activities include clicker questions using an audience response system at the beginning of class, mini-lectures on difficult content, problem-solving and collaborative activities (Table 2.2). During class, students can conduct a group discussion, case study, student presentation and simulation (Njie-Carr et al., 2017; Ward et al., 2018).

Table 2.2 Major In-class activities in flipped nursing education

In-class activities	Descriptions
Student response and open questions	Students respond to clicker questions through a student response system regarding pre-class content. According to students' response, the instructor can give feedback and answer students' questions regarding the class. Students review pre-class information (Barbour & Schuessler, 2019).
Mini lecture	10-minute lecture to clarify a concept (Barbour & Schuessler, 2019).
Problem-solving and collaborative learning	Students perform individual and collaborative problem-solving activities. Instructors give feedback and individualized instruction to support student learning. Instructors circulate around the room and evaluate students quickly for a quality check.

The key point to designing in-class teaching learning strategies is that they should enhance active learning and engage students. First, if the instructor did not conduct a before class quiz, they can utilize a student response system via mobile phones or tablet computers to estimate to what extent the students prepared for the in-class content (Park et al., 2018). Based on student performance, the instructor can then identify areas which are difficult and confusing for the students as well as students' misconceptions of the pre-class content which then brings the use of mini-lecture to clarify concepts (Barbour & Schuessler, 2019; Hew & Lo, 2018). It also serves as a powerful motivator for students to complete the pre-class work (Hew & Lo, 2018).

Moreover, linking pre-class work with in-class activities allows for questions from the pre-class preparation prior to the in-class activity and solidifies pre-class work concepts (Puppe & Nelson, 2019). Questioning at the start of class benefits students by recalling the knowledge acquired before class. Stimulating the recall of prior knowledge facilitates better understanding of new concepts by linking them to what the students have already learned (Hew & Lo, 2018, Oh et al., 2017).

Second, some instructors deliver in-class mini-lectures to address difficult topics rather than presenting all learning materials outside the classroom. One should avoid presenting advanced topics through instructional videos because it is hard to expect all students to understand them independently. Bergmann and Talbert (2017) suggest introducing advanced topics in face-to-face class because instructors can elaborate on those topics in a more interactive environment as well as give immediate answer to students' questions.

Third, the spirit of FCM is to free more in-class time for peer and teacher-student interactions, providing students more opportunity for higher-order learning (Bernard, 2015; Chung et al., 2019). Therefore, it is suggested that more peer and teacher-student interactions and higher-order-thinking activities can be implemented in the FC. Collaborative and problem-solving activities which allow students to have more peer-peer and teacher-student interactions and higher order thinking are commonly used in the FC.

These activities include the case study, group discussion, group presentation and simulation. In the nursing context problem-solving activities allow nursing students to incorporate nursing knowledge into practice in the classroom. Case studies are implemented to utilize various approaches. Peisachoviach et al. (2016) used role-play of the patient, family member and healthcare provider to bring real-world scenarios to the students. Hanson (2016) used case studies to demonstrate the application of drug science to medication administration. Pence (2016) used real-world clinical experiences as case scenarios. Some studies used simulation as an active learning tool (Missildine et al, 2013; Post et al., 2015, Pence, 2016).

Moreover, collaborative activities allow students an opportunity to learn and practice collaboration which is an important element in health care professional work. Multiple studies use group activities as in-class activities (Hanson 2016; Maxwell & Wright, 2016; Peisachovich et al., 2016; Pence, 2016; Schwartz, 2014; Simpson & Richards 2015). For example, groups of three to five students hold a group discussion or develop a summary of pre-class work and produce presentation materials (Dehghanzadeh & Jafaraghaee, 2018; Green, & Schlairet, 2017; Park & Park, 2018). The group presentation can also lead to in-class discussion and the group are responsible for replying to classmates enquires. Group discussion benefits student

performance and their understanding of the content (DeLozier & Rhodes, 2017). Instructors and peers can also provide immediate and constructive feedback during the in-class group activities.

In their systematic review of FC in undergraduate nursing education, Youhasan, et al. (2021) reported that the most commonly used in-class activity in nursing education is discussion followed by problem-solving activities such as doing exercises or case study and group projects. In term of the technologies employed in the class, some studies mentioned the use of mobile phone and tablet computers for in-class activities.

A large proportion of studies did not adopt technologies to conduct in-class activities. A proportion of FC studies were delivered using traditional in-class teaching and learning strategies such as discussion or doing exercises. Chung et al. (2019) explained that this could be due to the fact that the nursing instructors are not familiar with newer technologies. Some studies have provided evidence that the integration of proper technologies and learning strategies can enhance the students' learning compared with traditional instructional approach (Eryilmaz et al., 2014). Eryilmaz et al. (2014) conducted an experimental study with two groups consisting of 24 first year doctoral students. Their results indicated that the guidance software considered in the study offered students in the treatment group a way of focusing their attention on deep processing of challenging concepts. It is recommended therefore that there is potential for implementing technology-enhanced learning in the future in nursing education.

2.3.3 After-class activities

When implementing the FCM, it is crucial that the instructor realizes this approach aims at connecting the learning outside the classroom with in-class learning (Flipped learning network, 2014). The most significant reason for after-class activities is to offer students a chance to report frustration or confusion related to the in-class learning in the FC.

The after-class activities include after-class assessment, learning diaries, after-class discussion, personal projects and group projects (Table 2.3). Assessment is an essential part of the after-class portion of the FCM and has to align with the objectives of the offloaded content and in-class activities (Gilboy et al., 2015). Moreover, students can write their learning diary to reflect their learning at home. Instructors can provide more information and feedback in the after-class discussion. Students can complete the assigned learning tasks either individually or collaboratively to summarize their knowledge acquired.

Table 2.3 Major after-class activities in flipped nursing education

Learning method	Descriptions
After-class assessment	Students complete the assessment which is related to their pre-class and in-class content.
Learning diary	Students write reflections on their learning at home.
Discussion	Instructor provides additional data at an after-class session, and relevant feedback (Kim & Jang, 2017)
Personal project and group project	Students complete the assigned learning tasks either individually or collaboratively.

Many studies do not have after-class activities, whilst some conducted after-class assessment, learning diaries or after-class discussion (Youhasan et al., 2021). This is as expected because the core value of FC is to engage students in knowledge application during class with instructors or peers' support (Bernard, 2015; Chung et al., 2019). However, the after-class activities can offer students an opportunity to extend their learning and summarize their knowledge they obtained in the three stage of learning activities (Bergmann & Smith, 2017).

2.4 Students' achievement in flipped classroom

A majority of studies examining the effect of FCM in nursing education have taken a quantitative approach. They primarily find out whether differences in student achievement in terms of test scores exist between a FC and a traditional classroom (TC). It may be that the test scores can be used to measure the effect of the FCM on the learning outcome objectively. The quantifiable scores in those studies include unit tests, quizzes, online test scores and final examinations.

Overall, the results of students' achievement under FC vary from study to study. This is understandable due to the different context and ways in which the FCM is implemented and therefore, a generalized conclusion about the effect of FCM on students' achievement cannot be drawn. Therefore, the current study can provide more evidence of the effect of the FCM. Nevertheless, it is helpful to consider some of the more common findings found across different existing studies.

First, Missildine et al. (2013), Ratta (2015), Greenwood & Mosca (2017), Joseph et al. (2021), Kim & Jang (2017), Oh et al. (2017), Hu et al. (2018) and Tan et al. (2017) all reported that FCM enhanced students' achievement. A quasi-experimental study was conducted by

Misssildine et al. (2013) on two adult health courses that were provided consecutively in semesters on undergraduate nursing students in the USA. A convenience sample of 589 students was used over a period of 3 semesters, randomization was not discussed. In the fall of 2009, lecture only was used by faculty. In the spring of 2010, lecture plus lecture capture classroom was used. Lecture capture allowed the updating of content. In the fall of 2020, lecture plus innovation (flipped classroom method) was used. Comparable examinations were used from previous semesters to ensure consistency, but reliability coefficients and validity of the exams were not addressed.

Findings from the Missildine et al. (2013) study revealed that the FC group had a 2-point improvement (on a test marked out of 100) compared with the Lecture Only group ($p<0.001$). However, a faculty-developed 4-point Likert satisfaction survey indicated that students were significantly less satisfied with the FC compared with other approaches ($p<0.001$).

In Ratta's (2015) study, team-based learning was concurrently introduced to the students (n =80) with a FC in two sequential undergraduate fundamental nursing courses in the USA. The students' score on standardized examinations from the FC were higher than those from previous classes. However, Ratta did not describe the statistical data and how significant was the difference of examination scores between classes. Moreover, two interventions are used (FCM and team-based learning), thus it is difficult to distinguish which of the 2 or perhaps even the combination of the 2 approaches, positively affected test scores.

Similarly, Greenwood & Mosca (2017) conducted a nonequivalent control group with a quasi-experimental quantitative design on junior undergraduate nursing students taking a medical-surgical course in the USA. By comparing student test scores before and after flipping the classroom, a statistically significant increase of 8.04 points out of 100 after the instructional change was found ($p <.001$). The test scores were higher in the FC in the above studies which implied that the FC may provide a learning environment that allows a better understanding of nursing concepts.

Moreover, Joseph et al. (2021) conducted a quasi-experimental design study on two cohorts of 112 first-year undergraduate nursing students on an anatomy and physiology course in Oman. The final examination scores of the FC group were significantly higher than those of the TC group in a previous cohort, $p < .005$. Students' knowledge before and after each FC session was evaluated. The results showed that students performed significantly better on the post-test compared to the pre-test (83.43 ± 16.65 versus 63.81 ± 22.02, $p < .001$). A limitation was that only one eight-hour section of the 75 hour-course was flipped.

Similar results were also found on Asian undergraduate students. Kim & Jang (2017)

conducted a randomized, controlled trial on undergraduate nursing students in South Korea. A total of 106 students were selected to participate in the experimental, flipped group in 2015, and 96 students were selected to participate in the control group in 2014. Four knowledge assessments were conducted in the 10-weeks study. The knowledge assessment scores showed statistically significant differences between the measurement points ($p < .001$), and the interaction between the groups and the measurement points ($p < .001$) meaning that there were differences between the learning rates in the two approaches.

Further, in the study of Oh et al. (2017), 64 undergraduate students participated in a 15-week flipped nursing informatics course in South Korea. They indicated that the post-test scores in the FC group were 1.26 times higher than in the TC group ($p < .001$). The mean scores of the pretest and posttest of knowledge were compared between participants in the FC. There was a significant increase of 23.06 points in the posttest, compared with the pretest ($p < .001$).

Two meta-analyses have been conducted by Hu et al. (2018) and Tan et al. (2017), drawing on studies examining the FCM in nursing in China. Hu et al. (2018) focused on randomized controlled studies of the FCM in undergraduate nursing education in China between 2015 and 2017. Eleven randomized controlled trials met the criteria used and were selected. The meta-analysis reported that the students in FC had significantly higher scores than in control group in terms of theoretical knowledge and skill.

Tan et al. (2017) also conducted a meta-analysis of the FCM in Chinese nursing students between 2014-2016. Twenty-nine articles involved undergraduate nursing (n=15), associate nursing (n =13), and higher vocational nursing (n=1) were considered. They measured theoretical examination scores (n = 16), skills examination scores (n = 16) and self-learning through questionnaires (n = 15). They found significant differences in favor of the FCM for all three outcome measures.

In contrast Harrington et al. (2015), Phillips & O'Flaherty (2019) and Kim et al. (2021) found no significant difference in the test scores between groups. An experimental study conducted by Harrington et al. (2015) used a convenience sample of 82 undergraduate nursing students in a one-semester medical-surgical nursing course in USA. Students were randomly assigned to either the FC or the TC groups. They concluded that both FC and TC were equally effective. There was no significant difference in the final exam scores between groups ($p = 0.92$).

Similarly, in the study of Phillips & O'Flaherty (2019), the final course grade of the undergraduate student in 2016 flipped virtual classroom delivery ($n = 650$) was compared to that in 2015 online-face to face mixed mode ($n = 635$) in Australia. Final course grades were similar for both deliveries. In 2015, student average final course score was 63 with a course

pass rate of 96% whereas in 2016 in the online flipped the average score and pass rate was 62 and 97% respectively. However, in this study two interventions are introduced (FCM and virtual classroom), it is therefore difficult to distinguish which of the 2 approaches or even the combination, affected final course scores.

Kim et al. (2021) conducted a quasi-experimental and convergent parallel study design on third-year undergraduate students in the 8-week Community Health Nursing I course in South Korea. The FC group (n = 32) demonstrated a significant improvement in class participation, academic self-regulation, and co-regulation compared to the TC group (n = 30), but academic performance did not exhibit a significant improvement. The mean score on the midterm test (p= 0.152) and final test (p= 0.320) were not statistically significantly different between the two groups.

Geist et al. (2015) and Chu et al. (2019) also reported that there were ambiguous differences between the FC and TC approaches. Geist et al. (2015) conducted a pretest-posttest nonequivalent group quasi-experimental study on undergraduate nursing students in a one-semester pharmacology course in USA. Convenience samples were used for both the control group (n = 40) and the treatment group (n = 46). Identical unit tests and a comprehensive final examination were used to reduce bias. They revealed that the flipped students improved the unit test scores but there was no significant difference in the final exam. This indicated that a researcher cannot depend solely on final examination to see impact of such interventions and they can use multiple modes of assessments in order to assess students' achievement. All 3 tests demonstrated variance in performance and high association with the instructional approaches. However, the reliability and validity of the exams were not addressed, and confounding variables and confidence intervals were not mentioned.

Similarly, Chu et al. (2019) conducted a pretest-posttest nonequivalent control group with a quasi-experimental design on nursing staff (5-hour course) in Taiwan. 75 nurses were in the control group and received training via traditional pedagogy whereas 76 were in the experimental group and engaged in the FCM. They reported no difference in the scores between groups in the pre-test. The posttest-pretest knowledge difference of the experimental group was higher than that of control group, with a difference of 11.98 marks on the test (p <.001), but there was no significant difference one month after the course.

The majority of studies measure the test score solely at the end of course. However, the student performance could be reflected by various assessments. In the study in this thesis, multiple assessments such as the comparison of pretest and posttest scores, assignment scores, quizzes and final examination will be used at different measurement points to assess the student

performance more accurately.

Note that five of the studies above are conducted in Korea and China, where students have a similar cultural background as in this study. Use of FCM in undergraduate students from both non-Asian and Asian backgrounds yield either neutral or positive differences in students' academic achievement. However, the studies mainly focus on undergraduate nursing students. The results may therefore be difficult to generalize to other level such as associate degree nursing.

2.4.1 Benefits of flipped classroom

Many studies demonstrate the benefits of FC including 1) preparing students for in-class learning, 2) releasing more in-class time for applying knowledge into practice, 3) releasing more in-class time for peer and instructor-student interaction and 4) instant feedback (Table 2.4).

Table 2.4 Major Benefits of Flipped Nursing Education

Aspects	Examples
1) Preparing students for in-class learning	Students can repeatedly review the pre-class learning materials anytime and anywhere to better understand the subject matter (Schwartz, 2014; Puppe, & Nelson, 2019). Based on students' pre-class performance, instructors can make adjustment to the in-class teaching plan (Hew & Lo, 2018).
2) Releasing more in-class time for applying knowledge into practice	Increase in-class active learning time for problem-solving activities and group work. Provide students with greater opportunities to develop skills of application, analysis, synthesis and evaluation (Ramnanan & Pound, 2017; Greenwood & Mosca, 2017). Application of knowledge into practice is important in nursing education.
3) Releasing more in-class time for peer and student-instructor interaction	Many in-class activities such as small-group discussion and presentation enhance peer and student-instructor interaction.
4) Instant feedback	Instructors circulate among the group and provide instant feedback and interaction during in-class activities.

First, the students can prepare themselves for in-class learning. Students have unrestricted access to pre-class learning materials on the Learning Management System which enables them to learn anywhere and anytime. Students can also repeatedly review the materials for revision before class (Schwartz, 2014; Puppe, & Nelson, 2019). In Schwartz's study (2014), 9 PhD nursing students in a flipped statistics course reported that they liked the formats of video (mean=5) in a 5-likert point questionnaire. They reported that they could review the materials again at their individual optimal times.

The use of videos enables students to study outside the classroom and at their own pace (Harris Ware & Benson, 2019). In Harris Ware and Benson's study (2019), a total of twenty students participated in one-semester flipped nursing mobility courses at two institutions of higher education in the USA. In three focus group interviews, students reflected they could learn everywhere and the videos supported self-paced learning. Students also reported that completion of pre-class activities made them better prepared to engage in the in-class activities. Based on students' pre-class performance, the instructor can also adjust the in-class teaching plan (Hew & Lo, 2018). To be more effective, it is significant that videos are viewable from various mobile devices (Harris Ware & Benson, 2019).

Second, more in-class time in the FC spent on collaborative and problem-solving activities which allow students to have more peer and teacher-student interactions and higher-order-thinking. Students accessing the learning material before class increases in-class time to help enhance students' understanding of the subject matter (Hew & Lo, 2018, Chu et al., 2019; Harris Ware & Benson, 2019). During class, students can perform active learning, problem-solving activities and group work (Betihavas et al., 2016; Ward et al., 2018). These activities include the case study, group discussion, group presentation and simulation. There are greater opportunities for students to develop skills of application, analysis, synthesis and evaluation in the FC (Ramnanan & Pound, 2017; Greenwood & Mosca, 2017). FC enables nursing students to apply nursing knowledge into practice in the classroom. Application of knowledge into practice is one of the key goals of nursing education.

Third, many of the in-class activities such as small-group discussions and presentations enhances peer interaction (Greenwood & Mosca, 2017; Hew & Lo, 2018). Fourth, the instructors have greater chance to give instant feedback and interaction during in-class activities (Missildine et al., 2013; Critz, & Knight, 2013; Post et al., 2015; Puppe, & Nelson, 2019). During in-class activity, instructors can also know how well students master the materials (Schwartz, 2014).

2.4.2 Challenges of flipped classroom

Whilst there are a range of benefits for the FCM, there are also some challenges associated with implementing this approach. The challenges of using FC include: 1) student challenges, 2) instructor challenges and 3) technical challenges.

For students, several studies reported students' dissatisfaction centering on students' unfamiliarity with the FCM and the time commitment for the pre-class work (Missildine et al., 2013; Njie-Carr et al., 2017; Peisachovich et al., 2016; Post et al., 2015; Ward et al., 2018). Some students do not get used to flipped learning. They find that the large amount of work required in the FC makes them feel overwhelmed (Missildine et al., 2013; Peisachovich et al. 2016; Post et al., 2015; Simpson & Richards, 2015; Bingen et al., 2019).

For faculty, several studies noted that the FCM increased instructors' workload for the preparation of FC (Geist et al., 2015; Schwartz, 2014; Njie-Carr et al., 2017, Lo & Hew, 2022). Peisachovich et al. (2016) informally gauged that the instructors will increase their preparation time for FC by 1.5 times. To facilitate group activities and discussion effectively, the instructors should have a strong academic and clinical background (Crtiz & Knight, 2013). At the same time, there are numerous technical issues like lack of internet access and slow internet speed for rural students to access the course materials (Agu et al., 2021; Lo & Hew, 2022). Lack of IT skills of instructors and insufficient IT support are also some technical issues affecting the FCM (Post et al., 2015; Missildin et al., 2013; Barranquero-Herbosa et al., 2022).

2.5 Student Engagement in flipped classroom

One aim of transforming traditional classroom teaching to the FCM is to enhance student engagement. Active student engagement leads to decreased dropout rates (Fredricks et al., 2004) and improved academic performance (Greenwood & Mosca, 2017). The FC has the potential to engage students more effectively in deep learning compared to those studying in TC (Phillips & O'Flaherty, 2019). However, research on student engagement in the flipped course is limited (Elmaadaway, 2018), and especially not much is known about student engagement in flipped nursing education in Asia. This literature review excluded K-12 education, non-nursing education and other reviews that are published in Chinese.

2.5.1 Constructs of Student Engagement

According to Fredricks et al. (2004), the framework of student engagement is multi-dimensional and it includes three constructs namely behavioral, cognitive and emotional engagement. Using this framework of engagement, can help one understand student engagement in flipped courses. The following section describes this framework plus the findings of several flipped nursing education studies which give examples of each construct of student engagement.

2.5.2 Behavioral engagement

According to Fredricks et al. (2004), behavioral engagement refers to an activity as being represented by good behavior such as involvement in learning and positive conduct. For positive conduct, this includes following the rules and the absence of disruptive behavior such as skipping class. For involvement in learning, this includes concentration, persistence, effort, asking questions and contributing to class discussion. Several studies provided evidence that FCM promotes behavioral engagement such as student's engagement in the pre-class activities and in classroom discussion.

In the aforementioned study of Phillips and O'Flaherty (2019), student responses (strongly agree/agree) to questions in course evaluation were compared. They found a 30% subjective increase in student engagement with pre-class activities in the FC compared to non-flipped classes and a similar increase in student preparedness for class activities in flipped classes.

Similar results were reported in Mikkelsen's study (2015) on flipping 48 undergraduate nursing students in an anatomy and physiology course in Denmark. The study found that the FC had a large potential to engage students better in the classroom setting. Thirty-four students (71%) answered the anonymous questionnaire. Twenty-eight students (82%) reported that they had watched all the assigned videos prior to class. Twenty-six students (76%) said that they had paused a video and resumed playing later to a high or to some degree. All responding students agreed that there was a good linkage between video content and in-class activities, and all agreed that watching the assigned videos was good preparation for the in-class activities. Some students commented: "I watched the videos before class, then I had a better chance to understand what was said in class"; "If there's something you haven't understood, you can go home and watch the videos again".

Graduate students in the study of Critiz and Knight (2013) also responded positively.

Eleven pre-class modules that used pre-recorded PowerPoint lectures, videos, textbook readings, and 4-5 evidence-based journal articles and quizzes were assigned for the 15-week semester in a pediatric family nurse practitioner program in the USA. In the survey, 15% of students reported they were more engaged in classroom discussions. Students could regulate their own learning and then come to class ready to actively engage in collaborative learning. There is more time for application of knowledge. However, 25% of students commented that the pre-class work was slightly too much for the students.

These findings imply that student orientation of FCM and the design of teaching and learning strategies are important to engage students in the FC. First, students will engage in the learning activities which they think are related to their learning. Betihavas et al. (2016) who carried out a systematic review of FC in nursing education, reported that engagement of students in the FCM was achieved when instructors rationalized the purpose of the FCM to students. Adult learners want to know the cause why various learning activities are applied in FC (Knowles et al., 2005) and that they are relevant to their learning. Clear communication with students about the objectives and routine use of the class activities and why these activities are directly relevant to their learning at the start of the FC is important to engage students' learning.

Second, it is important to design and implement learning activities which can promote student engagement behaviorally, emotionally and cognitively. O'Flaherty & Phillips (2015) conducted a scoping review on the FC in higher education. They reported that students do not tend to engage in pre-class activities that lack interactivity, no provision of formative feedback and are not coherently connected to the in-class learning. Similarly, instructors make a balance between time spent on pre-class work and in-class work. A lack of engagement with the pre-class activities leads to variability of student preparedness. Both students and instructors have to be fully engaged in the class activities. Therefore, whatever the instructors decide to choose for the pre-class activities, it is crucial to ensure that the activity is applied to the course content to be effective in engaging students in learning. Students are likely to engage in a shorter video and pre-class activities which are related to the in-class activities.

2.5.3 Cognitive engagement

Cognitive engagement refers to investment in learning. It includes students' preference for challenges, their desire to go beyond the requirements, and how they regulate their learning. Several studies show that students preferred FC and they have more responsibility for their

learning in the FC.

In the aforementioned study of Phillips & O'Flaherty (2019), 85% of responding students strongly agreed/ agreed that they would recommend the flipped approach to their peers. Similar results were reported by Mikkelsen (2015), 41% responding students preferred FC, 18% preferred TC and 41% did not prefer one approach over the other.

Further, Simpson & Richards (2015) conducted a study on flipping an undergraduate population health course in the USA. In the course evaluation, 68% of responding students suggested that more courses should be flipped. Students indicated that they had more responsibility for their learning. They appreciated the case studies and felt they were learning relevant information.

Graduate students in the study of Mackavey & Cron (2019) also responded positively to the case discussion in the FC. Case studies and group discussion are one of the common activities used in the FC. Case discussion allows students to apply their knowledge to real-world scenarios and allows them a safe environment to make medical decisions without fear of harming an individual. The case in this study is designed to increase in complexity as the student progress through the course. Students need to develop a plan and an intervention to the case. In the course evaluation of an online family nurse practitioner program in the USA, students indicated that case discussion promoted critical thinking and class participation. Mackavey & Cron (2019) revealed that case discussion can keep the student engaged in online learning.

Greenwood & Mosca (2017) also found that case study was useful to facilitate student-led group work. Questions from case studies were edited to improve increasingly complex levels of thinking. Using rotating group leaders, groups presented the answers to the class. The above findings show that not only do students take more responsibility for preparation for class, but the instructors also have to design learning activities such as case study to engage students in the FC.

Conversely, Bingen et al. (2019) reported that many students appeared to be dependent on social assistance. They might not be ready for taking full responsibility to study adequately by themselves in a flipped physiology course in a Norwegian university college. Students reported that memorization was a frequently used strategy when preparing for tests in high school and they experienced the transition from high school to university college as challenging. Bingen et al. (2019) found that the students might have resisted adopting these active learning strategies because their old passive learning strategies required less effort. They suggested that more time could be allocated to facilitate the students to adapt to being university college students and

self-regulation strategies could be introduced before the course.

Similar results were reported in the qualitative multiple-case study of Harris Ware & Benson (2019) on 2 undergraduate nursing courses at 2 institutions in the USA. They reported that the student role was shifted in the flipped learning environment which requires more instructor support. Students in both cases pointed out the work commitment increased in the FC. Case A was a 10-week flipped nursing mobility course at a community college and the instructor with 13 years of teaching experience. Case B was an 8-week flipped nursing pharmacology course at a private institution and instructor with 4 years of teaching experience. The study does not describe any difference in the types of FC teaching between case A and B. Case A students noted time management skills was the key to success in the FCM; Case B students identified more self-learning is required. These findings show that the FC involves skills that are not required in the TC setting.

Similarly, Hessler (2019) reported that graduate students were anxious when they were exposed to a new instructional approach. Nursing students usually have a traditional view of didactic learning. The instructional change can bring them a feeling of confusion and a lack of security in the learning process. They indicated that they could be more passive and require less effort in the TC whereas they were required to have time commitment and active learning in the FC. However, they revealed that the FCM allowed them to apply the knowledge through the interactive activities which promoted a deeper learning when compared to the TC.

These findings show that students with different levels also require time and support to adapt to changes in instruction. As mentioned earlier, to engage the students in a new instructional approach, it is important for the instructor to provide orientation, feedback and support to the students as well as to design and deliver high impact learning experiences for the students.

Support for this comes from a calculus study of Cronhjort et al. (2018). The engagement survey showed that students felt more engaged in the FC than in the TC. The items that differed most between the two groups showed that the teacher-student relationship was the most significant difference regarding engagement. Students appreciated more instructor interaction and feedback in the FC. These teacher-student interactions may boost student's sense of belonging and a greater connection to the learning environment. The social aspects of peer in the FC seemed to improve student learning.

Similar results were reported in the study of Gilboy et al. (2015) on flipping an undergraduate nutrition course. 142 students (72%) completed the surveys about students' perceptions of FC before and during class. Five survey items included how students felt

connected to the teacher with FC; student preference on watching the video lecture, student preference on participating in the in-class activities; the effectiveness of learning by viewing the video lecture; how they use the materials in the FC. A majority of students (70%) felt connected to the teacher with the FC. Over three-quarters of the students (76%) preferred watching the video lecture over face-to-face lectures for the topic. A majority of students (64%) would rather participate in the in-class activities rather than listen to an expert for the same amount of time. 62% of students agreed that they learned the material more effectively by viewing the video lecture rather than face-to-face lecture. 56% of students thought they learned how to use the materials for each topic more effectively using the FC format.

2.5.4 Emotional engagement

Emotional engagement refers to satisfaction and feelings such as interest, boredom, happiness, sadness and anxiety in the course. Overall, use of the FCM in higher education nursing program yield a mixed picture for interest, feelings and satisfaction.

First, several studies indicated positive feedback with satisfaction and FC. In the studies of Hanson (2016) and Pence (2016), students felt the videos enhanced learning and they were satisfied with the FC. Xu et al. (2019) conducted a meta-analysis that considered data from Chinese nursing education published in Chinese journals. Six studies reported the degree of enjoyment of the FC and fifteen studies reported the participation interest. The FC increased the students' enjoyment of the course (effect size = 1.39, 95% confidence interval 0.81-1.97) and the participant interest (effect size = 1.58, 95% confidence interval 1.28-1.87).

In the aforementioned study of Oh et al. (2017), students in the FC reported positive effects (above the middle degree) of satisfaction (3.78 ± .35) in the 5-point Likert questionnaire. The most student satisfied items were related to learning activities and the instructor's materials. Students experienced the FC as intellectual, interesting, and stimulating.

Moreover, in the aforementioned study of Joseph et al. (2021), students in the FC filled in the online questionnaire anonymously. 75% of students agreed or strongly agreed that the FCM increased their interest in the course.

Similar results were reported by Kim & Jang (2017). The flipped group received higher satisfaction levels than the control group ($p < .001$). Kim & Jang (2017) found that being able to try learning strategies that match their learning styles and being given an opportunity to apply their pre-class learning in class promoted students' satisfaction. Pre-class and after-class problem solving required students to take responsibility for studying adequately by themselves

and exercise independence. Students with diverse inclinations seem satisfied with the variety of the flipped learning teaching methods. They also revealed that students likely felt more comfortable with the instructor's facilitation of peer interaction to understand the course content than a lecture in a traditional class. This corresponds with the results of the aforementioned study of Cronhjort et al. (2018). Again, the design and implementation of learning activities as well as the teacher-student interaction and peer interaction in the FC will affect student satisfaction.

Second, several studies reported that the students were initially dissatisfied with FC, but they subsequently appeared more satisfied over time. This may be related to the student adapting to the FC over time or a smoother student transition from passive to active learning approaches. Such incremental changes were observed in the studies of Greenwood & Mosca (2017), Ratta (2015) and Simpson & Richards (2015).

In the aforementioned study of Greenwood & Mosca (2017), students felt dissatisfied with the FC when it was first implemented in the nursing program. Students initially seemed to struggle with the absence of a teacher-centered classroom. Later when the FCM had been adopted in multiple courses, students barely complained. In retrospect, the transition may be smoother if more courses have used this approach as well as the instructors could have allocated more time to the explanation of the FCM. This is in agreement with the results of Puppe & Nelson (2019) and Ward et al. (2018), who found where students were provided with a further detailed rationale for instructional change this increased their satisfaction and engagement in the FC.

Similarly, in the aforementioned study of Ratta (2015), students' score on standardized examinations were higher than those in previous classes. However, most of the initial feedback from students was negative, but final student feedback was more positive. This may again be related to a smoother transition from passive to active learning approaches in the FC. Ratta (2015) did not describe the items which student were unsatisfied with. Ratta (2015) found that student satisfaction was not an important indicator of learning because satisfaction was unrelated to grade.

In the aforementioned study of Simpson and Richards (2015), students initially felt frustrated by pedagogical change but later in the course were positive about the change. Some students felt overwhelmed with pre-class work. A majority of students indicated in the satisfaction survey that they could control the pace of learning in the FC, bringing a sense of responsibility for their own learning. They also reported that the active learning environment increased interaction and engagement. Reliability and validity were not addressed for the

university-based course evaluations.

Third, in some studies, the students were overall dissatisfied with the FC. In the aforementioned study of Missildine et al. (2013), although the average grade scores were significantly higher (p <.001) for the flipped group compared to the traditional lecture group and lecture capture group, students were significantly less satisfied with the FCM compared to the other two groups (p <.001). To the student, class activities were without value and they have to make a substantial time commitment in the FC. This agrees with the result of Ratta (2015), in that student satisfaction may not be a useful indicator of learning.

Further, in the study of Post et al. (2015), three focus group interviews were conducted regarding the FCM compared to the TC. They found that students feel frustrated because they were not able to ask questions and they felt disconnected from the use of videos. They felt depersonalized because of their different learning styles and slow internet connections.

To conclude, when students feel frustrated, overwhelmed by pre-class work and find less value of the in-class activities, they are less likely to engage themselves in a new instructional approach. Instead, to increase student satisfaction and engagement in the FC, student orientation, instructor support and feedback as well as various learning activities which can enhance student learning experience should be provided.

2.6 The use of flipped classroom during the COVID-19 pandemic

The COVID-19 pandemic has increased the number of digital developments in higher education. First, as the crisis began, in many instances face-to-face FC was moved to an online flipped format. The online FC, in a similar way to the face-to-face FC, consists of pre-class work, followed by interactive activities during class. The difference is that in the online FC, students do not meet face-to-face inside the classrooms, but rather in synchronous online meetings (Jia et al., 2022). For example, students can post their ideas and discuss with peers and the instructor using the features of Zoom, such as breakout rooms, screen sharing, the chat box, the raising of virtual hands and polling. Divjak et al. (2022) conducted a systematic review of online FCM in higher education during the pandemic. They reported that those who had employed FCM in face-to-face learning environments more successfully continued to apply online FC unlike those who had not employed it before.

Further multiple studies have indicated that in courses which have already used FC before the pandemic, they are likely to be able to conduct the course fully online with minimal

adjustments (Attarabeen et al., 2021; Collado-Valero et al., 2021; Jia et al., 2021; Liberman-Martin & Orgba, 2020; Veldthuis et al., 2020). In a systematic review of the effectiveness of FC in nursing education, Barranquero-Herbosa et al. (2022) reported that the level of technological competence of instructors was important for implementing successful FC. The factors related to instructor dissatisfaction included the need for significant time investment to prepare materials and more technological support. For students, students' interest levels remain high in online FC (Jia et al., 2021) and they are even generally more satisfied with online FC (Veldthuis et al., 2020).

Furthermore, during the worldwide COVID-19 pandemic, the quality of learning experience in health professional education changed suddenly, faced by major restrictions. Students' presence in the clinical setting was reduced to a bare minimum and face-to-face teaching was diminished. Online learning was therefore used increasingly as an alternative and feasible approach for health professional training (Schmitz et al., 2021). Sezer and Esenay (2022) conducted a quasi-experimental study with undergraduate nursing students in a one semester pediatric course in Turkey. Due to the COVID-19 pandemic, both theoretical (12-hour/week) and practical classes (164-hour) were conducted online, with no significant differences in critical thinking skills shown between the online FC group (n= 32) or the online TC group (n=31).

Conversely, Lanahan et al. (2022) reported that the transition from live in-person education to entirely online learning during the pandemic resulted in feelings of unpreparedness. 103 participants, including nursing students and those with less than two years of experience, completed the Casey-Fink 'Readiness for Practice' Survey (Casey et al, 2011). There was a significantly reduction in reported levels of comfort in performing common nursing skills independently ($p<0.001$) and decreased comfort was reported when caring for a multiple patient assignment ($p<0.05$). Moreover, internet accessibility and affordability seemed negatively affected by the online delivery of nursing courses in some developing countries during the COVID-19 pandemic (Agu et al., 2021). Overall, although there are some possible limitations of online learning, FCM may provide a robust instructional method in a crisis like that experienced with the COVID-19 pandemic or in case of future urgent school closures (Jia et al., 2021). An effective online learning design, especially high-quality video and collaboration in online flipped courses can be a successful formula to fill the need for remote learning (Veldthuis et al., 2020).

Second, diverse practices regarding the implementation of FC with e-learning approaches during the pandemic have been increasingly reported. The FC combined with other

approaches, like problem-based learning and game-based learning, has proved to be a successful combination for some study fields such as medical education (Portela, 2020; Ng & Lo, 2022; Schmitz et al., 2021). For example, in the study of Wang et al. (2022), 75 ophthalmology postgraduates in China were randomly divided into problem-based learning FC and TC groups. Problem-based learning FC group's post-class theoretical performance was significantly higher than the traditional group's (86.11±7.08 vs 79.10±8.95, p<0.001). There was no statistical difference between the groups regarding skill performance. Moreover, Ng and Lo (2022) conducted a mixed-methods study of a combination of FCM and game-based learning with 68 postgraduate business students in China. Three instructional methods were applied in a 10-week course. They found that the gamified TC group had significantly higher assignment scores compared to the non-gamified FC group (p=0.004). The class observation reports and student interviews revealed that the gamified FC group had the highest level of engagement in term of level of participation.

Third, more studies determine the effectiveness of the FC on other related variables such as self-directed learning besides student achievement which is most frequently measured. Khodaei et al. (2022) conducted a quasi-experimental single-group study with pretest-posttest design on 34 sophomore nursing students who studied in an 8-week online FC in Western Iran. They found that students had a significant improvement in self-directed learning (p<0.001) and metacognitive awareness (p<0.03) compared to before the intervention. Nepal and Rogerson (2020) and Divjak et al. (2022) recommended that future research could focus more on investigating the effectiveness of the online FC for different courses and contexts and the student's cognitive and emotional engagement in the FC to inform policy-decision in enhancing student engagement.

2.7 The use of flipped classroom in local higher education during the COVID-19 pandemic

In addition to the studies conducted in higher education worldwide previously mentioned, the FCM has recently been commonly applied in higher education in Hong Kong due to the COVID-19 pandemic, with a majority of the studies conducted on undergraduate courses. In the study of Ha et al. (2019), 5 themes emerged from three 60-min focus groups conducted with a total of 13 flipped students, and five 30-min individual interviews conducted with 5 teacher educators at a public university in Hong Kong. Three themes to emerge were

about the benefits of FC for students, including enhancing perceived competence, providing a foundation and platform for in-depth learning and providing flexibility and triggering students' motivation for self-learning. Two further themes highlighted the start-up facilitating strategies and implementation strategies used. They found that Hong Kong students were traditionally more used to a spoon-fed approach and required a drive to help them adapt to active learning in the FC. A frequently mentioned strategy by students and instructors was to link specific elements, e.g., pre-class work to assessment. The instructor commented that only half of the class completed the pre-class work without such a linkage, a finding which echoed a previous study by Kwan (2017). Here two cohorts (n=80) completed a flipped nursing therapeutics course in a public university in Hong Kong. The findings revealed that giving timely reminders and incentives, for example setting some pre-class materials as exam questions, improved students' participation. The completion rate of pre-class work increased under these conditions from 40-50% to 70-80% compared to the previous cohort.

To facilitate student online pre-class learning, Lu et al. (2021) applied an augmented reality (AR) app in a year 4 undergraduate chemistry flipped course at a public university in Hong Kong. By reading through self-learning materials in the AR before class, students were free to review unfamiliar topics like hazardous chemicals in the household. After using the AR, 37 students out of 46 (80%) completed a 20-item questionnaire consisted of 6-Likert scale items and an open-ended question. The Cronbach's alpha of the questionnaire was over 0.8 indicating a good reliability. The results showed that students generally had a positive learning attitude (M= 4.55) and satisfaction (M= 4.29) toward the FC with AR. There was a positive Pearson correlation between learning attitude and satisfaction, r =0.443, p<0.05. Students appreciated the AR as a valuable tool in the FC to allow them to be better prepared and show deeper understand the content before class.

Similarly, spherical video-based immersive virtual reality (SV-IVR) was adopted to support the pre-class learning of education students in a public university in Hong Kong (Jong, 2022). 3 out of 10 classes were conducted using FC with SV-IVR. Students could access three 15-minutes SV-IVR clips of real-time recording of authentic Grade 10 lessons using their mobile phones and the provided cardboard goggles. 176 out of 188 (93.62%) completed a 20-item questionnaire using a 5-Likert scale. The Cronbach's alpha of the questionnaire was 0.89 indicating a good reliability. The results indicated that students positively perceived SV-IVR as having desirable motivational affordances in terms of attention (M=4.17, SD= 0.99, p<0.001), relevance (M=4.20, SD= 1.18, p<0.001), and satisfaction (M=4.08, SD= 1.07, p<0.001) but not confidence (M=2.98, SD= 1.27). Participants in the semi-structured focus

group appreciated that the immersive pre-learning tasks situated them in authentic classroom contexts and facilitated peer discussions in the in-class stage of FC.

The abovementioned studies revealed that students had to be motivated and well prepared to participate actively in the FC. This finding echoed those in the study of Wut et al. (2022) on undergraduate business students in a university in Hong Kong. This study revealed that the intention to participate in the FC setting was associated with readiness. The readiness components included technology readiness, self-directed learning and motivation. If students knew how to participate in a FC, their intention to join the class appeared to be higher. The study also suggested that the ideal length of a pre-class video was around 15 minutes for optimal effectiveness, with the video divided into several clips if it had too much content. The study also suggested that artificial intelligence such as chatbots could be used to support students' pre-class learning. Students sometime had their questions during pre-class learning and some felt pressure to ask instructors, especially Asian students. Chatbots can answer students' question frequently and promote communication in the pre-class stage.

Due to the pandemic, two conventional FC in Fall 2019 (n=23; n=25) were transformed into fully online FC in Spring 2020 (n=26; n=25) at the Faculty of Education of a public university in Hong Kong (Hew et al., 2020) and the impact of the intervention was evaluated. There was no significant difference in the final marks of the conventional flipped (course 1: M=65.04; course 2: M=83.4) and online flipped classes (course 1: M=66.0; course 2: M=83.25). Qualitative analysis of student and staff reflection data identified seven good practices for online FC. These included muting participants' microphone when not speaking, switching on participants' webcams, management of the pedagogical change, use of a mobile instant messaging app such as WhatsApp's or WeChat to foster quicker online response and asking questions, use of a variety of presentation media and activities to sustain student interest.

Besides, Lo and Hew (2022) conducted a systematic review on fully online FC in health professionals' education during the first 2-year of the COVID-19 pandemic. The majority of the reviewed studies were conducted at the undergraduate level and in the United States. They identified various useful elements for online FC practice including cognitive presence (e.g., application of knowledge/skills), social presence (e.g., peer interaction), teaching presence (e.g., instructors' real-time demonstration/facilitation), and learner presence (e.g., care and emotional support). The challenges of online FC were broadly categorized into student-related challenges (e.g., unfamiliarity with online FC), faculty challenges (e.g., increased workload), and operational challenges (e.g., students' technical problems). Based on the findings, nine effective practices for online FC were recommended by the study..

Moreover, Chan et al. (2021) conducted a quasi-experimental single group study, with a matching pre- and posttest design on first-year undergraduate nursing students in a public university in Hong Kong. 5 out of 13 lectures were conducted using the FCM in which 30% of the class time was spent on mini-lectures and the remaining 70% on guided discussion, e.g., breaking down a long lecture into several mini-lectures and supplementing them by interactive learning activities. 139 out of 200 (69.5%) paired pre- and post-questionnaires of generic capabilities and metacognitive awareness were received. Significant improvements in critical thinking ($p < 0.001$), creative thinking ($p = 0.03$), problem-solving ($p < 0.001$) and communication skills ($p = 0.04$) were found. Significant changes were also noted in knowledge of cognition ($p < 0.001$) and regulation of cognition ($p < 0.001$) in the metacognitive awareness scales.

Furthermore, Jia et al. (2022) conducted a mixed methods study on students enrolled in an 8-week course at the Faculty of Education of a public university in Hong Kong. Due to the pandemic, 24 students received online FC teaching while 25 students in the previous cohort had experience a face-to-face FC experience. The results showed no significant difference in students' final grades between the two groups. The results of student survey and interviews suggested five key factors that could help engage students in online FC including interaction, active learning with feedback, problem-solving learning supported by clear explanations and real-life examples, different types of learning activities and teacher attributes such as humor, caring, commitment, and knowledge. Similar conclusions are reached in a study by Ng (2021), who reflects on an initiative she led as an academic developer in collaboration with six teachers across different faculties in a public university in Hong Kong. She found that the FC's success was due to the appropriateness of content and teachers' pedagogical knowledge, rather than just their technological competence.

To summarize, the findings of those local studies of FCM were consistent with other studies in flipped nursing education as mentioned in Section 2.3.1, Section 2.3.2 and Section 2.5.4. For example, giving support and incentive to promote student's pre-class preparation; appropriate content and amount of pre-class work to avoid overwhelming student; various interactive activities such as interaction and problem-solving to engage students in the FC; and instructor commitment and feedback can all enhance student flipped learning experience.

2.8 Discussion and Implications for research and practices

This literature review offers some suggestions for the current study. FCM has the potential for engaging undergraduate nursing students and promoting academic achievement. Further research is however needed to investigate the effect of FCM on associate degree of nursing studies students. The current review indicated the implementation challenges. For instance, poor student preparation prior to class would lead to poor engagement in the classroom (Long et al, 2017). The variability of student preparation for in-class learning would be higher when students do not complete pre-class work (Puppe & Nelson, 2019). This brings extra learning challenges of the already diverse first-year student cohort, especially in a fundamental course with large classes.

Based upon this literature review, 5 recommendations for boosting future practice are developed (and summarized in Table 2.5). These five recommendations will be adopted in the pilot and main study (See Section 3.2.2 for details). First, the instructor can reduce student frustration with instructional change by good communication with students about the objectives and routines of FC as well as the expectations of pre-class work. Second, appropriate amounts of pre-class work should be assigned to avoid overwhelming student's workload. As aforementioned practices in flipped nursing education, the instructors could use a series of shorter videos instead of one longer presentation and create one recording per topic. Thirdly, online low-stakes assessment can be embedded after students watch the videos to ensure individual student accountability for class preparation.

During class, the instructor should communicate with students their academic directions and expectations such as in-class engagement activities. This is crucial because the spirit of the FC is to engage students in application of knowledge in the class with the instructor and peers' support. Fourthly, to reinforce their learning from pre-class activities, students can perform some revision exercises such as clicker questions. Fifthly, to motivate students' class participation, case-based discussion and group work can be used. The instructor can perform a quality check by going around the room and evaluating student work promptly. In the literature students perceived the value of this work and were willing to comply. Most importantly, students can conduct some activities for real-world application of learning content to enable them to realize the relevance and feasibility of what they learn.

Table 2.5 Recommendations for implementation of flipped classroom

Period	Recommendations
At the beginning of flipped class	1. Good communication with students regarding the objectives and routines of the flipped class as well as the expectations of pre-class work to reduce students' frustration with the change of instructional approach.
Pre-class preparation	2. The instructor should assign appropriate amount of pre-class work to avoid overloading students. 3. Online low-stakes assessment can be embedded after the videos to motivate student's pre-class preparation.
In-class learning	4. Fundamental exercises can be offered to reinforce student learning from pre-class activities. 5. Problem-solving and group activities which encourage student in-class participation and real-world application of educational content.

2.9 Limitations of existing studies

In their systematic review of FC in undergraduate nursing education, Betihavas et al. (2016) reported that there was a lack of evidence on FCM in nursing education compared to other health professionals. Most such studies were conducted with undergraduate students. Thus, the approach was not broadly generalizable to other levels.

Meanwhile, student engagement of FC is still underexplored in Asian nursing education. As mentioned earlier, student engagement is a key concept for the learning process. Further studies involving nursing studies students are needed to enhance the understanding of their engagement in FC. Furthermore, most studies published are conducted in the United States. Thus, they may not capture the effect of FCM on non-American (e.g., Asian) students. Further study is required to examine the effect of using FCM in nursing education outside the United State.

2.10 Summary

This chapter has reviewed previous studies of the flipped classroom, showing instructional video as a common form of pre-class activities, while in-class activities are dominated by problem-solving and collaborative activities. This chapter summarized the research findings on the benefits and challenges of the FCM. This review focuses on student achievement and student engagement under FC in comparison to the traditional classroom. The findings suggested that use of FCM in undergraduate students in both non-Asian and Asian contexts yields neutral or positive effects on students' academic achievement. In terms of the student engagement, the FCM can enhance behavioral engagement and cognitive engagement, whereas it yields mixed results in emotional engagement. Overall, student orientation as well as the design and implementation of learning activities in the FC will affect student achievement and engagement. Based upon the results of the literature review, five recommendations for improving future practice are constituted which will be adopted in this study. Furthermore, most studies focus on undergraduate nursing students. More research is therefore needed to investigate the impact of FCM on associate degree nursing.

Chapter 3 Research Methods

3.1 Introduction

In the last chapter we looked at the literature around the topic of the flipped classroom and particularly in nursing education. From this literature review we identified a gap in the literature in terms of the use of flipped classroom with associate nursing studies students which our study will address, and in this chapter we will discuss the methods we require for our study. First, this chapter presents the research philosophy and methodology, the research design, and the mixed methods approach to be used (Section 3.2). Second, it will describe the research setting and participants for the study (Section 3.3) and intervention (Section 3.4). Third, the data collection (Section 3.5), the data analysis (Section 3.6), the validity and reliability (Section 3.7) and ethical consideration (Section 3.8) of the study are discussed. Finally, the chapter describes a pilot study that is to be carried out (Section 3.9) before finishing with an overall summary (Section 3.10).

3.2 Methodology

3.2.1 *Post-positivism*

Guba and Lincoln (1994) suggested that research paradigms can be epitomized through the philosophical assumption of ontology, epistemology and methodology. A researcher's ontological assumption concerns the nature of reality. Positivism assumes that an objective truth exists "out there" to be discovered and there is a single reality. In contrast, constructivism assumes that the truth is relative, the reality is constructed by individuals and therefore there are multiple realities (Crotty, 1998). My past nursing training leads me to the former because as a nurse I work in the health science world which is scientific, governed by natural laws "out there" to be discovered by the researcher. I therefore believe that knowledge is gained through scientific and experimental research, it is objective and measurable.

My research on the flipped classroom will therefore be done from a post-positivist perspective. Post-positivism is concerned with the fact that the reality that is assumed to exist

can be only imperfectly appreciated because of the fundamentally intractable nature of the phenomena and the limitation in the inquiry methods (Guba and Lincoln, 1994). I believe in facts. In my ontological assumption, I believe that the flipped classroom may have certain effects on a students' learning. However, the effect of the flipped classroom depends on students' characteristics (See section 1.5.1), adding uncertainty to the problem. Therefore, it is impossible to regard the students as simple physical objects in deducing the effect of the flipped classroom on them, despite the objective existence of such an effect. There is no rejecting the concept of objective reality but instead there is belief that the researcher and the study participants are interrelated and interactive.

Correspondingly, my epistemological assumptions, which deal with the nature of knowledge, are similar to those of the "modified objectivist", in which the reality can be known but only approximately and incompletely whereas the findings are probably true. According to Guba and Lincoln (1994), these are the philosophical assumptions of post-positivism. These assumptions challenge the pure positivism stance which assumes objective and absolute truth and uses quantitative methods to observe and measure the data. In the natural sciences, the researcher can control and manipulate the conditions (variables), implement an intervention and measure the outcomes. In this study, although I could examine the effect of the flipped classroom, it is impossible to control and manipulate all conditions. Therefore, the causality between the conditions and outcomes of an experiment are difficult to determine.

Thus, apart from conducting an experiment in the natural sciences, Guba and Lincoln (1994) stated that post-positivism allows inquiry in a more natural setting, using exploratory approaches as an element of the inquiry and soliciting both quantitative and qualitative approaches. In this study, therefore both quantitative and qualitative date will be collected. In a convergent parallel mixed-methods study, the data are compared for agreement and disagreement whereas qualitative data are used to explain the quantitative data in the explanatory sequential mixed-method (Creswell & Plano Clark, 2011). The mixed methods design used is mentioned in section 3.2.2.

3.2.2 Research design

In this study, a quasi-experimental research design will be used to investigate the effects of two instructional approaches on student achievement. A student engagement survey and focus group are then used to examine student engagement under flipped learning. Students

from the two groups (e.g., traditional and flipped classes) will participate in a 12-week nursing fundamental course. The two groups will be taught by the teacher researcher (who has over 15 years of clinical and teaching experience) and both sets of course materials to be used are identical. The only difference between the two groups is the instructional approach (independent variable): traditional and flipped classroom (Table 3.1).

Table 3.1 Instructional approaches for two research groups

	Instructional Approaches	
Major instructional activities	Traditional Classroom (TC)	Flipped Classroom (FC)
Pre-class	No pre-class work	Students gained basic knowledge prior to class through pre-recorded videos, pre-readings and online follow-up exercises.
In-class	Most of the in-class time is used for teacher-directed lecturing on both basic and advanced materials. A small amount of time is spent on problem-solving exercise and group discussions.	Doing fundamental exercises and reviewing pre-class learning, then advanced material is delivered in mini-lectures The in-class time is mainly spent on knowledge application, problem-solving exercises, group discussions, feedback from peers and instructors. Class activities include clicker, case study and group presentation
After-class	Assign the problem-solving exercises as assignment	Extend problem-solving skill through assignment

The students in the TC will learn in a traditional lecture-based classroom. The students will have the objectives and routines of the course explained to them (e.g., the outline of learning activities) at the start of the course. Students will attend face-to-face lectures (180 minutes) and finish the case study assignment at home (60 minutes). The case study assignment will be related to a real-world application. Teacher-directed lecturing on both basic and advanced topics are the major in-class activities (150 minutes). The remaining in-class time will be spent on problem-solving activities and asking questions (30 minutes).

The students in the FC will learn in a flipped course with interactive activities. In Chapter 2 through the literature review we identified a series of strategies relevant for optimal implementation of the FCM. These strategies will be adopted in this study (Table 3.3). For example, at the start of the course, the objectives and routines (e.g., how to access pre-class learning materials, and descriptions of how class time will be used) of the flipped course will be introduced to the students (Strategy 1). Too much pre-class work will be avoided (Strategy 2). Table 3.2 shows that the students will review basic knowledge through the pre-recorded videos and doing online follow-up exercises (approximately 30-40 minutes) prior to class (Strategy 3).

In the 180-minute face-to-face class, the students will first work on a fundamental exercise through an audience response system (15 minutes) to reinforce their pre-class learning (Strategy 4). These exercises cover the key concepts of the pre-class learning materials. Based on the students' performance, a brief review of the exercise and recall of the basic knowledge (15-20 minutes) will be offered. Then, advanced topics will be explored through mini-lecture (15-30 minutes). Most of the in-class time will be used for problem-solving exercises, group discussions, peers and instructor feedback (120 minutes). The students can then work in self-selected groups of three to five classmates on some problem-solving exercises which are connected to real-world application (Strategy 5) (Walker et al., 2020).

Table 3.2 Implementation of Flipped classroom

Outside Class	**In-class**
Online individual activities	In-class individual and group activities
Watch a series of pre-recorded videos for basic concepts (10-15 min each video)	Discuss unsolved questions and feedback on the learning exercises/ Fundamental exercise to link the pre-class stage and in-class stage (15 min.)
Pre-reading (5-10min.)	Mini lecture to recall basic concept (15-20 min.)
Complete the follow-up exercise (for students' self-evaluation and instructor's adjustment of teaching plan) (10 min.)	Doing activities of question-answer discussion, concept mapping, case studies and provide peer and instructor's feedback (60 min.)
	Mini lecture to elaborate advance topic (15-30 min.)
	Role play, group discussion, case studies, and provide peer and instructor's feedback (60 min.)
Evaluation: Assignment, Quiz and Final Examination	

Table 3.3 Examples of the Strategy of Flipped Classroom in this study

Period	Strategy
At the beginning of flipped class	1. Introduce an orientation for the objectives and routines of flipped class to reduce their frustration with new instructional approach.
Pre-class preparation	2. Assign appropriate amount of pre-class work to avoid overloading students. 3. Embed some online exercises after the videos to motivate student's pre-class preparation.
In-class learning	4. Offer some fundamental exercises to reinforce student learning from pre-class work. 5. Conduct some problem-solving and group activities which encourage student in-class participation and real-world application of content.

In the TC conducted in the research College, each session includes a 3-hour lecture and 6-hours of self-study. The FC, similar to the TC, includes equivalent lengths of lecture and study. The difference is that in the FC, students are informed that 30 minutes of their 6 hours of their study time will be moved to pre-class learning for each session, although it needs acknowledging that there is no guarantee that the students now only take 5.5 hours of self-study on top of the pre-watching. Simultaneously, the spirit of the FCM is to shift lectures to homework status, releasing in-class time for interactive activities (Bernard, 2015; Chung et al., 2019). As mentioned in Section 1.2, the FCM allows more in-class time for activities instead of direct lecturing in the TC. In the TC, the instructor can spend only limited time on class activities after covering all the content (Al-Mugheed & Bayraktar, 2021; Geist et al., 2015). The question is however does using FCM, moving the lecture outside the class to free class time for activities, really help students learn better?

3.2.3 Mixed methods approach

Creswell & Plano Clark's (2011) explanatory sequential mixed methods design (explanatory design) will be employed in this study. The explanatory design allows the researcher to implement the quantitative and qualitative strands in sequence, which in turn further elaborates initial quantitative data by then using qualitative data to explain findings. In the quantitative strand, the quantitative data such as assessment scores will be collected and statistical analysis will be used to demonstrate the group differences in students' academic achievement. In the qualitative strand, the more qualitative data such as student engagement survey response and student interview data will provide more understanding of students' learning experience. The researcher can then use the qualitative data to explain initial quantitative results such as any group difference in student achievement. This will hopefully then enable instructors to draw meaning and guidance for designing the FC in the future.

3.2.4 Procedures for implementing explanatory design

According to Creswell and Plano Clark's (2011) suggested explanatory design, the sequence of the data collection in the study is quantitative followed by qualitative, with more weight being on the quantitative strand (Table 3.4) In this study, the qualitative data from student survey and interview will only be used to explain initial quantitative data from

academic performance. In fact, as the qualitative data in the survey is available for the whole cohort this data has been categorized and analyzed quantitatively via descriptive statistics whilst thematic analysis is used for the richer interview data. The study will work as follows: In phase one, various quantitative data are collected to answer the first research question regarding student achievement. This data includes pre/post-tests, assignment, quiz and final examination scores, attendance rate and pre-class activity records and survey responses (student survey using a 7-point Likert scale at the end of the course). In phase two, the quantitative data is then analyzed. Here comparison is made between the pre/post-test within group and between groups. Comparisons will also be made of assignments, quiz and final examination scores between groups. Parametric tests (independent t tests) are to be used when the data meet the parametric assumptions, otherwise Mann-Whitney U-tests will be used. These tests examine any group differences for statistical significance and are supported by descriptive statistics from the student survey.

In phase three, based on the quantitative results (significant, non-significant, outlier) the precise format of the qualitative data collection will be designed. The original plan was to recruit six participants (2 of each with high, middle, low examination scores) to form a semi-structured focus group. However, following the pilot study, it was felt better to arrange a second focus group to hear different voices. The interview questions will be refined depending on the results of the assessment scores and student survey. In phase four, the qualitative data is to be collected from a single, 60-minute, semi-structured, focus group interview. In phase five, the qualitative data will then be analyzed. The qualitative data will be transcribed and coded and themes developed. In phase six, the result of both datasets will be interpreted together. These 6 phases will be conducted in the pilot study to inform feasibility and identify modifications required for the main study.

Table 3.4 Procedures for implementing explanatory design

Phase	Procedure
Phase 1 QUANTITATIVE Data Collection	- pre/post-tests - assignment, quiz, final examination - attendance - pre-class work study record in Learning Management System in the FC group (access frequency, study time on pre-recorded video) - survey responses in the FC group (student survey using a 7-point Likert scale completed at the course completion and some open-ended questions)
Phase 2 QUANTITATIVE Data Analysis	- Compare the pre/post-test within group and between groups - Compare the assignments, quiz and final examination scores in two groups of students. Using the parametric test (independent t test) or non-parametric test (Mann Whitney U test) depending on distribution. - Descriptive statistics of the student survey using a 7-point Likert scale, attendance rate, pre-class work record in Learning Management System in the FC group - Categorisation of the open-ended survey questions and descriptive statistics
Phase 3 Connection QUAN and Qual	- Design the qualitative content based on the quantitative results - Determine two focus group of participants. Each group with six participants (two with high, middle, low examination scores respectively) to be selected for the qualitative sample - Refine the key topic of the student focus group interview guide
Phase 4 Qualitative Data Collection	- 60 minutes single, semi-structured, focus group interview
Phase 5 Qualitative Data Analysis	- Transcribe interview data, coding and emerging themes of qualitative data from the interview responses
Phase 6 Interpretation of the connected results	- Explain quantitative results based on qualitative findings

3.3 Research setting and participants

The participants for this study are the students of the first-year associate degree of nursing studies in a community college in Hong Kong SAR. The chosen sample is a convenience sample because the student population is available to the researcher (Figure 3.1). The convenience sample consists of 271 first-year associate nursing studies students who are enrolled in nursing fundamental course from two academic years, of whom 141 are in the traditional class (2019-2020) and 130 are in flipped class (2020-2021).

As historical data such as demographic and assessment data were available, and to avoid any ethical issues of allocation to different teaching, all students in the year of the study were allocated to the FC group and the historical data from last year's cohort was used as the TC group. This made the project feasible but had the disadvantage that no interview data was available for the TC group.

At the time of study, there had been no systematic implementation of flipped classroom in the associate degree nursing course of the research college. Table 3.5 shows two research groups in the main study, including a group for traditional classroom (n = 141) and a group for flipped classroom (n = 130). The participants in the FC group have provided their demographic data such as age, gender and educational level in the demographic survey after taking written consent forms. Because the participants are not randomly assigned, prior ability levels of both groups may not be equivalent. Thus, a pre-test is used to evaluate any statistical differences in the initial ability between the two groups.

Figure 3.1 Timeline for data collection in the pilot and main study

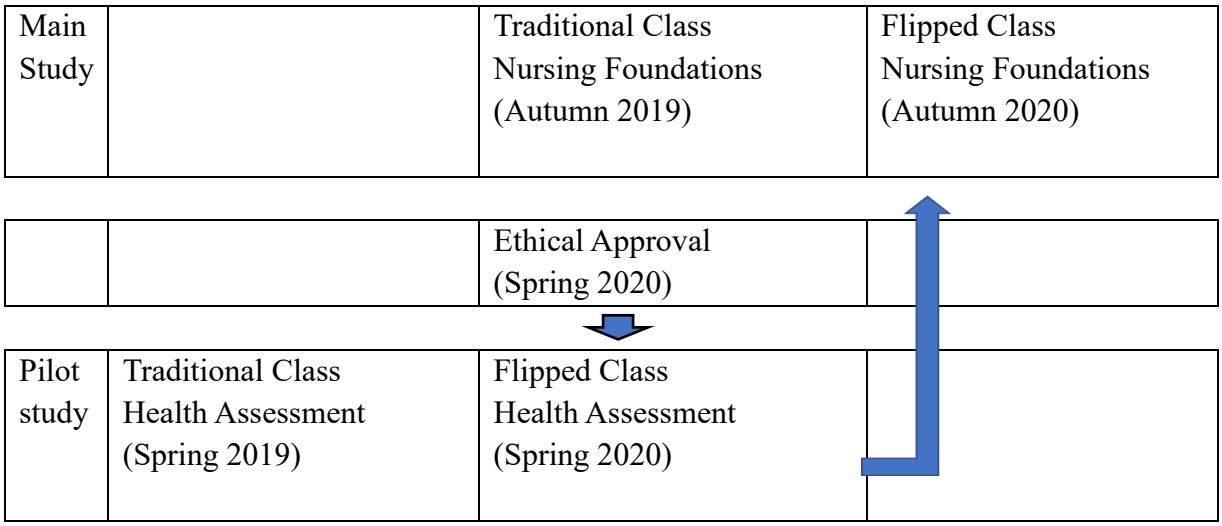


Table 3.5 Two Research Groups in the Main Study

Variable	**Traditional classroom in 2019-2020** (n= 141) **Mean (SD) or n (%)**	**Flipped classroom in 2020-21** (n= 130) **Mean (SD) or n (%)**	χ^2 *or t*	*p*
Age (years)	18.33 (0.71)	18.5 (1.59)	-1.2	>0.05
Gender Male	45 (32)	45 (35)	0.22	>0.05
Female	96 (68)	85 (65)		

The participants in this study are students on the Associate Degree in Nursing Studies in a community college in Hong Kong. An associate degree is equivalent to one-third of a 3-year university degree on the UK model or 50% of a 4-year university degree on the North America model. Graduates of associate degrees can therefore articulate to Year 2 of a 3-year university degree in the UK model or Year 3 of a 4-year university degree in the North America model (CSPE, 2017).

For the associate degree graduates, the availability of senior year undergraduate places in the publicly-funded universities provides them a second opportunity to enter a publicly-funded undergraduate programme in Hong Kong. Taking the associate degree as the first part of a university course in a community college is now an alternative path to articulate to publicly-funded senior year places of first degree or locally-accredited self-financing top-up degree programmes Moreover, by taking the second part of a university course later on, students have a pathway to pursue further study should they want one.

In Hong Kong, a two-year associate degree of nursing studies is equivalent to the first two-years of a five-year university degree nursing program. For example, HKU SPACE community college (2022), one of the largest community colleges in Hong Kong, provides a 2-year associate degree of nursing studies. It includes health assessment, human anatomy and physiology, health promotion and education, and practicum and so in the curriculum. The programmes of study are recognised as equivalent to Year 1 and 2 courses offered by nursing degree programs of publicly-funded universities and locally-accredited self-financing institutions. Credit transfer of certain courses between community college and universities is therefore permitted.

Although no data could be found to capture the difference in general characteristics between the types of students who take the courses, one major tangible difference between these two courses is their admission requirements. The minimum entrance requirements and language requirements for the undergraduate programs are generally higher than those of associate degree programs. Associate degree of nursing studies students could equip themselves in the community college which support them to pursue further study in a publicly-funded or self-financing nursing related degree program. According to HKU SPACE community college (2022), the associate degree of nursing studies provides students with basic academic and specialized training and prepares them for pursuing a nursing related degree program, with a 91% overall progression rate. Hence, an associate degree provides an alternative pathway for students of nursing studies to continue their academic journey in university. Besides, an exit qualification for employment purpose, associate degree graduates can take up jobs at elementary management and assistant professional levels. The Hong Kong SAR government has taken the lead in setting the qualifications of associate degree as one of the entry requirements of civil service grades, including ambulance officer, health inspector II, occupational safety officer II and so on (CSPE, 2017).

3.4 Intervention

The pilot study will be conducted in the course, entitled Health Assessment which aims to equip the nursing studies students with knowledge of the concept of health assessment and practice on health assessment on different systems. It is both a theoretical and practical-based course. Whereas the main study will be conducted in the course entitled Nursing Foundations which provides nursing principles of assessment and care, therapeutic communication, legal and ethical nursing. It is a theoretical-based fundamental course. Both courses provide students with the opportunity to develop their problem-solving skill in different clinical situations.

Before the flipped classroom, the instructor could reduce student frustration with instructional change by good communication with students about the objectives and routines of FC as well as the expectations of pre-class work. Because students' online attention span is shorter, the instructor used a series of shorter videos for the pre-class work (Appendix 6). To reinforce their learning from pre-class activities, online follow-up exercises were embedded after the videos. Follow up exercises can validate if students view the materials and assess how well the content is understood (Smith & McDonald, 2013).

During class teaching, the instructor communicated the academic directions and

expectations such as in-class engagement activities to the students. This is as expected since the spirit of the flipped classroom is to engage students in doing exercises or applying knowledge in the class with assistance of the instructor or peers. To motivate students to participate in class, clicker questions via a student response system were designed. More importantly, students performed some problem-solving activities with real-world applications of course content to assist them to understand the value and feasibility of what they learnt. Students were put into groups in the flipped virtual classroom and presented their work by sharing their screen. On the other hand, the in-class time in the control group was mainly spent on conducting the lecture. The instructor conducted the lecture during class and students performed the problem-solving assignment after class.

3.5 Data Collection

The data to be collected come from six main sources: (1) Pre/post-tests, (2) Assignment, (3) Quiz, (4) Final Examination, (5) Student Survey, (6) Student Focus Group Interview (Table 3.6).

Table 3.6 Data Sources in the Main Study

Data sources	Objectives	RQs addressed
Pretest and posttest	To assess students' knowledge content	1
Assignment	To assess students' learning outcomes	1
Quiz	To assess students' learning outcomes	1
Final examination	To assess students' learning outcomes	1
Student survey (Intervention group only)	To study student opinion on the flipped classroom	2
Student focus group interview (Intervention group only)	To understand student learning experience and opinion on the flipped classroom	2

As listed in Table 3.6, student's academic scores including pre/posttest, assignment, quiz and final examination are to be compared to answer RQ 1. Student survey and focus group date will be used to answer RQ 2. It needs acknowledging that in the study only academic scores are used to assess performance but that there are obviously other aspects of performance

that are harder to assess. The impact of the FC on other aspects of performance besides student academic performance could be determined in future research. In this study, it does not only depend on final examination to assess the impact, but it tries to use multiple modes of assessments in order to objectively assess students' academic performance. Moreover, it needs acknowledging that the engagement survey is only given to the FC group, and therefore the study cannot make any specific conclusions about whether the FC increases engagement in comparison to the TC. In this study, multiple data including focus groups, closed-ended and open-ended student survey response were used to gain an in-depth understanding about the students' engagement in the FC.

3.5.1 Pre/post-tests

Pre/Post-tests are to be used to determine differences within groups and between groups under two instructional approaches. A 15-min (30-min) pretest marked out of 15 marks (30 marks) in the pilot (main) study is to be conducted before the course starts. Then, an identical post-test will be conducted at the end of Week 12 in both pilot and main study. In the pilot study, the test includes 15 five-option multiple-choice questions about health assessment on different body systems. In the main study, the test comprises 30 five-option multiple-choice questions. The tests assess four areas, namely (1) nursing assessment and care, (2) therapeutic communication, (3) legal nursing and (4) ethical nursing. The test results will demonstrate the effectiveness of the two instructional approaches. To assess the initial abilities of the students in the two research groups, an identical pre-test is to be used. The pre-test paper and answers will not be returned or explained to the students to avoid cheating (e.g., circulating the test paper). The test will be designed by the author and reviewed by experienced instructors and subject matter experts. The validity and reliability of the test will therefore be ensured. The pre/post-test act as normal practice of the teaching activities in my nursing courses every year and they are not designed specifically for the research study and hence were already present for the control groups.

3.5.2 Assignment

An identical assignment for both groups is to be used to evaluate student achievement under the two instructional approaches. The assignments are different for pilot and main study and will be given to students at Week 4 in both studies. It consists of a case study for real-world

application of nursing assessment and care. It assesses student problem-solving skill. Sample case studies are practised inside the classroom. A more complicated case study will be used to extend student's problem-solving skill after class. To avoid plagiarism, all assignments will be checked for similarity when they are uploaded to the Learning Management System.

3.5.3 Quiz

A quiz will also be used to evaluate student achievement under the two instructional approaches. A 60-min quiz will be conducted at Week 6 in both pilot and main study. It consists of 60 five-option multiple-choice questions. In the pilot study, the quiz covers health assessment on different body systems. In the main study, the quiz assesses two areas: (1) nursing assessment and care and (2) therapeutic communication. The quiz results will indicate the effect of each instructional approach. College's assessment policy suggested using different quiz and examination paper to avoid cheating in two cohorts. Therefore, the quiz is different for both groups, but the scope and the difficulty level are similar. The quiz will be designed by the author. The difficulty level and objectives of each item of the quiz and final examination will be evaluated and revised by two experienced instructors. The validity and reliability of the quiz are therefore assured.

3.5.4 Final Examination

The Final examination is also to be used to evaluate student achievement under the two instructional approaches. A 120-min final examination is conducted at the completion of each course. It consists of 40 five-option multiple-choice questions and two short answer questions. The tests assess four areas, including (1) nursing assessment and care, (2) therapeutic communication, (3) legal nursing and (4) ethical nursing. The examination results will indicate the effect of each instructional approach. The examination is different for both groups, but the scope and the difficulty level are similar. The examination is designed by the author and the difficulty level is reviewed by experienced instructors and subject matter experts. The validity and reliability of the examination are therefore assured.

3.5.5 Attendance

The attendance of each student is recorded in each class. Attendance will be used as a measure of behavioural engagement. Any change in student attendance after flipping the course will be analysed.

3.5.6 Pre-class work activity record

The pre-class work study record of each FC student is tracked in the Learning Management System. The activity record includes the access frequency and study time on pre-recorded video. It will be used as a measure of behavioural engagement.

3.5.7 Student survey

For the FC group, a 15-minute online student survey (through Google forms) will be conducted to understand student engagement and opinion on the flipped classroom at the end of the course (Week 12). In the survey, both the quantitative data (e.g., 14 closed questions) and the more qualitative data (e.g., 4 open-ended questions) will be collected (Appendix 1). The survey items are adapted from Reeve's (2013) survey on engagement. The survey is used to examine three major area: (1) Behavioral Engagement (Items 1 to 5), (2) Cognitive Engagement (Items 6 to 9), (3) Emotional Engagement (Items 10 to 14). For the closed questions, a 7-point Likert scale ranges from "Strongly disagree" to "Strongly agree". The open-ended question will ask the students to share their opinions and experience on the FCM. These open-ended questions will be then categorized when major themes are identified so that popularity (percentages of responses) for each theme can be identified.

3.5.8 Student focus group interview

According to Creswell & Guetterman (2018), "interviews can provide useful information when you cannot directly observe participants and they permit participants to describe detailed personal information" (p. 218). In fact, students' feelings and how they interpret the FC are a matter which cannot be observed directly, however, it is useful to enrich the understanding of their engagement in the FC. Thus, student interview is necessary in this study.

Bryman (2016) summarized that interviews can be structured, semi-structured and unstructured. A semi-structured interview enables the interviewer to ask questions focused on the topic, but at the same time allows for variation using probing and follow-up questions Bryman (2016). In this study, the semi-structured interview will be guided by a list of questions to be explored, but also enables the interviewer to respond to the situation at hand, to the

opinion of the interviewees, and to new ideas on the topic. Thus, semi-structured interviews will be used to probe more understandings of student engagement in and opinions of the FC.

Moreover, the researcher will follow an interview guide to investigate student engagement and opinions about the FC (Appendix 2). For student engagement, the key content is designed based on the concept of engagement (Fredricks et al., 2004), including behavioural engagement (e.g., tasks completion), cognitive engagement (e.g., investment in learning) and emotional engagement (e.g., feeling). For student opinion, the interview questions ask students' opinions towards the FC, in terms of benefits, challenges, and advice for improvement.

In the explanatory sequential design of the mixed methods approach used here, the qualitative data collected are used to explain further the significance of the initial quantitative results (Creswell & Plano Clark, 2011). The interview guide will be prepared according to the results of the pre/post-test, assignment, quiz, final examination and close-ended student survey response. Based on the results of examination scores, the students in FC will be divided into three ranked groups (high, middle and low). Two students in each rank will be selected randomly for the focus group interview. In the pilot one such focus group will be used whilst two focus groups (12 students) will be used in the main study (Table 3.7). Another student in the same ranked group will be randomly selected if the first one selected declines the interview. Thus, the feedback from students with different ability levels will be considered in the selection process. Furthermore, the author will ensure that the focus group participants are not students that she will teach again in any other course in the future, in order to reduce the likelihood that any students would feel under pressure to participate.

Table 3.7 Characteristics of participants in the focus groups in the Main study

Name	Gender	Age	Educational level
Focus group 1			
Student A	M	18	first-year of associate degree
Student B	M	18	first-year of associate degree
Student C	M	18	first-year of associate degree
Student D	F	18	first-year of associate degree
Student E	F	18	first-year of associate degree
Student F	F	18	first-year of associate degree
Focus group 2			first-year of associate degree
Student G	M	18	first-year of associate degree
Student H	M	19	first-year of associate degree
Student I	F	18	first-year of associate degree
Student J	F	18	first-year of associate degree
Student K	F	18	first-year of associate degree
Student L	F	18	first-year of associate degree

The researcher will conduct the face-to-face focus group in a meeting room on campus. It will last for 60 minutes to avoid overwhelming the interviewees. To maintain confidentiality, interviewees' names will be changed in recording and reporting of data. The interviews will be conducted in Cantonese. All data are translated into English for reporting purposes. The interview will be audio-recorded and transcribed verbatim by the researcher who is fluent in both Cantonese and English. The researcher will compare written transcripts with original audiotapes to verify the accuracy. To enhance study credibility, all interviewees could review the transcripts and final report (member checking) to avoid any discrepancies.

3.6 Data Analysis

The mixed method approach in this study consists of collecting quantitative and qualitative data. This section first describes the general methods of quantitative and qualitative analysis, giving reasons for why these choices were justified. Then, it elaborates the specific procedure of both forms of data analysis and how the analysis addressed the two research questions regarding student achievement and engagement.

3.6.1 Quantitative analysis

The quantitative data includes pre/post-test, assignment, quiz, final examination scores and closed-ended student survey responses and will be analysed using the SPSS statistical software (Windows version 26.0). Prior to conducting the analysis of quantitative data (via independent t tests), parametric assumptions including normality of outcomes, identifying the presence of extreme outliers and homogeneity of variance are tested. The independent t test is appropriate if the testing revealed that the assumptions are satisfied. Although the open-ended student survey responses are qualitative due to the large number of responses and the amount of consistency across students, a quantitative approach was used to analyse them were first the responses to the specific questions were categorised into groups and then these grouped responses were reported using descriptive statistics.

3.6.2 Qualitative analysis

Qualitative data can offer a chance to explore and understand complex and multifaceted situations (Maxwell, 2013). A Qualitative approach is concerned with understanding how

people interpret their world by exploring feelings and thoughts about the lived experience. Data collected through a qualitative approach provides a more thorough understanding of student's learning experience to answer the research questions.

The remaining qualitative data are the student interviews which will be analyzed in a way that is commensurate with this approach. In particular, Braun and Clarke's (2006) six step-by-step method will be used because thematic analysis allows for a systematic way of seeing, as well as processing qualitative data using "coding". First, the researcher becomes familiar with the data by careful reading of the transcript and deciding what it is about. The researcher will print, repeatedly read and annotate the transcripts. By this means, the researcher notices things that might be relevant to the research questions and thinks about the meaning of the data (e.g., how did the interviewee feel and why might that be?)

The coding is performed to identify any data which is directly related to the research questions. This phase includes generating initial codes from reviewing the transcript, where the researcher has preliminary thoughts about what themes have emerged. Open coding is used, that is without pre-set codes and she makes a note of emerging themes. The verified transcripts are to be coded manually, that is beneficial to the researcher for immersion in the data (Braun & Clarke 2006). The coding technique is used similarly to an approach to code student learning experiences in a manual manner using paper and pen. The researcher has initial ideas about codes when she finishes step one. For example, students' feelings, engagement and their social interaction with peers and instructors in the FC might be some items that keep coming up in all focus groups and are directly relevant to the research questions. Therefore, in this example any meaningful keywords about emotional engagement such as students' satisfaction, increased interests, enjoyment, motivation and pleasure in learning would be coded. This study includes data analysis using an inductive approach to identify themes in the coding process without pre-determining them. The analysis pinpoints themes which surface from the responses given in the case of each of the interviewees and which relate to the research questions. It is data-driven inductive coding, that is the researcher mirrors interviewees' language and concepts. To undertake this task well, enough time will be assigned to complete it adequately, otherwise some crucial information may be left out (Braun & Clarke 2006).

Next, searching the themes involves sorting the different codes generated into potential themes, with some codes forming main themes or sub-themes directly. The approach requires the researcher to identify as a theme a pattern that describes something important or noteworthy about the research question (Braun & Clarke, 2006). For instance, the idea might be that there is something about the way students learn and how they interact with peers and instructors,

post-intervention, that greatly impacts their flipped learning. In this example, the themes called "peer-collaboration" and "teacher-student interaction" could capture an idea of students' social interaction with peer and instructors in the FC respectively. In this phase, the researcher starts to mark out potential emerging themes using colored pen. Data is subsequently examined line by line, with meaningful keywords highlighted and closely examined. Any pattern about students' opinion and engagement in the FC is identified. Codes with shared properties will be linked together into a theme. For example, several codes with a similar pattern such as "peer discussion", "sharing ideas", "asking help from their peers", and "working together" could be compiled into a theme called peer collaboration.

Then, reviewing themes involves re-examining and refining the themes ensuring there are no overlap. The researcher refines the findings into shared themes. The researcher collates and compares the coded themes across data from all interviews. The aim of coding is to be consistent and specific attention is given to avoid making a theme which is not directly related to the research question (Braun & Clarke, 2006). The researcher remains systematic by attending carefully to consistency throughout the coding of the interview data. The researcher completes the process with a final review of the entire dataset to ensure that the themes adopted capture the meaning of the dataset relating to the research questions. For example, the researcher might feel that a preliminary theme, "Virtual Element", does not really work as a theme. There is not much data to support it and it overlaps with another theme called "Workload of online pre-class work" considerably.

Defining themes means fine-tuning every preliminary theme with the intention of uncovering the theme. The aim is to identify the essence of what each theme is about. The researcher will define what each theme is, which aspects of data are being captured, and what is noteworthy about the themes. Microsoft Word is used to compile and condense the data analysis. This tool is flexible to sort codes and themes. In this final refinement of the themes, the researcher thinks about what the theme is saying and how the themes relate to each other. A thematic map (see Figure 5.5 for the map for this study) is developed to illustrate the relationship between themes. For instance, the course content and design of the FC might be associated with students' application of knowledge, in which students could apply prerequisite knowledge constructed in the pre-class stage in the in-class stage.

Finally, writing-up the qualitative findings. The researcher will first read, think and plan. Then the researcher writes up their findings, communicating what she already knows. The writing will be used to generate ideas, rather than simply to report them. It is through writing that analytic ideas are crystallized.

3.6.3 Student achievement

To answer the first research question (RQ1), pre/post-tests, assignment, quiz and final examination scores are to be used to compare student achievement under the two instructional approaches. First, this study is a between-groups pre-post-intervention study design. The independent t test will therefore be used to compare the two groups. For the pre/post-tests the independent variables are the two classes (control group – traditional classroom and experimental group –flipped classroom) and the dependent variables are the students' academic performance over the pre/post-tests and the improvement (difference between post and pre-test scores).

Second, for comparison of scores in the assignment, quiz, and final examination between the two groups, the independent t test will also be applied. Generally, educational researchers make the decision to reject the null hypothesis with a significance level of less than 0.05 (Field, 2013) and we use that here also. The Cohen's *d* calculation for effect size will be performed. A small effect would be considered as d= 0.2, a medium effect at d=0.5, and a large effect at d=0.8 (Cohen, 1988).

3.6.4 Student engagement

To answer RQ2 which addresses student engagement, the quantitative data (e.g., closed-ended student survey responses) and the qualitative data (e.g., student interviews) are both analyzed. First, each of the three components of student engagement (behavioral, cognitive and emotional engagement) are measured by multiple survey items in Reeve's (2013) engagement survey. The Cronbach's alpha of each component will be calculated to check the reliability of the instrument.

Second, the mean of each of the (7-point Likert scale) survey items as well as the median category are calculated to identify student rating in each component of engagement. Third, the Spearman Correlation (ρ) between engagement and student achievement will be calculated because the engagement variable is ordinal categorical. Cohen's effect size measures where an effect is small if r is around 0.1, medium if r is around 0.3, and large if r is greater than 0.5 are generally only used with Pearson's correlation so are only approximate for Spearman's correlation.

Finally, the open-ended survey questions will be categorised into consistent themes that come up in answers to each of the 4 questions individually and these will then be summarised using descriptive statistics.

After the quantitative analysis, a qualitative analysis of the student interviews will be conducted to identify any examples described by the students that are able to explain initial quantitative results of student achievement and engagement. For example, how students' learning experience in the FC affects their achievement.

3.7 Validity and Reliability

Validity refers to the researcher checking for the accuracy of the findings by employing certain procedures (Creswell & Creswell, 2018). Reactivity and researcher bias are two major threats to the validity of research (Maxwell, 2013). Reactivity refers to when participants alter their behaviour due to the influence of researchers on the research setting (Maxwell, 2013). To address the validity threat of reactivity, first, the participants are assured that their personal information will not be identified in any way from this study. Second, students' participation is voluntary, and they have the right to withdraw at any time without penalty. Third, it will be made clear that students' opinion will not affect their course grades or instructor's perception toward them. Fourth, the students are assured that they will not be taught by the researcher again in other course in the future to reduce the likelihood that they may feel under pressure to express their opinion.

Researcher bias means the possibility that researchers select data which match their personal perspectives (Maxwell, 2013). Potential bias identified includes my pre-existing knowledge of the use of the flipped classroom through the attendance of difference conferences. However, I strived to remain unbiased throughout the study. First, the mitigation of biases in this study by using open-ended questions during interview ensured the data collected is from the interviewees' experiences and supported by the recordings (Creswell & Guetterman, 2018). Second, each interviewee will be asked to verify verbatim interviews transcripts. Member checking is conducted in which each interviewee is asked to confirm the accuracy of their interview transcript data to reduce any misinterpretations and to minimize bias (Maxwell, 2013).

Creswell and Creswell (2018) proposed several strategies to increase accuracy in the study findings including member checking and triangulation. In this study, I instil the validity

with strategies that enhanced the data collection processes. First, I ensure that data collection processes are accurate including following the interview guide and ensuring accurate transcription. Second, various data are to be collected during the study through different means. This offers the opportunity to compare data sets so as to answer the research questions. Students' engagement in and opinion of FC is to be collected using survey and student interviews. Pre/post-tests, assignment, quiz, final examination data is to be statistically analysed to provide in-depth understanding about the students' academic achievements. The findings are also triangulated between all of the data sources to check whether similar or different conclusions are reached (Maxwell, 2013). For example, data triangulation between student survey and interview will be conducted to determine any similar or different conclusion. Third, when reporting the interview findings in this study, direct quotations from the interviewees are used to increase the validity (Creswell & Creswell, 2018).

In the quantitative strand, Cohen et al. (2018) refers to reliability as a measure of consistency over time and over similar samples. For a survey instrument, a reliability check for the internal reliability of scales (e.g. Cronbach's Alpha) is vital to ensure its reliability (Cohen et al.,2018; Field, 2013). The student engagement survey is adapted from Reeve's (2013) 7-point Likert scale survey. The Cronbach alpha of this original instrument is higher than 0.8, indicating good reliability (Field, 2013). In the qualitative strand, the reliability means that the researcher's approach is consistent across different researchers and among different projects (Creswell & Creswell, 2018). In the qualitative strand, the reliability of this study will be enhanced by multiple checking the interview transcripts to reduce any mistake made during transcription (Creswell & Creswell, 2018). Other means to increase the reliability is to find another researcher who can cross-check the codes to validate the consistent use of the codes or to expose potential inconsistencies in the coding (Creswell & Creswell, 2018). A second researcher is not to be involved in the coding in this study. However, there is a pilot study conducted. The researcher as the instrument of the data collection uses a unique set of questions that fit the context of the study (Creswell & Creswell, 2018). In this study, one of the purposes of the pilot study is to determine whether the interview questions are made sense and whether the answers captured resemble the expectations from the questions.

3.8 Ethical considerations

As mentioned in section 3.3 and 3.5.1, the TC group would not participate in any interview nor survey. This data is historical but were permitted by the College to be used as a comparison. The pre/post-test were conducted routinely in my teaching every year whereas they were not something designed for research study and that was why they were considered as historical data.

For the flipped class, prior to any research being undertaken and in order to ensure all students rights and privacy are protected (Punch & Oancea, 2014), students' consent forms are to be signed (Appendix 3) before the study. This will inform students about the nature of the study; the kinds of participation expected of them including, for example survey and interview; steps to maintain confidentiality and reassuring them that their participation is voluntary. They will have the right to withdraw from participation at any time without negative consequences (Cohen et al., 2018) and all the data collected from them will be erased. The FC group will be experiencing the FC because that is what has been decided by the College to teach. Students remain in the flipped learning, but they have the right to withdraw from survey or interview without any negative consequences. In this case they will remain in the same learning environment, however their assessment scores would not be analyzed, and they will not be required to fill out the survey/interview. All assessment scores are to be analyzed anonymously to determine if differences exist in academic performance between the two instructional approaches.

No incentives are to be provided for student surveys and interviews. The focus group participants will have the right to review the interview transcripts. It will also be ensured that they are not students that the researcher will teach again in any other course in the future, in order to reduce the likelihood that any students would feel under pressure to participate or express their opinions. Letters of ethical approval of the IRB of the university of Bristol (Appendix 4) and research college (Appendix 5) have been obtained in support of the research. All information collected will be kept strictly confidential and only used for research purpose.

3.9 Pilot Study

A pilot study involves 300 first-year associate nursing studies students from two classes in two academic years (2018-2019 and 2019-2020) will be carried out. The pilot study aims to evaluate the feasibility of some crucial components of the main study. The pilot study aims to test the course design, the use of the student survey and interviews in the context of the flipped classroom. Detailed information of the pilot study and the implications for the main study are elaborated upon in Chapter 4.

3.10 Chapter Summary

This study investigates the effects of flipped classroom compared to traditional classroom on associate nursing studies students. The student achievement under the two instructional approaches and student engagement in the flipped class are to be investigated in a 12-week nursing fundamental course in a community college. The data are to be collected from six main sources: (1) Pre/post-tests, (2) Assignment, (3) Quiz, (4) Final Examination, (5) Student Survey, (6) Student Focus Group Interview. Creswell & Plano Clark's (2011) explanatory sequential mixed methods design (explanatory design) is to be used to explain the quantitative results (e.g., students' achievement and engagement survey response) using qualitative data from two focus group interviews. The quantitative data are to be analyzed using statistical tests (e.g., independent t tests) and descriptive statistics whereas the qualitative data are to be analyzed using thematic analysis as suggested by Braun and Clarke (2006).

Chapter 4 Pilot Study

4.1 Introduction

Starting small by flipping one or two classes to allow instructors to learn from experience and the first implementation may not be smooth enough, therefore it is important to ask students their opinion to make improvement (Sharma et al., 2015). A pilot study was therefore conducted to prepare me as a teacher-researcher to gain adequate understanding of the design and implementation of the flipped classes. This chapter will first describe the research background (Section 4.2) and the research method (Section 4.3) of this pilot study. Next, it will discuss the data collection and analysis (Section 4.4). The major results (Section 4.5) and the implications for the main study (Section 4.6) are then discussed. Finally, it will conclude with a discussion (Section 4.7).

4.2 Research Background

In this study the aim is to investigate the effects of the flipped classroom on specific aspects of students' academic performance and engagement in Associate Degree of Nursing Studies in Hong Kong. In spring 2020, a pilot study was therefore conducted in first-year associate nursing studies students enrolled in their Health Assessment course which was chosen as it is a specialism course taught by the researcher (see Section 3.4)

4.3 Research Method

4.3.1 Study design

A quasi-experimental study was conducted using a control group to determine the effects of a flipped classroom on academic performance and student engagement among associate nursing studies students. Though a randomized control trial is one of the best ways to minimize bias and control for cofounding variables, a quasi-experimental design is selected to preclude

ethical issues for testing interventions and to improve the external validity of the study (Cohen et al., 2018).

Regarding quantitative data analysis, a number of dependent variables were considered including: 1) academic performance (4 types: pre/post-tests knowledge, assignment, quiz and final examination scores); 2) Engagement (3 types: behavioral, cognitive and emotional); 3) Attendance. Then thematic analysis will be used to analyze the qualitative data (for more detail see Section 3.2.4).

4.3.2 Setting and participants

As the pilot study was exploratory in nature, the duration of the flipped course was short (6 weeks out of 12 were flipped). This pilot study was conducted in a Health Assessment course in a local Hong Kong community college. The convenience sample consisted of 300 first-year associate nursing studies students, of whom 179 were in the traditional classroom (2019 class) and 121 were in the flipped classroom (2020 classes). The difference in sample size was due to different size cohorts in the 2 years. These cohorts will not participate in the main study. For the traditional class in 2019, the students did not participate in any survey nor interview, only their historical data such as demographic and assessment data were used with permission given by the college to use the data (see Section 3.8).128 enrolled in the flipped course in 2020 with 121 students providing written informed consent to participate in the intervention group. The response rate is therefore 95%.

Admission standards were equivalent for both groups. The admission score was based on the scores of Hong Kong Diploma of Secondary Education which were similar in both groups, t (298) = 0.35, p>.05 for age and χ^2 (1) = 0.88, p>.05 for gender. The results show that there is no significant difference between the two groups among any of the demographic variables.

4.3.3 Intervention

The orientation for the flipped classroom was given in the first face-to-face class on 20th Jan 2020. Due to the COVID-19 pandemic, face-to-face classes were suspended after the second class. It was thus changed to an online virtual classroom afterwards (for detail see Section 3.4).

4.4 Data Collection and Data Analysis

Table 4.1 summarizes the data collection and analysis**.** To evaluate the effectiveness of the intervention, an identical 15-mark pre/post-test evaluating students' (gain of) content knowledge was administered in the first class and the last class respectively. The participants underwent this pretest and posttest using multiple-choice questions. In addition, during the teaching they did an assignment, quiz and final examination, which were all based on the course outcomes and developed by this study's author. For both groups, the instructor recorded student performance using an identical pre/post-test and assignment whereas the quiz and the final exam were different each year but similar in terms of scope and difficulty.

Visual inspection of histograms, normal Q-Q plots and box plots showed that all the measures considered (the pre/post-test knowledge, assignment, quiz, final examination scores, behavioural engagement, cognitive engagement, emotional engagement) are approximately normally distributed and so will be analyzed using t tests. One or two measures (the final examination scores and post-test for the FC group) exhibited some negative skew due to ceiling effects and in these cases the alternative non-parametric (Mann Whitney) test gave the same results as the t test used.

Table 4.1 Data collection and analysis in the pilot study

Data sources	Objectives	Data Analysis
Pretest and posttest Change in score	To assess students' knowledge content	Independent t test
Assignment	To assess students' learning outcome	Independent t test
Quiz	To assess students' learning outcome	Independent t test
Final examination	To assess students' learning outcome	Independent t test
Student survey (Intervention group only)	To study student opinion on the flipped classroom	Descriptive statistics
Student focus group interview (Intervention group only)	To understand student learning experience and opinion on the flipped classroom	Thematic analysis
Attendance	To understand students' attendance rate	Descriptive statistics
Pre-class work activity record (Intervention group only)	To validate if students had completed the pre-class work.	Descriptive statistics

To understand students' opinion on FCM, a 15-minute student survey and semi-structured interviews were conducted after completing the course. The survey was adapted from Reeve's (2013) survey on engagement (See Table 4.5). A 7-Point Likert scale was used, ranging from "Strongly disagree" to "Strongly agree". The Cronbach alpha of this instrument was higher than 0.8 for each subscale (Table 4.2), indicating good reliability (Field, 2013). For the student group interview, an interview guide (Appendix 2) was developed.

Table 4.2 Reliability Values of Engagement Survey

Variable	No. of Items	Cronbach α
Behavioral Engagement	5	0.935
Cognitive Engagement	4	0.934
Emotional Engagement	5	0.930

To analyze these data, descriptive statistics of the survey were also used to study student opinion on the flipped classroom. The answers to the open-ended questions in the survey were categorized and then summarized by descriptive statistics. The qualitative data collected from the student interview was analyzed using thematic analysis. Braun and Clarke's (2006) six phases of thematic analysis was used to perform the thematic analysis (see Section 3.6.2).

4.5 Results

4.5.1 Assessment-based findings

Students exhibited 1 of 4 patterns of attending, attending either 6,8,10 or 12 sessions in totals. The class attendance rate of both groups was similar, with 82.96% for control group and 86.64% for flipped classroom group, χ^2 (3) =7.10, p >.05. According to the pre-class work activity record in the FC, each video has been watched by students on average 1-2 times. Each online exercise embedded after video was completed by students between 1 and 8 times.

In Table 4.3 we give summary statistics for all the test scores for the two groups. The student assessment includes pretest and posttest in both groups. The mean pretest scores of the FC group (6.94) is significantly higher than that of the TC group (6.15), t (174.6) = 2.07, p =.040) with small effect size, d = 0.27. The FC group in this case was stronger than the TC group prior to teaching. However, the independent t test on post scores shows difference of

performance at post-test. There is a larger significant difference in the posttest. The mean posttest score of the FC group (10.51) were significantly higher than that of the TC group (9.02), t (178) = -3.91, p <.001, with medium effect size d = 0.51.

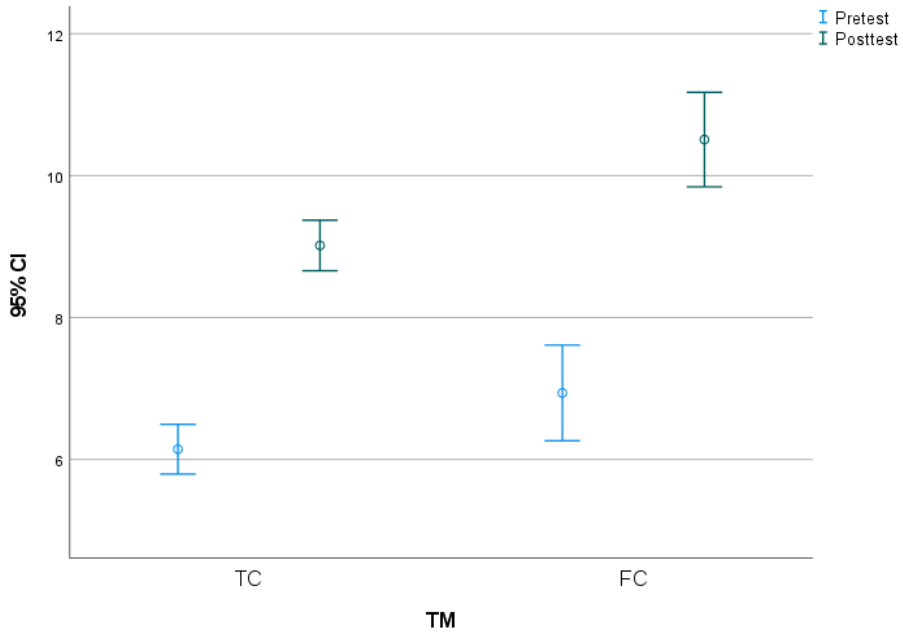
Figure 4.1 shows an error plot to illustrate the differences between the two groups at pre and post-test. We can also directly compare the improvement in test score by subtracting the pretest from the posttest. Here the mean improvement of the FC group (3.57) is significantly higher than that of TC group (2.87), t (160.3) = 2.02, p =.024 with small effect size, d = 0.26. So here we see that even though the FC group were stronger in advance they still make a significantly greater improvement in their content knowledge. This indicates that the FCM facilitates student in-depth understanding of the content.

As student performance cannot be solely assessed by a single assessment, the researcher also considers the other 3 measures of assessment (assignment, final exam and quiz). For the assignment the mean score for the FC group (16.20) was significantly higher than for the TC group (14.82), t (295.0) = 5.42, p <.001, medium-to-large effect size d= 0.60. For the final exam the mean score for the FC group (82.23) was significantly higher than for the TC group (64.91), t (286.6) = 14.13, p <.001, large effect size d=1.61. For the quiz the mean score for the FC group (28.30) was significantly higher than for the TC group (23.53), t (267.2) = 6.94, p <.001, medium-to-large effect size d= 0.72. Therefore, these 3 other measures all show that the FC group did significantly better that the TC group at these points in the course.

Table 4.3 Comparison of summary statistics for the Flipped Classroom Group (n = 121) and Control Group (n = 179) on assessment measures. (Means (SDs))

Variable	Traditional Classroom (n=178)	Flipped Classroom (n=114)	*P*	*D*
PreTest	6.15 (2.37)	6.94 (3.63)	0.04	0.27
Post Test	9.02 (2.41)	10.51 (3.59)	<0.001	0.51
Difference / Improvement	2.87 (1.91)	3.57 (3.36)	0.024	0.26
Assignment	14.82 (2.61)	16.20 (1.78)	<0.001	0.60
Final Exam	64.91 (11.71)	82.23 (9.22)	<0.001	1.61
Quiz	23.53 (8.00)	28.30 (3.71)	<0.001	0.72

Figure 4.1 Error bar plot of the pre and post test scores for the two different Teaching Methods (TM), Flipped classroom (FC) and Traditional Classroom (TC) groups



To ensure the difference of final exam score between the two group is due to the teaching method but not the cohort difference, a regression model was used to analyze the significant effect of pretest, admission score, age and gender as well as teaching method on the final exam score (Table 4.4). The admission score, gender and age have no significant effect on the assignment and quiz score (p >.05) The pretest had a significant effect with an increase of .338 and .402 on assignment and quiz score for each extra mark on the pretest respectively. Group difference was however still significant (1.075 marks on assignment) and (4.365 marks on quiz) when controlling for pre-test. For final exam, the gender and age had no significant effect, but the admission score and pretest (0.802 marks for each extra mark on pretest) had a significant effect (p <.05). Interestingly, the students get on average 0.622 marks lower in the final exam score for each extra admission score mark. As mentioned before, even though the FC group were stronger in advance they still make a significantly greater improvement. The final exam score was still significantly different for the two groups (17.231) when controlling for pre-test and admission score (p < .001).

Table 4.4 The result of a regression model to predict the assessment scores for the pilot study while controlling for intake variables

	Assignment		Quiz		Final Examination	
Variable	Coefficient (SE)	*P*	Coefficient (SE)	*p*	Coefficient (SE)	*P*
Intercept	19.898 (7.518)	.009	21.423 (23.404)	.361	23.216 (37.17)	.533
Flipped classroom method	1.075 (0.254)	<.001	4.365 (0.790)	<.001	17.231 (1.261)	<.001
Pretest score	.338 (0.43)	<.001	.407 (0.132)	.002	.802 (.212)	<.001
Admission score	.062 (0.061)	.308	-.346 (0.190)	.069	-.622 (.305)	.042
Gender	-.339 (.266)	.203	.763 (0.825)	.356	.385 (1.324)	.772
Age	-.393 (0.409)	.337	.552 (1.272)	.434	.3591 (2.021)	.077

4.5.2 Engagement-based findings

4.5.2.1 Student engagement survey response

115 students (95%) in the FC responded to the survey (Appendix 1). Students' engagement in the FC is generally positive (See Table 4.5). More importantly, the closed-ended survey data is triangulated with the open-ended student response (See Table 4.6) and interview data (See Table 4.7). For example, counting for scores from slightly agree to strongly agree, the behavioral engagement data shows 80% of students agree to the statement "I try hard to do well in this class" (Item 3). It is consistent with the student interview comment *"I try hard to complete the pre-class work and actively participate in the class activities"* (Student N). The cognitive engagement data shows 86% of students agree that "When doing work for this class, I try to relate what I'm learning to what I already know" (Item 8). It echoes with student open-ended survey response "*We can have chance to apply the knowledge which gained in the pre-*

class during class" and interview comment *"I try to relate what I learnt in the pre-class work into the in-class activities for knowledge application"* (Student M). The emotional engagement data shows 76.6% of students agree that "I enjoy learning new things in this class" (Item 12) and "When we work on something in this class, I get involved" (Item 14). It resonates with student open-ended survey response *"The class is interesting and interactive. I can concentrate and participate in the class"* and interview response "*We enjoy the FC which is interesting and we are satisfied with our involvement in class activities"* (Student E).

Table 4.5 Student Survey Result of the Flipped Classroom of the Pilot Study with the category containing the median response highlighted

	Response options (%)						
Survey items	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
Behavioral Engagement							
Q1. When I'm in this class, I listen very carefully	0.8	6.0	8.6	15.6	**23.5**	38.5	7.0
Q2. I pay attention in this class	0	8.7	6.1	14.8	**24.3**	37.4	8.7
Q3. I try hard to do well in this class	2.6	3.5	2.6	11.3	19.1	**38.3**	22.6
Q4. In this class, I work as hard as I can	2.6	5.2	1.7	12.2	17.4	**39.2**	21.7
Q5. When I'm in this class, I participate in class discussion	0.9	8.0	5.2	17.7	**25.7**	32.8	9.7
Cognitive Engagement							
Q6. When I study for this class, I try to connect what I am learning with my own experience	2.6	1.7	8.7	11.3	**34.8**	28.7	12.2
Q7. I try to make all different ideas fit together and make sense when I study for this class	2.6	3.5	6.1	18.3	**32.2**	24.3	13
Q8. When doing work for this class, I try to relate what I'm learning to what I already know	1.8	2.6	3.5	6.1	33.4	**37.7**	14.9
Q9. I make up my own examples to help me understand the important concept I am studying for this class	2.6	4.3	8.7	16.5	**32.2**	24.4	11.3
Emotional Engagement							
Q10. When we work on something in this class, I feel interested	0	7.0	5.3	17.5	**28.1**	27.2	14.9
Q11. This class is fun	4.3	8.7	10.4	16.5	**20.9**	29.6	9.6
Q12. I enjoy learning new things in this class	0.8	5.2	2.6	14.8	**26.1**	34.8	15.7
Q13. When I'm in this class, I feel good	1.8	5.3	7.1	21.2	**28.3**	24.8	11.5
Q14. When we work on something in this class, I get involved	1.7	5.2	5.2	11.3	**27**	37.4	12.2

4.5.3 What are the opinions of the students regarding the FCM?

Only those doing FCM are invited to respond to the survey. 79 students (65.3%) made comments in the free boxes in the final 4 questions (See Table 4.6). In the student survey, when the students are asked about their feedback about the pre-class video and in-class activities, 28 out of 61 respondents (45.9%) expressed they can understand the basic concepts before class through the pre-class video. One wrote *"Videos are useful to understand the content before class"*.

When the students are asked about their experiences of the flipped classroom, 20 out of 58 respondents (34.5%) stated that FC is more interesting than the lecture-base classroom as they enjoy the interactive in-class activities and discussion in the FC rather than just listening to the instructor in the TC. One wrote *"Interactive and interesting class activities"*. Following this answer, other positive comments included that they could apply the knowledge during class. Some wrote "*We can have chance to apply the knowledge in class"* and *"More exercises and practice in class"*.

When the students are asked about their favorite aspects of the FC, 25 out of 60 respondents (41.7%) stated that they liked the teacher-student interaction and have more opportunities to ask questions during class activities. Some wrote *"More teacher feedback during discussion"* and *"Real life case study and example, feedback from lecturer"*.

The students are also asked what their preference is between teaching methods. A majority of the respondents (60.8%) prefers the FC than lecture-based classroom. 32 out of 79 respondents (40.5%) prefer learning the content outside class and doing exercise to consolidate the knowledge in the class by saying for example *"Practice is more important and effective"*.

Interestingly, the survey result indicates that the FC students seem satisfied with this new instructional approach. They found that pre-class video is useful for class preparation. They felt in-class activities are interesting and promote knowledge application. Additionally, they discovered that there is more in-class time for discussion and teacher feedback which facilitate students in-depth understanding of the content.

Table 4.6 Students' Comment Regarding the Flipped Classroom in the open-ended survey

Question (no. of student answering question)	Answer	No. of students (%)
Students' feedback about the pre-class video and in-class activities (n=61)	Pre-class learning The pre-class video is short and useful for understanding the basic concepts before class.	28 (45.9%)
	I can repeatedly review the pre-class materials	7 (11.5%)
	It requires stable network connection and IT competence	2 (1.6%)
	In-class activities I learn the content outside the classroom, and I can consolidate and apply my knowledge during the in-class activities	16 (26.2%)
	The in-class activities are interesting and interactive	9 (14.8%)
Students experience on the flipped classroom (n=58)	I am satisfied in the flipped classroom and the teaching method is interesting	20 (34.5%)
	The in-class problem-solving exercise is useful	10 (17.2%)
	I can concentrate, participate and apply my knowledge in the in-class activities	9 (15.5%)
	The revision exercise after video is useful	2 (3.4%)
favorite aspects of the flipped classroom (n=60)	Teacher-student interaction and asking question during class activities	25 (41.7%)
	Learning flexibility	20 (33.3%)
	Understand the basic concept via the pre-class learning	11(18.3%)
	Application of knowledge via the in-class activities	5 (8.3%)
	Case Study	10 (16.6%)
	Group discussion	7 (11.7%)
	Kahoot	4 (6.7%)
The reasons of student preference of the flipped classroom (n=79)	I can practice and apply the knowledge during class activities	32 (40.5%)
	I can understand basic concept via pre-class learning	14 (17.7%)
	I have more teacher-student interaction during class activities	14 (17.7%)
	It is more fun than lecture-based classroom	12 (15.2%)
	I have more peer collaboration during class activities	10 (12.7%)

After analysing the survey open-ended responses to gain an initial understanding of students' learning experience in the FC, then I analysed the interview data using Braun and Clarke's (2006) six step-by-step thematic analysis (for detail see Section 3.6.2).

Table 4.7 illustrates several representative student quotes on three major themes identified in this pilot study, namely course design, peer collaboration and teacher-student interaction. For the course design, the students in the FC want the advanced concepts to be introduced inside the classroom. For example, a student suggested "The instructor could elaborate advanced concepts inside the classroom instead of through the video as we may not fully understand it outside the classroom" (Student V). It is noted that students may not be able to understand advanced topics independently outside the classroom and want instructors to elaborate those topics in face-to-face classes instead, giving immediate answers to students' questions.

For the peer collaboration, the students commented that the FCM provides many opportunities for peer collaboration. For example, *"We can give feedback and learn from each other in the peer discussion"* (Student E). *"Students can share idea and work together in the class activities"* (Student N). These findings indicated that the FCM encourages student learning from one another, explaining a problem or an idea to peers. Regarding teacher-student interaction, the students recognized that there is more teacher-student interaction in the FC. For example, *"Instructor could give immediate feedback and clarify my misconception during class activities"* (Student I). It is important to note that students in the FC recognized there is more time for in-class activities which allow more teacher-student interaction. Students and instructors are encouraged to engage in discussion about the class activities as well as the instructor giving timely feedback. This finding echoes with the open-ended survey response that students like the teacher-student interaction in the FC because it benefited their learning.

Table 4.7 Major Themes Identified in the Pilot Study

Themes	Example quote
Course design	"No long video lasting over 20 minutes, we could concentrate on short video" (Student E). "The instructor could elaborate advanced concepts inside the classroom instead of through the video as we may not fully understand it outside the classroom" (Student V).
Peer collaboration	"We can give feedback and learn from each other in the peer discussion" (Student E). "Students can share idea and work together in class activities" (Student N)
Teacher-student interaction	"There is more teacher-student interaction during class" (Student M). "Instructor could give immediate feedback and clarify my misconception during class activities" (Student I).

4.6 Implications

This pilot study has some implications for the main study regarding the design of flipped class and research methods. In designing the flipped class, the instructor can introduce certain advanced items inside the classroom rather than through the instructional videos. In fact, instructors could expand the explanations corresponding to students' questions in the face-to-face class.

For the research methods, it was realized that the way of collecting the data was unable to relate the engagement response with the corresponding academic outcome for each student. Therefore, I plan to do that in the main study. For example, the students will be randomly assigned a 4-digit number to identify them. They can write the digit number in the survey. In order to relate their engagement with the academic outcome, the result of the survey will be related to their academic performance accordingly. Second, to understand more students' opinion toward the virtual aspects of the FC, how comfortable do they feel to the virtual element will be asked in the focus group interview. Third, to collect different voice of students toward the FCM, one more focus group interview will be conducted in the main study. Furthermore, the pilot study has shown that it was sufficiently large enough to find significant differences between the traditional and flipped classroom. The pilot study worked well.

Therefore, it can be replicated in another course in the main study. In the main study, the plan is therefore to basically repeat the same design on a different course with very similar sample size in order to show that the findings generalize to more than one course.

4.7 Discussion and limitations

This chapter presents the results pertaining to the research questions.

1) How does the flipped classroom method influence students' academic performance compared with traditional classroom?
2) How does the flipped classroom method influence students' engagement?

First, the results of the Pre/post-test knowledge, Assignment, Quiz and Final examination revealed that the students in the flipped class outperform those in the traditional class (RQ1). They indicated that students in the flipped class makes a greater improvement than in the traditional class and there is a greater increase from Pre/post-test knowledge, and higher scores on Assignment, Quiz and Final examination. Most importantly, although there is a significant improvement of students' performance in the flipped classroom than in the traditional classroom in this pilot study and it may be just the course the researcher chose. To generalize the findings, another course will be considered in the main study.

Second, the overall student-reported behavioral, cognitive and emotional engagement in the flipped class are generally positive (RQ2). However, the correlation between the engagement and the academic performance has not been considered in the pilot study. Therefore, this will be considered in the main study.

Third, the qualitative findings might explain any quantitative improvement we found. The behavioral, cognitive and emotional engagement in the flipped class impact positively on student learning. The students in the flipped class recognized that there is more in-class time for in-class activities which allows them to have more peer collaboration and teacher-student interaction. Therefore, these might positively influence students' academic performance.

The experiences learned from this pilot study allowed me to make improvement in implementing future flipped courses. Specially, any advanced concepts would be elaborated inside the classroom because students may not fully understand them through the pre-class video. Similarly, Xiu et al. (2018) found that some students were resistant to flipped learning because they were not able to understand the content and ask question in the pre-class learning. Serafim and Meireles (2019) also revealed that the advanced topics could be introduced inside the classroom whereby instructors can know whether students could follow the topic in a face-

to-face class. Besides, students will engage and value the learning activities only if they can actually understand them (Arghode et al., 2018). Therefore, the amount and difficulty of the pre-class work should match the learning ability and needs of the students in the main study. Moreover, the students in the flipped class commented there is more teacher-student interaction which benefited their learning. This resonates with the study of Özbay & Çınar (2021), the instructor could give instant feedback after identifying student's misconceptions in the FC. In the main study, therefore, I will provide more remedial work based on students' performance in the pre-class exercise and in-class activities.

Furthermore, the duration of the course in this pilot study is short (six weeks) and the students may pay attention to the virtual elements. The novelty effect might become a confounding variable of their engagement and learning outcome. Therefore, how the virtual element may have affected their learning needs to be taken into consideration. The researcher recognized that the students adapt to the virtual element easily in the new generation raised with digital technology. The attendance of both groups is similar. It can be seen that the virtual element might not negatively affect their learning. Therefore, further research with a longer duration is required to examine the effect of the flipped classroom. In the interview of the main study, students will be also asked about any influence of the virtual element on their learning.

The teacher-student relationship might be a limitation in this study. However, I ensured that I will not teach the focus group interviewees again in any other course in the future and conducted the focus group interview after the end of semester assessment had been graded. Moreover, the interviewees are assured that they can freely express their views without any negative consequence.

Chapter 5 Main Study

5.1 Introduction

The main study was conducted in a 12-week nursing fundamental course in a local Hong Kong community college. Two instructional approaches were employed in two academic years. The two research groups were (1) a class for traditional classroom teaching (n = 141) in 2019-2020 and (2) a class for flipped classroom method (n= 130) in 2020-2021. 134 were enrolled in the flipped course in 2020-2021 with 130 students providing written informed consent to participate in the intervention group. The response rate is therefore 97%.

The students in the main study were different students to those in the pilot. After the pilot study, one more focus group was conducted to collect different voices from students, the interview questions were revised and the correlations between student engagement and student achievement were analyzed. Due to the COVID-19 pandemic, the face-to-face flipped class was suspended for the first two classes. They were therefore changed to a flipped virtual classroom. Afterward, face-to-face flipped class was resumed, and mixed mode online teaching was adopted. Most of the students chose the face-to-face class and 1% chose the virtual classroom (detail of research design are given in Sections 3.3 to 3.5). This chapter will first present the quantitative statistical analyses (Section 5.2), next the thematic analysis of qualitative data (Section 5.3), followed by a summary (Section 5.4).

5.2 Quantitative Analysis

As we have reasonably large datasets (>100 students in each group) then parametric statistical methods (t tests and paired t tests) are appropriate. The data were however still checked for normality and for those that showed evidence of skew the results were double checked using non-parametric methods (Mann Whitney tests) which in all cases agreed with the parametric findings.

5.2.1 Demographic data

The demographic data for the control group and the FC group were similar (for age, *t (176)* = -1.20, $p > .05$ and gender, χ^2 (1) = 0.22, $p > .05$). The sample for the TC group (n = 141) included 68% females, with an average age of 18.33 years whilst for the FC group, the sample (n = 130) included 65% females and an average age of 18.5 years. Admission standards were equivalent for both groups. The admission score was based on the student's scores of Hong Kong Diploma of Secondary Education. The mean admission score of the TC group (17.89) was higher than the FC group (17.0), t (262) = 3.06, $p < .05$.

5.2.2 Student Achievement

We first consider research question 1: How does the flipped classroom method influence students' academic performance compared with the traditional classroom? In terms of quantitative measures pre and post-tests, Assignment, Quiz and Final Examination scores were used to compare student achievement between the two instructional approaches (See Section 3.5 for details of each measure).

5.2.3 Assessment-based findings

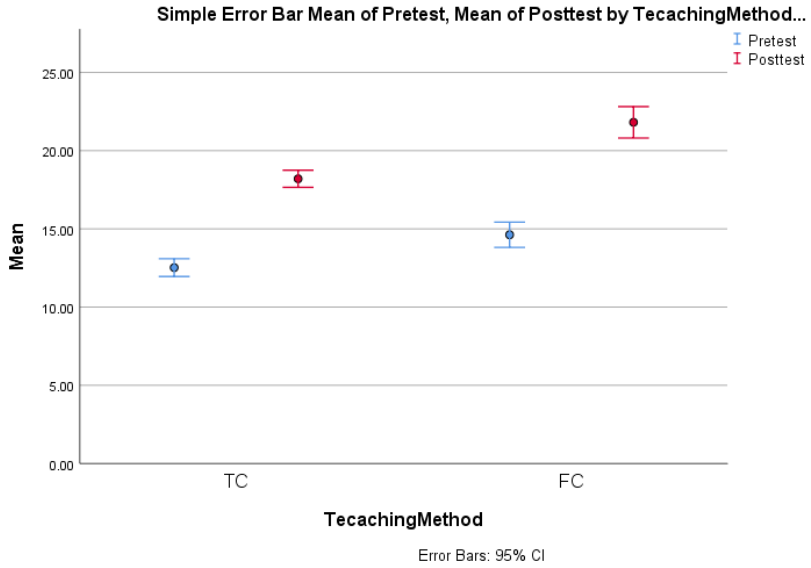
I) Pre test and Post test knowledge

An independent t-test at Time-point 1 (pre-course) for pre-test knowledge was used to check the ability of both groups at baseline. The mean of pre-test score of FC group (14.59) was significantly higher than in the TC group (12.46), t (*223)* = -4.35, $p <.001$, with medium effect size d= 0.54. FC students were stronger than TC students at Time-point 1. Both groups had improvement in the pre/post-test knowledge at Time-point 2 (post-course). The mean of post-test score of FC group (21.62) was significantly higher than in the TC group (18.20), *t(194)* = -5.90, $p <.001$, with a medium-to-large effect size d = 0.74.

The improvement scores were calculated by subtracting the pretest from the posttest and it was analyzed between groups by an independent samples t-test. A statistically significant difference in the improvement score between two groups was noted (Figure 5.1). The mean improvement of pre/post-test in the FC group (7.19) was significantly greater than in the control

group (5.68), *t (189)* = -2.51, *p* = .013, with a small effect size *d* = 0.32 (Table 5.1). It indicated that the FC improved by a greater degree than in the TC and there is a greater increase from pre- to post-test knowledge.

Figure 5.1 An error plot to illustrate the differences between the two groups at pre and post test



II) Assignment, Quiz and Final Examination Scores

As student performance cannot be reflected by a single assessment, another 3 measures of assessment (Assignment, Quiz and Final Examination scores) were compared. After the completion of the course, a statistically significant difference in the Assignment and Final Examination between two groups was noted (Table 5.1). The mean Assignment score in the FC group (34.00) was significantly higher than in the TC group (25.14), *t* (233) = -19.9, *p* < .001, with a very large effect size *d* = 2.47. The mean Final Examination score (86.8) was significantly higher than in the TC group (82.81), *t* (250*)* = -4.759, *p* < .001, with a medium-to-large effect size *d* = 0.60. The mean Quiz score (18.0) was higher than in the control (17.86) but it is not significant, *t* (173*)* = -9.62, *p* = 0.337, but not significantly so with a very small effect size *d* = 0.12.

Table 5.1 Academic Outcomes of the Flipped Classroom Group (n = 130) and Control Group (n= 141) of the Main Study

Variable	**Flipped Classroom Group, Mean (SD)**	**Control Group, Mean (SD)**	***P***	***d***
PreTest	14.59 (4.48)	12.46 (3.29)	<.001	0.54
Post Test	21.62 (5.71)	18.2 (3.21)	<.001	0.74
Difference/Improvement	7.19 (5.82)	5.68 (3.35)	0.013	0.32
Assignment	34.00 (4.08)	25.14 (3.01)	<.001	2.47
Quiz	18.00 (1.52)	17.86 (0.68)	0.337	0.12
Final Exam	86.8 (6.33)	82.81 (7.00)	<.001	0.6

Having noted that the FC group had higher pretest scores the differences in these additional assessment measures could simply be indicative of a stronger cohort. To ensure the difference of final examination score between two groups is therefore due to the teaching method but not the cohort difference, a multiple regression model that account for pre-test (and admission score, gender and age) was applied. Prior to performing a multiple regression analysis, the correlations among the independent variables were considered to ensure there was no collinearity diagnosed according to tolerance and variance inflation factor. In this study, the variance inflation factor score was below 10 and tolerance score was above 0.2 suggesting that this assumption was met. By checking with scatterplots, the relationship between dependent variable and independent variables was rather weak with no evidence of non-linearity (Figure 5.2). The plot of standardized residuals versus standardized predicted values indicated no obvious signs of funneling, suggesting the assumption of homoscedasticity was met (Figure 5.3). The P-P plot for the model revealed that the assumption of normality of the residuals was satisfied (Figure 5.4).

Figure 5.2 A scatterplot to illustrate a linear relationship between exam score and pre-test score

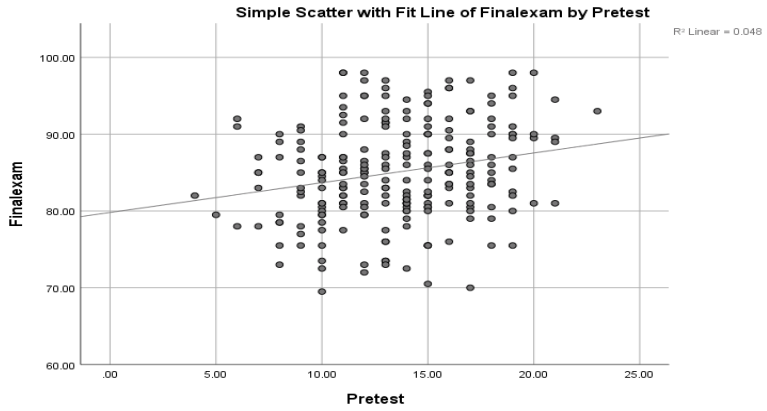


Figure 5.3 A scatterplot to illustrate the variance of the residuals is constant

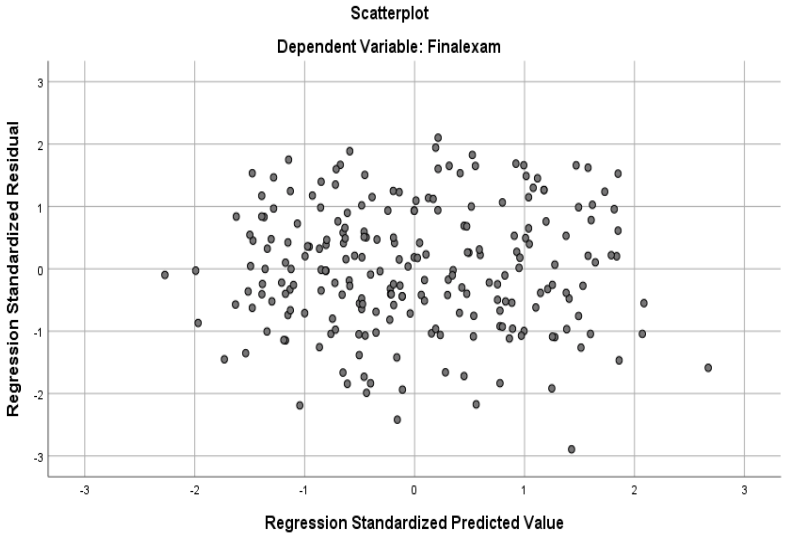
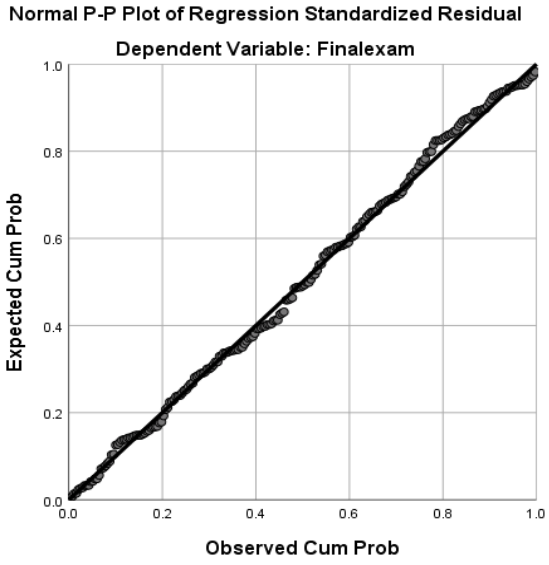


Figure 5.4 A P-P plot to illustrate the values of the residuals are normally disturbed



In this study, a multiple regression model was used to determine the extent to which two or more independent variables were related to the dependent variable e.g. how gender, age, pretest score, and teaching method affect the exam score (Table 5.2). The pretest score, admission score gender and age had no significant effect on the assignment and quiz score (p > .05). Similar finding was found for the final examination except age. The final examination score was significantly affected by the FCM and age (p <.05). Older students got better score 1.12 higher final exam score for extra 1-year-old.

Table 5.2 The result of a multiple regression model to predict the assessment scores for the main study while controlling for intake variables

Assignment				**Quiz**			**Final Examination**		
Variable	Coefficient (SE)	*p*	R^2	Coefficient (SE)	*p*	R^2	Coefficient (SE)	*p*	R^2
Intercept	35.319			15.788			61.102		
Flipped classroom method	9.070 (0.441)	<.001	.606	.241 (0.147)	.102	.004	3.764 (0.921)	<.001	.83
Pretest score	.035 (0.56)	.537	.086	.005 (0.019)	.788	.005	.190 (0.116)	.103	.04
Admission score	.125 (0.093)	.180	.01	.053 (0.031)	.088	.002	.152 (0.194)	.434	.001
Gender	-.353 (-0.434)	.417	.000	-.101 (0.145)	.486	.000	-4.57 (0.905)	.613	.000
Age	-.194 (0.242)	.423	.007	.073 (0.080)	.364	.002	1.121 (0.495)	.025	.015

I) Class Attendance

Students exhibited 1 of 5 patterns of attending, attending either 6, 9, 10, 11 or 12 sessions in total. The average class attendance rates of both groups were similar, 85.9% for control group and 89.2% for the FC group, χ^2 (4) = 8.76, p>.05. According to the pre-class work activity record in the FC, each video had been watched by students between 3 and 5 times. Each online exercise embedded after video was completed by student between 1 and 3 times.

II) Closed-ended survey response

Only the flipped class students were invited to fill out the student engagement survey from Reeve's (2013). 119 out of 130 students (91.5%) responded to the survey (Appendix 1). Students' engagement in the FC was generally positive. The survey indicated that a majority of students engaged positively with the FCM (Table 5.3). In a FC, most of the respondents enjoy learning new things in this class (item 12) which had the highest mean (5.96) among 14 items (Table 5.3). In the FC, however, the item 9 addressing whether students make up their own examples to help them understand the important concept they are studying for this class had the lowest mean (5.22). Nonetheless, the students overall engage well in the FC.

More importantly, the closed-ended survey data is triangulated with the open-ended student response (Table 5.5) and interview data (Table 5.6). For instance, summing scores from slightly agree to strongly agree to count those who agree with each statement, there is 92.5% of students who agreed that "I enjoy learning new things in this class" (Item 12) and 89.2% of students agreed that "This class is fun" (Item 11). This is consistent with the open-ended responses and student interview comment that they enjoy the FC and the teaching method is fun. Furthermore, 90% of students agreed "in this class, I work as hard as I can" (Item 4). It echoes with the student interview comment that they try hard to complete the pre-class work and actively participate in the FC. In addition, 89.1% of students agreed to the statement "I pay attention in this class" (Item 2). It is in line with open-ended survey and student interview comment that they concentrate and participate in the in-class activities. Moreover, 87.4% of student agree both that "When we work on something in this class, I get involved" (item 14) and "When doing work for this class, I try to relate what I'm learning to what I already know" (item 8) and It echoes with the open-ended response and student interview comment that they get involvement and apply what they learn in the pre-class to the in-class activities. Moreover, 90.8% agreed that "When I'm in this class, I feel good" (Item 13). This resonates with the student interview feedback that they feel good that there are more teacher-student interaction and peer collaboration in the FC.

Table 5.3 Student Survey Result of the Flipped Classroom of the Main Study with the category with the median respondent highlighted

Survey items	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree	
Behavioral Engagement	%	%	%	%	%	%	%	Mean
Q1. When I'm in this class, I listen very carefully	0.8	1.7	2.5	6.8	18.5	**54.6**	15.1	5.65
Q2. I pay attention in this class	2.5	2.5	1.7	4.2	19.3	**48.8**	21.0	5.66
Q3. I try hard to do well in this class	2.5	2.5	0	8.4	10.1	**51.3**	25.2	5.76
Q4. In this class, I work as hard as I can	3.3	1.7	0	5.0	19.4	**43.7**	26.9	5.74
Q5. When I'm in this class, I participate in class discussion	2.5	0.8	3.4	14.3	20.2	**46.2**	12.6	5.38
Cognitive Engagement								
Q6. When I study for this class, I try to connect what I am learning with my own experience	1.7	1.7	0.8	8.4	25.2	**48.7**	13.5	5.54
Q7. I try to make all different ideas fit together and make sense when I study for this class	1.6	4.2	1.7	7.6	28.6	**48.7**	7.6	5.34
Q8. When doing work for this class, I try to relate what I'm learning to what I already know	1.7	4.2	1.7	5.0	26.1	**48.7**	12.6	5.46
Q9. I make up my own examples to help me understand the important concept I am studying for this class	1.6	3.4	3.4	13.4	**31.1**	35.3	11.8	5.22
Emotional Engagement								
Q10. When we work on something in this class, I feel interested	3.4	2.5	0	5.9	21.0	**45.4**	21.8	5.62
Q11. This class is fun	2.5	2.5	0.8	5.0	20.2	**34.5**	34.5	5.79
Q12. I enjoy learning new things in this class	2.5	2.5	0	2.5	14.3	**40.4**	37.8	5.96
Q13. When I'm in this class, I feel good	2.5	2.5	0	4.2	21.0	**46.3**	23.5	5.72
Q14. When we work on something in this class, I get involved	2.5	3.4	0	6.7	18.5	**52.1**	16.8	5.59

Table 5.3 demonstrates the median of all questions apart from Q9 is 'Moderately agree as are the median scores for the 3 engagement types as a whole. Therefore, the students overall engaged in the FC behaviorally, cognitively and emotionally. As the medians are very similar

across all questions we have also constructed the mean by giving the categories values 1 to 7 respectively and also averaging this for each engagement type. Students are most engaged emotionally (mean=5.73) and slightly less engaged cognitively (mean= 5.39).

III) Correlation of engagement with students' achievement

There is a positive correlation between assignment scores and behavioral, cognitive and emotional engagement (Table 5.4). This means students that are more behaviorally, cognitively and emotionally engaged, have higher assignment scores on average. For behavioral engagement, $p < .05$, with a small-to-medium effect size of Spearman correlation ρ=.21. For both cognitive engagement and emotional engagement, all $p <.01$, all with a medium effect size of Spearman correlation $\rho = .30$. There is also a positive correlation between quiz and behavioral, cognitive and emotional engagement, $\rho = .26$, $p <.01$, $\rho =.23$, $p <.05$, $\rho = .25$, $p <.01$ respectively and all with a small-to-medium effect size. Students that are more behaviorally, cognitively and emotionally engaged tended to have higher quiz scores. Besides, there is a positive correlation between post-test and behavior and cognitive engagement, all $p <.05$, all with a small-to-medium effect size $\rho = .20$. There is no significant relationship between engagement and any of other performance measures (final exam and improvement).

Table 5.4 The correlation between student performance and behavioral, cognitive, and emotional engagement.

	Assignment	Quiz	Final Exam	Post test	Improvement
Behavior Engagement	.208*	.255**	-.086	.195*	.110
Cognitive Engagement	.296**	.231*	-.114	.199*	.104
Emotional Engagement	.296**	.245**	-.113	.095	.060

The asterisks (*) represent the level of significant; * = $p < .05$; ** = $p < .01$.

IV) Engagement survey open-ended response

Though not all of the FC students provided open-ended responses in the engagement survey, 93.3% students expressed their experience of the FCM. To analyze these responses, the researcher searched for recurring codes and compiled them into a table (Table 5.5). First, when the students were asked about their feedback about the pre-class video and in-class activities, 27 out of 102 respondents (26.5%) expressed they found the pre-class video is short, clear, fun and useful for understanding the basic concepts before class. For example, two students wrote *"The videos include the main idea within a short period of time." "More videos and have more fun."* Another student wrote, *"Watching video before class can let me have a better understanding before the lesson".* Besides, 11 students (10.8%) stated they can ask questions and have more discussion with their instructor and peer in class. 6 students (5.9%) stated they learn the content outside the classroom, and they can consolidate and apply their knowledge during the in-class activities. These percentages are low but as these are free text responses it is not the case that those not saying this did not agree. It is important to note that students in the FC are positive about the role that the videos and in-class activities played in their learning experience.

When the students were asked about their experience on the flipped classroom, 22 out of 83 respondents (26.5%) stated that they enjoy the FC which they think is interesting. Students wrote, "*We can play Kahoot (clicker questions) and learn our knowledge in a fun way during class."* and *"In-class activity such as case study is funny and useful".* Following this answer, other positive comments included that they have more opportunity to ask questions and discussion with their instructor and peer; they found the in-class problem-solving exercise was useful and they can apply the knowledge during class.

When the students were asked about their favorite aspects of the FC, 32 out of 100 respondents (32%) appreciated the learning flexibility, including that they can learn anytime and anywhere. One wrote "*"I can watch it whenever I want, it is good for me to take revision!".* 16 (16%) stated that they could understand the basic concepts via the pre-work. They also liked the teacher-student interaction and having more opportunities to ask questions during class activities. Case study and group discussion are the students' favorite in-class activities. It is interesting to note here that the learning flexibility and teacher-student interaction are particularly effective in helping them understand the material.

The students were also asked what their preferred teaching methods were. 70.2% of respondents preferred the FC. 23 students (20.7%) reported the FCM benefited their learning

by learning the content outside class and doing exercise to consolidate the knowledge, and more teacher-student interaction during class activities. For example, one wrote, *"It provides us with an opportunity to express our ideas as well as to practise and get immediate feedback from our instructor. This method will help application of knowledge during class."*

With a different perspective, 10 students (9%) expressed that they prefer listening than doing class activities by saying, "*I prefer the content presentation by the instructor and so I can know more about the concepts through the explanations of the instructor"*, 2.7% students indicated that they felt worried about the workload of pre-class work. One wrote, *"I cannot watch all videos when it is a heavy workload."*

On the whole, the FC students largely seemed satisfied with this new instructional approach. They reported that they liked the videos and viewed the videos as a review resource and a way of preparing them for class. They felt that the in-class activities such as group discussion and case study helped them understand material better. Lastly, they felt that there was more in-class time for activities which allowed them to have greater interaction with their instructor and peers. However, some perceived the workload of the pre-class work and remained dependent on the lecture-based approach.

Table 5.5 Student's Opinion Regarding the Flipped Classroom in the open-ended survey

Question (no. of student answering question)	Answer	No. of students (%)
Students' feedback about the pre-class video and in-class activities (n=102)	<u>Pre-class learning</u> The pre-class video is short, clear, fun and useful for understanding the basic concepts before class.	27 (26.5%)
	I can repeatedly review the pre-class materials	3 (2.9%)
	<u>In-class activities</u> I can ask questions and have more discussion with my instructor and peer in class	11 (10.8%)
	I learn the content outside the classroom, and I can consolidate and apply my knowledge during the in-class activities	6 (5.9%)
	The in-class activities are interesting and interactive	3 (2.9%)
Students experience on the flipped classroom (n=83)	I enjoy the flipped classroom and the teaching method is interesting	22 (26.5%)
	I have more opportunity to ask question and discuss with my instructor and peer	13 (15.7%)
	The in-class problem-solving exercise is useful	9 (10.8%)
	I can concentrate, participate and apply my knowledge in the in-class activities	6 (7.2%)
	The revision exercise after video is useful	2 (2.4%)

Students' favourite aspects of the flipped classroom (n=100)	Teacher-student interaction and asking question during class activities	16 (16%)
	Learning flexibility	32 (32%)
	Understand the basic concept via the pre-class learning	16 (16%)
	Application of knowledge via the in-class activities	4 (4%)
	Case Study	10 (10%)
	Group discussion	9 (9%)
	Kahoot	8 (9%)
The reasons of student preference of the flipped classroom (n=111)	I can practice and apply the knowledge during class activities	23 (20.7%)
	I can understand basic concept via pre-class learning	16 (14.4%)
	I have more teacher-student interaction during class activities	23 (20.7%)
	It is more fun than lecture-based classroom	9 (8.1%)
	I have more peer collaboration during class activities	10 9%)

5.3 Qualitative Analysis

This section presents further results related to the research question 2: How does the flipped classroom method influence students' engagement? This research question is another overarching focus of this study. As discussed in Chapter 2 section 2.7, the gap in the literature revealed that student engagement in the FC remains underexplored in Hong Kong nursing education. This study is designed to surface students' learning experience to identify themes about their engagement in the FC. As per the design of this study (see Section 3.2.3), the purpose of the qualitative data analysis in this investigation is confined to understanding student engagement in the FC in support of the quantitative aspects of the study. Quantitative data obtained through the student engagement survey has also been used to investigate student engagement in the FC. The student survey open-response and interview data are used to explain the results in more depth (see Section 3.6 and Section 5.2.4).

5.3.1 Responses to Interview on opinions of the FCM

In the more quantitative analysis of the survey open-ended responses, an initial understanding of students' experience in the FCM was gained. The second phase involving qualitative analysis was performed on two focus groups with twelve students. Each interview was audio-recorded and transcribed verbatim see Section 3.5.7). All transcripts were acceptable

to interviewees with no disagreement noted. Braun and Clarke's (2006) six step-by-step method was used to perform the thematic analysis. First, I became familiar with the data. I remained engaged in the data beginning with the transcription and analysis. Next, I highlighted the meaningful keywords in the transcripts and checked for the relevancy to the research questions. For example, identifying keywords about students' opinion and engagement in the FC. Then, I compiled the codes into common themes by grouping sets of similarly patterned coded data. I used quotes from the interviewees to support themes and integrated them to form a composite response to the research questions (more details of the methods used are given in Section 3.6.2).

In analysing the data, the themes identified in the Figure 5.5 were discussed and considered as common emerging topics in investigating students' opinion and engagement in the FC. The themes show some of the factors that contributed to the positive students' achievement. The themes were therefore used to explain the quantitative findings further in the discussion in Chapter 6. Figure 5.5 displays the themes identified.

Figure 5.5 Thematic map displaying the themes

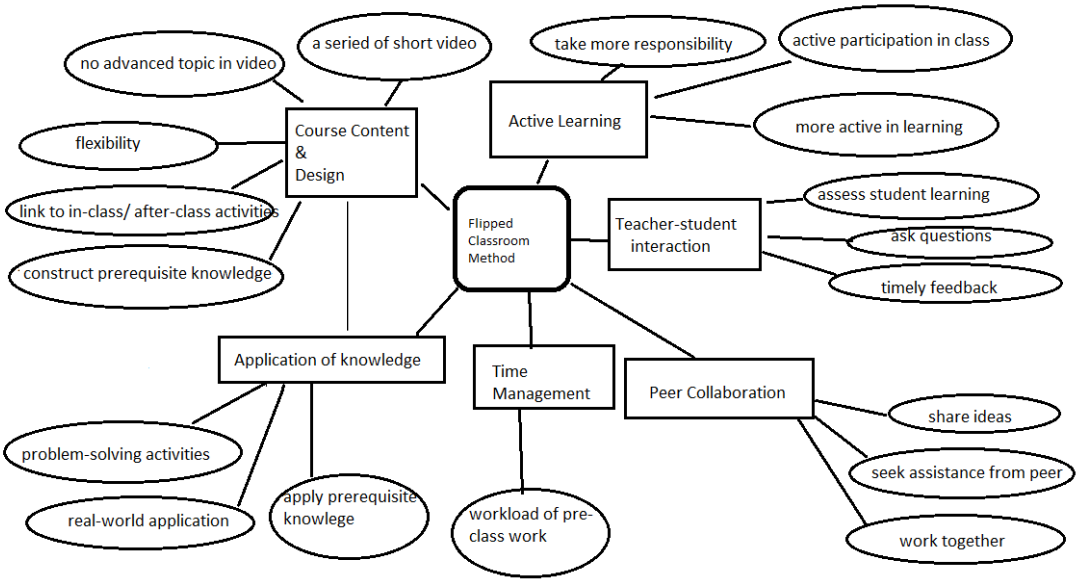


Table 5.6 shows several representative student quotes on the six major themes identified in this main study, namely course content and design, active learning, peer collaboration, teacher-student interaction, application of knowledge and time management.

Table 5.6 Major Theme Identified in the Main Study

Themes	Example quote
Course content and design	"I could concentrate on short video instead of long video lasting over 20 minutes" (Student H). "It's better to break long video into a series of short video" (Student L). "I prefer teacher created video rather than pre-made video as the tailor content can meet our need" (Student A). "Follow-up exercise after pre-recorded video is useful for self-evaluation" (Student H). "It is valuable to complete the pre-work because it is related to the in-class content and after class assignment (Student J).
Active learning	"I try hard to complete pre-work, search more information on the difficult topic, making notes and prepare some questions before class. The instructor is a facilitator for my learning." (Student E) "Active learning is required in the territory education. Now, I prefer active learning instead of passively listening to an instructor in high school" (Student L).
Peer collaboration	"Students can share their idea and give feedback during the group work. We can ask question and learn from each other in the group discussion during class" (Student D). "Peer interactions were minimal in the TC, most of the in-class time is for listening to the instructor" (Student F).
Teacher-student interaction	"I feel good that there is more teacher-student interaction, and I can have more opportunities to ask questions during the class activities" (Student F). "Instructor would give immediate feedback and clarify my misconception during class… I could identify my misconception during class rather than after class assignment in the traditional classroom" (Student D).

Application of knowledge	"Having basic concepts before class could facilitate a better understanding of the content. I can apply what I learn in pre-class in the in-class activities. I apply knowledge rather than memorization. It helps me consolidate our knowledge" (Student J). "There is more in-class time for problem-solving activities to develop my critical thinking" (Student K).
Time management	"I have to schedule my time for pre-work. Self-discipline is required" (Student H). "I feel worried when I have not completed the pre-work" (Student E).

In analyzing the data further, the six themes identified in the table above were discussed and regarded as important topics in understanding students' opinion and engagement in the FCM.

Theme 1: Course content and design

At the start of each interview, students reflected upon their experience in the pre-class learning in the FC. Students discovered the access to online learning material enabled them to assimilate content in their own time and at their own pace which allowed the students to have the ability to set the progress for their learning for pre-class work. Student F explained "*Watching the pre-recorded videos is flexible. We can have unrestrictedly access to the online learning materials anytime, anywhere and it allows us to learn at our pace*". Students stated they would pause and rewind the videos until concepts were understood. They also reported when they were struggling with concepts, more time and resource prior to class were available to address their concerns, because the content has been elaborated before class.

It was crucial to note that students did not always learn at the same pace, and individualization to meet students' needs was important to their success. Interestingly, no students preferred pre-made (external) online materials, but instead a series of short videos which is less than 20 minutes and created by the instructors. Student H suggested *"I could concentrate on short video instead of a long video lasting over 20 minutes"*. Student A added "*I prefer teacher created videos rather than pre-made videos as the tailored content can meet our need".* It is noted students in the FC really liked a series of short and instructor-created videos since they found their attention spans are not too long and the tailored content could

meet their exact needs.

Additionally, when students initially balked at completing the pre-class work, students found the need for incentives to motivate pre-class preparation. They described they were motivated to complete the pre-class work when they found the follow-up exercises after the video were useful for their self-evaluation as well as when their pre-class learning was directly connected with the in-class learning. Student J reported *"It is valuable to complete the pre-work because it is related to the in-class content and after class assignment"*. It was noted that students in the FC were more willing to accomplish all the pre-class work as well as staying focused on the in-class activities when they felt those were valuable. Furthermore, all students agreed that they adapted to the virtual element well as their generation was raised with digital technology. Students in the FC seemed not to experience major technical issues throughout the course, which could have negatively affected their learning, because they did not report any annoyance with technology.

Theme 2: Active learning

Regarding the active learning, the students recognized that they became more active in learning in the FC. For example, Student E reported *"I try hard to complete pre-work, search more information on the difficult topic, make notes and prepare some questions before class. The instructor is a facilitator for my learning*". Student L noted *"Active learning is required in the tertiary education. Now, I prefer active learning instead of passively listening to an instructor in high school"*. Furthermore, students revealed they became more responsible for their learning and more actively participated in the class. Student E commented *"I am responsible for my learning in FC. It enhances active participation"*. Student A added *"Knowing I was going into a FC motivated me to complete my pre-work. It enables me actively to participate in the class"*.

It is important to note that the FCM required students to take responsibility for their own learning, engaging with content in both online and face-to-face learning environment. Because the FCM called for a different course design, students discovered changes in their student roles. Students reported they became active in learning with the content, their peers and instructors, rather than having a passive reception of the content delivered by the instructor. Again, this transition was significant because the FCM transferred the ownership and responsibility of learning from instructors to students whereas active learning was vital in promoting the engagement of students in a learning process.

Theme 3: Peer collaboration

In terms of peer collaboration, the students commented that the FCM provided many opportunities for peer interaction. For example, *"Peer interactions were minimal in the TC, most of the in-class time is for listening to the instructor"* (Student F). *"Student can share their ideas and give feedback during the group work. We can ask questions and learn from each other in the group discussion during class"* (Student D). They reported feeling comfortable to seek help from peers as well as that group discussion could consolidate their knowledge. Other students' comments mirrored this thinking, *"I feel more comfortable to raise questions to my classmates during group discussion and the stronger peers can teach me"* (Student I*). "I teach my classmates at the same time as I could consolidate my knowledge"* (Student C).

These findings reflected that the more capable peers would ideally act as tutors of less capable students and this kind of peer tutoring facilitated both students with in-deep understanding of the content. In addition, students appreciated they were able to work together in groups, and they were motivated to study hard by their peers. For example, *"Solving problem together is a positive experience."* (Student F). *"Some classmates are well prepared, and it motivates me to prepare well."* (Student A). This was interesting because the FCM created a climate which encouraged students to stay outside their comfort zone, motivate each other, work together and be accountable for the learning process. The social connection of working in a group seemed to promote student learning.

From a different perspective, students found some classmates did not complete the pre-class work although it offered students a foundation for more in-class analytical activities. Student D reported that it was difficult to run a group discussion if their classmates were not enthusiastic or unprepared. This was disappointing to see as lack of preparation is likely to lower students' in-class participation and reduce the effectiveness of their in-class learning. Moreover, when students do not accomplish the pre-class work, the variability of student preparation for in-class learning is likely to be higher and it leads to another learning challenges of the already diverse first-year student cohort.

Theme 4: Teacher-student interaction

In term of teacher-student interaction, the students recognized that there was more in-class time for class activities and more teacher-student interaction in the FC. They appreciated that they were able to ask questions and get timely feedback during class, rather than waiting until the next day. For example, *"I feel good that there is more teacher-student interaction, and I can have more opportunities to ask questions during the class activities"* (Student F). Students described how the instructor could assess their learning and provide clarification during class which was important to them. One said, *"I am able to remember the contents well when the instructor corrects my misunderstanding during class."* (Student I). Another concluded *"Instructor could give immediate feedback and clarify my misconception during class activities… I could identify my misconception during class, rather than after class assignment in the traditional classroom"* (Student D).

All these comments indicated that teacher-student interaction impacted student learning in three important ways namely assessment for learning, instructor timely feedback and students' questioning. The FCM established a space and time for students and instructors to engage in dialogue and problem-solving activities. This perception was consistent with the survey finding in which the teacher-student interaction in the FC benefited their learning.

Theme 5: Application of knowledge

Regarding application of knowledge, students recognized that the FCM provided them with more opportunities to apply what they have learnt. Students discovered that they were able to research and master concepts before coming to the class to apply the concepts, therefore doing better in the knowledge application. Students viewed the in-class activities as a means to develop skills of application and critical thinking. In the words of two students, *"I can apply what I learn in pre-class in the in-class activities. I apply knowledge rather than memorization. It helps me consolidate our knowledge"* (Student J). "*There is more in-class time for problem-solving activities to develop my critical thinking"* (Student K). This echoed with the survey finding that the FCM helped application of knowledge during class.

It was interesting to note that students could perform lower-order skills that requiring less cognitive processing such as comprehending knowledge outside the classroom. During class, students with the support of the instructor and peers were able to focus on higher-order-

thinking work such as application. Additionally, students appreciated that the real-world application in the class were valuable. Another student's comment indicated similar findings "*I am able to discuss real cases with my group and integrate our thinking in the process of problem solving. These activities enhance my learning."* (Student B). Moreover, students also reported that they enjoyed the case study. All students commented that the case study was useful to allow critical thinking and keep students engaged in the class.

Clearly, the FC emphasizes higher-order-thinking by completing task through active engagement with learning materials whereas memorization is no longer regarded as a strategy for learning. Instead, students seemed eager to apply their prerequisite knowledge and enjoyed the real-world application during class. According to students, pre-class work offered foundational concepts and appeared strategic for the in-class, higher-order-thinking activities. Students found the FCM allowed more in-class time for problem-solving activities to develop their critical thinking. In light of the application of knowledge into practice being the core purpose in the clinical setting, real-world application was important to the nursing students.

Theme 6: Time management

As with benefits, some students experienced challenges and a degree of discomfort with use of the FCM. The students recognized that time management was very important in FC learning and described that the required changes in study habits induced anxiety. In TC, students had grown used to coming to class with less or no preparation and could sit quietly in the classroom without having to perform class exercises or discussion. The FCM required students to put more time into their learning. Student H stated *"I have to schedule time for pre-work. Time management is required".* Student B shared his experience *"I am accustomed to come to the class without any preparation and just listen and take note during traditional class, but I have to complete the pre-work and participate in-class activities in the FC. I may not be able to complete all pre-work if high workload".* Student E added *"I feel worried when I have not completed the pre-work"*.

Such comments revealed that some students did not merely find the FCM uncomfortable, but also may prefer to take notes quietly during class. It was interesting to note that some students initially struggled with the new instructional approach, taking time to adapt to it. In fact, some students remain dependent on the lecture-based approach, that when challenged, can bring up a feeling of frustration and a lack of security in their learning process. Therefore, instructors should expect resistance and take steps to ease student transition in the FCM as well

as avoiding assigning too much pre-work overwhelmed the students.

5.4 Chapter summary

This chapter presents the results pertaining to the research questions. First, for all academic measures (apart from the quiz) the FC group did significantly better than the TC group and this was still true even after adjusting for admission / pretest scores. There was a significant difference in Pre/post-test, Assignment and Final Exam scores for the FC. This indicated that the students in the FC outperformed those in the TC. Whereas the Pre/post-test demonstrated that the students in the FC improved to a greater degree than those in the TC. This demonstrated improvement in the content knowledge gained across the term in the FC (RQ1).

Second, the overall student-reported behavioral, cognitive and emotional engagement in the FC were generally positive (RQ2). The median category of all survey item questions apart from question 9 was 'Moderately agree'. The results of the student engagement survey suggested that the students in the FC showed they engaged in learning emotionally, cognitively and behaviorally. Positive and significant correlations were found between assignment scores and emotional, cognitive and behavioral engagement as well as between quiz and total engagement. This may be related to the fact that there is more in-class time for case study in the flipped class. This facilitates students to engage themselves in the after-class assignment with more challenging case studies. A positive and significant correlation was also found between post-test and cognitive and behavior engagement.

In the student survey, more respondents reported they preferred the flipped to traditional class. In the student interviews, students commented that they could learn basic concepts prior to class and this allowed more in-class time for application of knowledge in the FC. They reported that peer collaboration and teacher-student interaction in the FC promoted their learning. They also stated that they became more active in learning and greater time management was required in the FC.

Chapter 6 Discussion

6.1 Introduction

This discussion chapter includes two parts. In the first part, three main findings are elaborated upon. First, in spite of the FC group appearing to be slightly better than the TC group at Time-point 1 (pre-course), their academic achievement was higher on a range of assessments than that of the TC group, and students improved to a greater degree across the intervention (Section 6.2). Second, the self-reported student engagement in the FC group was generally positive (Section 6.3). The students showed highest values on emotional engagement, followed by behavioral engagement and cognitive engagement. There was a positive correlation between marks on their assignment, and emotional, cognitive and behavioral engagement as well as between quiz and total engagement. There was also a positive correlation between post-test score and cognitive and behavioral engagement. However, there was no significant correlations with the final exam and improvement. Third, based on students' preference of teaching method, students overall had positive opinions towards the FCM but not all of the students preferred the FC (Section 6.4). In the second part, a set of design principles of FCM (Section 6.5) is developed based upon the research findings. Adult learning theory (Knowles et al., 2005) is employed as the theoretical approach that is fundamental to promote student engagement.

6.2 Increased student academic achievement

In this study, the FCM enhanced student achievement in their Post-intervention test, Assignment and Final Exam (refer to Section 5.2.3). The students in the FC outperformed those in the TC, with the difference in average mark exhibiting a very large effect size for the Assignment and a medium-to-large effect size for the Final Exam as well as a small effect size for the difference in improvement as measured by the Pre/post-test. Indeed, the fact that FC group overall outperformed the TC group indicates the effect of teaching method. In spite of the fact that the FC group were a slightly stronger class than TC group from the outset as shown

by their performance at time point T1, the important finding then was that the FC group improved to a greater degree between time points T1 and T2 than the TC group. This demonstrated that, on top of them being slightly better to begin with, the improvement is larger according to the teaching method.

This result resonates with other studies of flipped nursing class. The study of Missildine et al. (2013), Ratta (2015) and Joseph et al. (2021) indicated that FC outperformed TC in exam scores whereas the study of Greenwood & Mosca (2017) and Oh et al. (2017) indicated that FC group improved in pre/posttest knowledge. These studies found that the use of FCM in undergraduate students from non-Asian or Asian countries yielded neutral or positive students' academic achievement. However, these studies mainly focus on undergraduate nursing students. Thus, the findings from this study give further evidence that FCM can enhance student academic achievement in other educational levels such as associate degree nursing.

Given that the quantitative results demonstrated the it was the stronger teaching method, it would be better to use the qualitative findings to elaborate on why students found it beneficial. The following sections elaborates on the five major FCM benefits identified in this study, including flexibility of learning materials, peer collaboration, teacher-student interaction, application of knowledge and active learning. Based on student interviews, these benefits improve student achievement in the FC.

6.2.1 Flexibility of online learning materials

The first main theme from the interview was the flexibility of online learning materials which broke down to the fact that students could repeatedly watch the materials, use them for revision, use them anytime and anywhere and learn at their own speed. Students revealed that the flexibility of online learning materials facilitated their learning. Students commented "*Watching the pre-recorded videos is flexible. We can unrestrictedly access the online learning materials anytime, anywhere and it allows students to learn at their pace"*. Consistent with Chang et al. (2019) and Hew & Lo (2018), they reported that students can repeatedly watch the videos to better understand a particular topic.

How the students utilized the online learning materials were identified as: (1) pausing or rewinding the pre-recorded video, and (2) for revision. First, some students stated that they could watch the videos repeatedly to better understand a difficult topic. One student said, "*I would pause the videos and catch up on my note taking or do research if I do not fully*

understand the content". Similarly, Love et al. (2014) and Nachatar Singh et al. (2019) stated the students would pause and rewind the videos to reinforce the concepts. The feature of pausing and rewinding the videos to enhance grasp of content was an oft-cited benefit in FCM literature (Chang et al., 2019; Hew & Lo 2018; Puppe, & Nelson, 2019; Schwartz, 2014).

Consistent with Choi et al. (2021), the students reported that the positive experience of the pre-class work was its ability to facilitate students to be more flexible in their learning and promote active participation. In fact, some students may need more time to understand the content relative to their peers (Schwartz, 2014). Some students may feel embarrassed to ask the instructor to present the content repeatedly in the TC because it may override the instructor's need to present all the course materials. One student stated, *"We could re-watch the video without disrupting the flow of the class."* Therefore, student can self-pace their learning.

The online learning materials gave flexibility in when students can comprehend the content, and at a pace to accommodate their personal learning needs, which spreads and reduces cognitive load (Ponikwer & Patel, 2018). Based upon adult learning theory (Knowles et al., 2005), adults have a self-concept and this makes their learning more self-directed. FCM was more sensitive to the individual needs of different students (Xu et al., 2019). FCM allowed flexibility of learning and students can learn at their own pace and participate in classroom problem-solving activities, that was conductive to their deeper understanding of the content (Choi et al., 2021). FCM can facilitate students to direct their own learning and the instructor became a facilitator to in-class problem-solving (Schwartz 2014), in turn the students became more independent learners in the FC.

Second, the students were supposed to have certain foundational knowledge from their previous learning stages, however, some students may lack this foundational knowledge for learning advanced topics. Failure to recall foundational knowledge could affect their class participation (Puppe & Nelson, 2019). A full revision of foundational knowledge was not necessary for all students, especially the higher performers. In this FC, the foundational materials would be elaborated through the pre-class video and reviewed at the start of the class. Self-revision of foundational knowledge through pre-class videos in the Learning Management System supports the students of a lower ability without consuming the whole class time.

Additionally, the students could use the online learning materials to prepare for their exam (Peterson, 2016). One student stated, *"Re-watching the pre-recorded videos is useful for revision"*. Dabney and Mitchell. (2017) also reported that students re-watched the video for reviewing for exams in their study. In this study, the online learning materials allowed students

to review anytime and anywhere, that may help students' revise more effectively. Similarly, Evans (2008) indicated that significantly more students thought the online material was more effective than revising from textbooks because the online material was flexible in when, where and how it is used.

6.2.2 Peer-collaboration in the flipped class

The second main theme from the interview was around peer-collaboration within the flipped classroom which broke down to aspects such as how students share idea, seek assistance from their peers and work together. According to the student interviews, peer collaboration was frequently reported as a positive experience in this FC but it was minimal in the TC. One student stated, *"Students can share their ideas and give feedback during the group work. We can ask question and learn from each other in the group discussions during class".* This finding echoed other studies of flipped nursing class (Greenwood & Mosca, 2017; Hew & Lo, 2018). These studies revealed that peer collaboration in FC supported student learning. By offloading direct lecturing outside the classroom in this study, more in-class time was released for peer collaboration which was appreciated by the students. One student stated "*In the FC, more in-class time is used for group discussion and more peer collaboration."*

In contrast, peer collaboration was limited in the TC. The in-class time of traditional nursing class is generally occupied by direct lecturing (Al-Mugheed & Bayraktar, 2021; Geist et al., 2015). The instructor can therefore spend only limited time on group discussion after covering all the content. One student commented *"Peer collaboration was minimal in the TC, most of the in-class time is for listening to the instructor"*. Because of this minimal peer collaboration, student achievement in the TC could not be promoted as much as in the FC. Similarly, Xu et al. (2021) reported that learning achievement had a positive correlation with peer interaction, $p < 0.01$. They explained that students in the FC were encouraged to ask for help and give help to each other and this could improve student achievement.

The student interviews further explained three kind of peer collaboration including: (1) Sharing ideas with classmates, (2) Seeking assistance from their peers, and (3) Working together. These peer interactions facilitated the students in the FC to outperform their counterparts. First, the FC students shared their ideas. Through the group discussions, the students could explore different ways to handle the clinical situation. One student said, *"We share our ideas about the clinical situation and discuss different solutions during class"*. Another student said, *"Hearing other idea from my classmates helps me to solve the problem*

from different perspectives." Consistent with the study of Choi et al. (2021), students expressed that they could hear various thoughts and opinions from their team members, and it facilitated them to think of various ways of solving problems. The peer collaboration motivated them to think more deeply about the clinical situation.

In this study, the FC students also explained how they benefited from group work during class. Apart from sharing ideas, students presented their work to their classmates and received feedback from them. One student stated, *"When we present our work to my classmates, we can reflect on our own way of handling the clinical situation. At the same time, our classmates could comment on our work".* The group activities allowed students to formulate their arguments and debate with the classmates (Schwartz 2014). In turn, this kind of peer interactions brought in arguing, convincing and defending.

Second, the FC students seek assistance from their peers. One student stated, *"I feel more comfortable to ask questions to my classmates during group discussion and the stronger peers can teach me".* Similarly, Hsu's (2018) students asserted that they were relaxed enough to ask for help from peers and their in-class interactions were used to solve the questions that arose from pre-class work. Interestingly, highly able students also benefited from the group activities. One student stated, *"I teach my classmates at the same time I could consolidate my knowledge".* In the FC, students tended to motivate each other when they worked together to solve problems. The FC encourages student learning from one another, explaining a problem or an idea to peers, developing students higher-order-thinking (Philips & O Flaherty, 2019). It further revealed the underpinning hallmark of Vygotsky's (1978) social learning in which students enhanced their understanding via the efforts of peers.

It is also in line with Schwartz (2014), Joseph et al. (2021) and Xu et al. (2021), that the more capable peers would ideally act as tutors of less capable students. Those peer tutors also benefited from activity, as the act of explaining learning material to their classmates will further solidify their own understanding. According to Topping and Ehly (1998), this kind of peer tutoring facilitated student in-deep understanding of the content because students not only learned what the right answers were, but also how to explain to their peers why those answer were correct. In this way, both the tutee and tutor benefited from helping.

In addition to seeking assistance from their peers, students learned to self-monitor their progress. One student stated, *"Some stronger classmates perform well in the group activities and it motivates me to work harder to catch up with them".* Sharing knowledge in group activities could encourage students to make necessary pre-class preparations and they were more committed to their smaller group (Bingen et al., 2020). When students could not fully

engage in the group activities as their progress lagged behind their peers, they realized they had to put more effort in before class (Schwartz, 2014). In turn, the students learned that they were required to take more responsibility for preparation for class (Greenwood & Mosca, 2017).

Third, apart from seeking assistance from their peers, the students worked together. A shift can happen when students came to class, working in team on the in-class activities (Philips & O Flaherty, 2019). In this study, one student said, *"We study and work together in the group-activities. It helps us to be actively participating in discussion. It also develops our collaborative skill which is important in the workplace"*. Peer tutoring facilitated students to understand their peers better and in-class group activities increased the level of participation and enhanced their collaborative skills (Kim & Jang, 2017; Lin & Hwang, 2018). The real clinical setting where the student nurse will work requires professional nurses equipped with collaborative skills (Kim & Jang, 2017).

This study has clearly indicated that promoting in-class group activities and providing an interactive classroom environment encouraged peer collaboration could have resulted in the observed improved student academic outcome. Our findings are consistent with that of Lo and Hew (2019) and Xu et al. (2021), in that increased peer interaction contributed to students' increased achievement in the flipped courses.

6.2.3 Teacher-student interaction

The third main theme from the interview was the teacher-student interaction which broke down to aspects of assessment for learning, timely feedback and students' questioning. According to student interviews, teacher-student interaction was the most frequently mentioned benefit of the flipped class. Özbay and Çınar (2021) and Simpson and Richards (2015) reported similar findings in their study of a flipped nursing course. These studies found that complementing the content with problem-solving skills instead of spending time defining and explaining the basic concepts inside the classroom increased the teacher-student interactions in the FC. In fact, more instructor feedback was the most frequently reported benefit of the flipped nursing class (Özbay & Çınar, 2021). For example, the medical teachers in Park et al. (2018) revealed that the FC allowed more in-class time for case studies, teachers could assess student understanding and guide those answering wrong. Assessment for learning and timely feedback can explain the benefits of instructor feedback.

First, the students in this FC reported that FCM allowed the instructor to assess student

learning during the in-class activity. One student stated "*The instructor could circulate the classroom to monitor student work*". Similarly, Özbay and Çınar (2021) reported that the instructor could give instant feedback after identifying students' misconception in the FC. Regarding assessment for learning, the instructor's feedback acts as a formative assessment to identify students' misunderstanding and to provide remedial work immediately. More importantly, feedback is most effective when it is timely (Hall, 2018).

However, the provision of feedback in the TC was usually not so effective as it was too slow. First, the instructors may not be able to identify each student's understanding and provide instant remedial work because the in-class time was occupied by direct lecturing (Özbay & Çınar, 2021). Second, the instructors normally took a few days to mark students' assignments and feedback could only be provided after class. Shifting direct lecturing outside the classroom means, the instructor in the FC can know the students, constantly, assess their learning and offer them timely feedback for improvement.

Second, the students in this FC revealed that they had more chance to ask the instructor to clarify misconceptions as the in-class time was no more occupied by direct lecturing, the instructor could explain further the nursing concepts and offer individualized support. One student stated, *"When I encounter problems, I can ask questions to my instructor. The timely feedback during class helps me to correct my misconceptions"*. Prior studies also reported that the FC students appreciated the teacher-student interaction and having more opportunity to ask question during class activities (Holman & Hanson, 2016; Hanson, 2016; Behmanesh et al., 2020). Class activities in the FC allow students to ask questions they would not or could not have asked during a TC, and to interact more with peers and instructor (Schwartz, 2014; Joseph et al., 2021).

Interestingly, questions arose not only in the in-class activities, but also in the pre-class work. Students could bring some concrete questions into the in-class activities. One student stated, *"Having the basic concepts through the pre-work, I could do research and prepare some questions before class."* Similarly, Chang et al. (2019) reported that the FC students were able to practice through pre-class work, could construct the prerequisite knowledge and even concrete questions before the in-class stage. Therefore, in such a circumstance, the FC students could bring some concrete concepts or questions into the in-class activities and interact with the instructor. Conversely, the students in the TC who did not have pre-class work could not acquire prior knowledge, therefore they had less interaction with the instructor during class than FC students did. Moreover, the students could concentrate on the on-site learning situation based upon the concrete questions that arose in the pre-class learning (Chang et al., 2019). One

student commented, *"I will more focus on those topics which I did not fully understand in the pre-work."*

Although students could pose their questions using the online discussion forum or by email to the instructor after class, students commented that online discussions are not as convenient as face-to-face discussions. One student stated, *"Feedback could be provided to clarify the misconception immediately during class better than after-class"*. Similarly, Koch et al. (2020) in their study reported that students preferred the instructor to give them guidance and clarification during face-to-face session. Students who had pre-class preparation would generally be able to have their questions clarified in more depth and detail.

6.2.4 Application of knowledge

The fourth main theme from the interview was application of knowledge. Student responses to the question about the reasons of student preference of the FC indicated that constructing the prerequisite knowledge through pre-work, knowledge application and teacher-student interaction during class were highly regarded. First, the FC can benefit students by encouraging them to easily connect the knowledge they gained in the pre-class learning to the in-class activities. Therefore, students come to class better prepared for deeper learning (Critz & Knight, 2013; Hanson, 2016; Behmanesh et al., 2020; Lo & Hew, 2022). In this study, one student commented, *"Having basic concepts before class could facilitate a better understanding of the content. I can apply what I learn in the pre-class to the in-class activities. I apply knowledge rather than memorization. It helps me consolidate our knowledge"*.

Consistent with Schwartz (2014) and Dabney & Mitchell (2017), students were better prepared for class after they had completed the pre-class work and the lecture could be used for knowledge application. The lecture offered a building block on which students were able to apply their knowledge to different scenarios. The class time was for practical learning (Behmanesh et al., 2020). In this study, the pre-class work was designed to expose students to key principles for a particular topic. Pre-class work in general has been shown to provide students with a foundation and seemed strategic for higher level work inside the classroom. Students commented*, "There is more in-class time for problem-solving activities to develop the critical thinking"*. Similarly, Lee and Hwang (2016) and Busebaia and John (2020) reported that the FC can facilitate student nurses to accurately grasp diverse and complicated scenarios and to respond independently so as to strengthen their critical thinking skills.

Students were more motivated to learn when they found applications that were relevant to their nursing profession (Schwartz, 2014). In this study, students commented, *"I became more interested in the problem-solving activity," "I was able to apply knowledge".* Similarly, Hampton et al. (2020) reported that students in the modern world do not like just listening to lectures but prefer to be involved in learning. Showing how content was applicable to the real world or providing practical information was observed to be important for the students nowadays in other studies (Roseberry-McKibbin, 2017; Seemiller & Grace, 2017). Hanson's (2016) study on a flipped pharmacology course also reported that students perceived the positive outcome of FCM including increased understanding of the content, practical application of knowledge and fostering higher-order-thinking.

6.2.4.1 Case study

In this study, students found using case studies were very valuable. Similarly, Critz and Knight (2013) reported that out of 20 students, most of students felt using case studies to extremely or very valuable. By offloading direct lecturing outside the classroom, more in-class time was released for problem-solving activities such as case studies. In this study, case studies were implemented utilizing various approaches. For example, case studies were used to demonstrate the application of nursing assessment and care; to use real-life clinical experience as case scenarios; case studies analysis was also combined with role play so as to integrate different concepts and enable student active application of essential concepts learned in the pre-class and in-class stage. These activities allowed students to apply nursing knowledge into practice in the classroom. Two students commented, *"I am able to discuss real cases with my group and integrate our thinking in the process of problem-solving. These activities enhance my learning," "By analysing cases together, we are able to apply knowledge directly during class".*

According to adult learning theory, adults learn better from a problem-based rather than content-based environment (Knowles et al., 2005). Problem-solving activities such as case studies could be used as analytical exercises, cultivating student learning. Besides, adult learners wanted to know the reason why learning activities are conducted in class (Knowles et al., 2005). By finding applications that were related to the types of activities the students would expect to experience in their career, students were more motivated to learn the content for reasons other than the curriculum requirement (Schwartz, 2014). Most importantly, students in

this FC study reported that their learning was promoted when they were able to apply their knowledge during class. Similarly, Hanson (2016) revealed that learning was most effective when students were actively involved in understanding the application of content.

In this study, students completed the case studies in groups and were invited to present their answers to the entire class. While some groups were active in the case studies, other also played an active role since they had to offer critique or suggestions. Meanwhile, when questions arose, the instructor with microphone circulated around the classroom and invited other students to provide suggestion. As mentioned before, the FC students commented that there were more interactions among students and instructor during these sessions. In the meantime, Greenwood and Mosca (2017) reported that active learning was enhanced in class by encouraging student-led group work using case studies.

6.2.5 Active learning

The fifth main theme from the interview was active learning. Active learning refers to any instructional approach that engages learners in the learning process (Prince, 2004). It is usually viewed as the opposite of passive learning, for example, listening and note-taking that are common to traditional lecture-based classrooms. Active learning strategies differ widely and can involve the use of audience-response system, peer discussions, and group work in class (Chung et al., 2019; Ward et al., 2018).

According to adult learning theory, adults learn better from a problem-based rather than a content-based environment (Knowles et al., 2005). In this study, there was an expectation that students had completed the pre-class work prior to coming to class. Instead of just listening and taking notes, class time was then reserved for interactive activities such as group work discussion, questions and clarification of content. A large amount of research on active learning suggested that it fosters in-depth understanding by actively engaging students in their own learning process (Cho et al., 2021; Nachatar Singh et al., 2019; Nouri, 2016; Roehl et al., 2013). In turn, students in the FC in this study focused on application of the basic knowledge through active learning strategies during class time, which was thought to induce higher academic achievement.

The student interviews further illuminated students' learning approaches. Students had a high preference for the FCM and were more motivated to become active in learning and that was evident from their responses. First, students took more responsibility for their learning. It

seemed to obviously mark a point in the learning process where the student's responsibility began. One student commented, *"I am responsible for my learning in FC. It enhances active participation"*. Similarly, Simon and Richard (2015) reported that most students revealed that the FCM provided them increased flexibility and the ability to control the pace of learning, inducing a feeling of being more responsible for their own learning. Ponikwer and Patel (2018) also reported the FCM allowed students to take active responsibility for their learning, in which they can learn at their own pace, and to perform problem-solving activities inside the classroom, that provided in-depth understanding.

Concurrently, peer interaction supported students' responsibility in the learning process. Hodgson et al. (2015) revealed that students' feelings of responsibility to their peers increased their responsibility for their own learning. In this study, students commented, *"Some classmates are well prepared, and it motivates me to prepare well"*. Students recognized their peers were relying on them to finish in-class group activities so as to contribute to group work and enhance the overall understanding of content.

Second, students became more active in learning. Matsuda et al. (2017) reported that there was an obvious difference in the students' role when comparing their traditional and flipped classrooms. Ge et al., (2020) also revealed that when instructors relied only on lectures, the students often arrived at class unprepared, passively took notes with minimal discussion, and used rote memorization to prepare for exams. In the TC, instructors were the source of all information and the mode of provision of information gave little chance for teacher-student interaction (Morrison, 2014). The student's task was to store the information provided by the instructor and it was no more than memorizing the transferred information (Simpson & Richards, 2015).

The TC environment increased the student's dependence on the instructor and may not offer the student chance to do research and provided limited student participation opportunity, the student may not therefore acquire adequate knowledge or skills in such an environment (Özbay & Çınar, 2021). In contrast, FC students in this study found that knowing they were going into a FC motivated them to complete their pre-work and it also enabled them actively to participate in the class. One student commented *"I would complete pre-work, search more information on the difficult topic, making notes and prepare some questions before class. The instructor is a facilitator for my learning."* Similarly, Koch et al. (2020) reported that in their study the FC students having pre-class preparation, came to class with a familiarity of content and to be prepared for participating in the problem-solving activities.

Instructors no longer stand at the front of the classroom for the whole class time to dispense facts. Instead, they design online learning materials with relevant intentional content and implement active learning strategies during class time that enhance higher-order-thinking (McDonald & Smith, 2013; Philips & O Flaherty, 2019). In this study, two students commented, *"Active learning is required in tertiary education. Now, I prefer active learning instead of passive listening to an instructor."* Similarly, Strelan et al. (2020) reported that students were satisfied to have the opportunity to engage with content at a surface level in their own time and then engage at a deep level with peers and an expert during class, relative to being passive learners in a traditional lecture-based classroom. Serafim and Meireles, (2019) also revealed that students in a TC were passive during class, were expected to absorb the new knowledge taught, and continued understanding the content through after-class assignments. When flipping occurred, in-class time could be utilized for more active forms of learning and individualized attention instead of content introduction.

Active learning has been demonstrated to have an effect on two key factors contributing to the positive gains in student learning: knowledge construction and student engagement. Instructors have long posited the theory that constructing knowledge is the way that students build an understanding of the world around them (Missildine et al., 2013; Vygotsky, 1978). Active learning strategies can facilitate knowledge construction by requiring students to apply concepts instead of just exposing them to ideas. Requiring students to ask or answer questions, have discussions, or solve problem can promote knowledge construction that has a positive impact on in-depth understanding (Vygotsky, 1978). Moreover, active learning also promotes student engagement during class time by assigning roles and responsibilities to students that enable them to build a new relationship to learning (McLaughlin et al., 2014).

The core value of the in-class stage in the FC is to enhance peer and teacher-student interaction, thus students can collaboratively solve the problems faced throughout their learning process with the assistance of peers and the instructor (Joseph et al., 2021; Puppe, & Nelson, 2019). In this study, students reported that the pre-class work could lead them to have the prerequisite knowledge and thus it increases the peer collaboration and teacher-student interaction during class. Ellis (2016) indicated that the FCM has been proposed as one strategy for improving critical thinking and student engagement in schools of nursing, topics which are often deficient in a lecture-focused, passive learning centered classroom. Similarly, a large amount of research has suggested that providing lecture materials ahead of time enables instructors to focus on application of knowledge through active learning strategies during class time, which is thought to induce higher-order-thinking and improve student engagement

(McDonald & Smith, 2013; McLaughlin et al., 2014; Gilboy et al., 2015; Cho et al., 2021). Therefore, flexibility of learning materials, peer collaboration, teacher-student interaction, application of knowledge and active learning in the FC contributes to the students' enhanced academic achievement in this study.

In this study, overall experience with the FC suggested that when the classroom becomes more student-centered, with more in-class time for higher-order-thinking activities such as skills of application and problem-solving, this will contribute to improved learning outcomes, through increased peer collaboration and teacher-student interactions.

6.3 Student Engagement

The previous section discussed the observed significantly higher student achievement in the FC compared with the TC (refer to Section 5.2.3). It also discussed how flexibility of online learning resources, peer collaboration, teacher-student interaction, application of knowledge and active learning potentially led to this higher student achievement. This section discusses the findings related to student engagement. In this study, student engagement included three constructs: behavioural, cognitive and emotional engagement as defined by Fredricks et al. (2004). As stated by Fredricks et al. (2004), behavioural engagement refers to participation; cognitive engagement is about the level of investment in learning; and emotional engagement refers to satisfaction and feeling. In this study in terms of the relationship between assignment scores and student engagement, the correlation with emotional engagement and cognitive engagement were higher, both ρ= 0.30, p < 0.01 and followed by behavioral engagement, ρ= 0.21, p <0.05. There is also a positive correlation between quiz and behavioral, cognitive and emotional engagement, p <0.05, with small-to-medium effect size ρ= 0.26, ρ= 0.23, ρ= 0.25 respectively. Moreover, a positive correlation was also found between post-test scores and both behavioral engagement and cognitive engagement, both ρ= 0.2 p <0.01. Here these findings are just for the FC group, and so we cannot make any specific conclusions about whether these relationships observed in the FC were different to those in the TC as the TC group did not fill in the engagement survey.

However, a limited number of studies have been conducted on student engagement and academic achievement in the flipped course (Fisher et al., 2021). The studies only investigate the relationship between engagement and exam score or course grade. In this study, a significant relationship was observed for total engagement and both assignment and quiz scores,

all p <0.05 as well as behavioral and cognitive engagement and post-test, p <0.05. The explanation may be that those students who were able to practise the case studies during class were therefore more confident and better prepared for the after-class assignment with more challenging case studies. As a result, they may have therefore got a higher score on the assignment. Similarly, students were more engaged and relaxed in the post-test which was regarded as another after-class exercise not counting towards their overall score as well as the quiz which counting small portion of their final score. Besides, in fact the correlations were negative for final exam, but not significant.

6.3.1 Emotional Engagement

Emotional engagement referred to satisfaction and feelings such as interest in the course. In this study, students commented they were satisfied in the FC and the teaching method was interesting. At the same time, students' response to the question about their experience of the FC indicated two themes: the teaching method was interesting, and teacher-student interaction was highly regarded. These two themes will be further elaborated in this section. Consistent with Critz & Knight (2013), the FC created an engaging classroom environment where students enjoyed having fun while learning and instructors could interact with students on a more personal level to clarify students' misconceptions.

6.3.1.1 Increased interests in the flipped class

The student engagement survey data indicated that the students' opinion on their learning interest in the FC was highly positive. First, the students on average moderately agreed that they enjoyed their learning in this class. In the FC, there was more in-class time for the problem-solving activities such as case studies. Students commented, *"The case study is useful to allow critical thinking and keep students engaged in the class" "I enjoyed the case study," "The process of reasoning with real cases is interesting".*

Case studies were effective in engaging students in a very challenging environment (Mackavey & Cron, 2019). Similarly, both Simon & Richard (2015) and Dabney & Mitchell (2017) reported that students felt they were learning relevant information and they enjoyed case studies as well and improved engagement was noted. Because the flipped students in this study enjoyed the case study during class, they would be more engaged in the after-class case study

assignment.

Second, 89.2% students agreed that the class was fun. For example, some students commented, *"The in-class group activities were interesting," "We have fun during group discussion." "It is more fun to work in a group than working by myself".* This revealed that peer collaboration helped to increase the interest in learning in the FC. Similarly, Chen et al (2017) reported that the FC can increase the students' pleasure in learning.

According to the adult learning theory (Knowles et al., 2005), adults learned better with intrinsic versus extrinsic motivation. Hampton et al. (2020) reported that performance engagement was reflected through extrinsic motivation like test scores, whereas emotional engagement was related to intrinsic motivators. Indeed, it was reasonable to expect students who enjoyed and were interested in the class problem-solving activities such as case-studies to be more motivated to learn and perform better in the after-class case-study assignment.

6.3.1.2 Increased satisfaction in the flipped class

Third, the students agreed or moderately agreed that there was a positive atmosphere in the class. Students commented that they were satisfied in the FC especially with the increased teacher-student interaction.

I) Increased teacher-student interaction

The student interviews revealed the teacher-student relationship was the most frequently mentioned item regarding engagement. This finding is in line with Hanson (2016), Cronhjort et al. (2018), Behmanesh et al. (2020), who found that students appreciated receiving more feedback and feeling more supported by the instructor in the FC. With more in-class time available for teacher-student interactions, students appeared to feel that the instructor cared about students' learning, answered their questions sincerely and that they got more support. These social interactions may encourage students to build a connection to the learning environment.

Clearly, increased teacher-student interaction and developing more trusting relationships facilitated student accomplishment of the learning tasks. As a result, students were more willing to complete more learning tasks such as after-class assignments. Strelan et al. (2020) reported that instructors themselves enhanced the student learning experience and

instructors committed to student-centered approaches such as FCM were more likely to be engaging with students more generally.

Similarly, Koch et al. (2020) indicated that their students not only appreciated the flexibility of the online learning materials, but they also preferred an experienced instructor with clinical experience in the face-to-face sessions. Because the instructor played a key role to provide clarification, engage and motivate students and create a classroom environment which enabled students to ask questions and discuss with their peers and instructors.

In this study, students revealed that the instructor had implemented various teaching strategies in the classroom to promote class participation and learning. Small group work and/or large group discussions were the main approaches employed by the instructor in this FC. Students were expected to come to class having done pre-class preparation and be more prepared for the class participation. Puppe and Nelson (2019) reported that class participation was necessary in the FC where the student asks questions and debates issues with their peers and instructors. Collaboration and feedback from their peers and instructors were timely and allowed for clarification (Cho et al., 2021). Similarly, Elmaadaway (2018) also revealed significantly higher perceived emotional engagement in the FC group than TC group, and it was explained by the FCM providing the opportunity for students to prepare course content before class, and to participate in class activities with more teacher-student interaction, allowing students to feel more engaged than in a TC.

Consistent with Koch et al. (2020), they reported that the majority of the students were satisfied that these approaches employed in their classes did promote their learning. In this study, 92.5% FC students agreed they enjoyed leaning in the class. The positive emotional engagement in the FC could be one explanation to why there was a positive correlation between emotional engagement and assignment score.

6.3.2 Cognitive Engagement

Cognitive engagement was about investment in learning such as the student's preference for challenges. In this study, cognitive engagement was the second highest correlation with assignment scores**.** Two main reasons were identified from the student interviews: 1) Increased peer interaction, 2) Increased opportunity to apply knowledge.

6.3.2.1 Increased peer collaboration

Hampton et al. (2020) reported that the students nowadays wanted intra-personal learning which means they like to learn independently and at their own pace, but they also enjoyed the social interaction with peers. An interesting finding reported in their study was that students who more preferred to work in groups also got higher engagement scores.

In this study, some students stated that peer collaboration facilitated them to comprehend the content from different perspectives, that enhanced their problem-solving skills. For example, students commented, *"In the past, I work alone but now we work together to solve problem"*. Similarly, Chiang and Chen (2017) reported their students worked together in group activities and developed a learning community which helped them to achieve the advanced cognitive goals of analysis, evaluation, and creativity. Burke and Fedorek (2017) also reported that the students in the FC tended to work in groups on problem-solving. Thus, students were able to engage in their learning at a deeper level and became more capable of solving problems.

Moreover, Gilboy et al. (2015) reported enhanced engagement and collaboration among the students in the FC. In this study, some students commented, *"We would discuss more challenging after-class assignments," "Solving challenge together is a positive experience".* This resonates with Bingen et al. (2020) that there was more in-class time spent on collaboration, the FC students became more engaged in learning tasks and actively assisted their peers to solve challenging problems. The FC environment enabled more peer collaboration and encouraged students to solve more challenging problems. The social connection of working in groups appeared to enhance student learning as well as students' performance on the assignment.

6.3.2.2 Increased opportunity to apply knowledge

In the FC, students would try to connect their experience with their learning and also link what they learnt in the pre-class stage to the in-class stage. Student rated survey item 6 ("when I study for this class, I try to connect what I am learning with my own experience") and item 8 ("When doing work for this class, I try to relate what I'm learning to what I already know") higher in the cognitive engagement. Students therefore expressed that they were able to connect relevant knowledge gained in the pre-class work with in-class practical application

of knowledge.

In the FC in another study, completion of pre-class work resulted in the students coming to class better prepared to engage in discussion and in-class problem-solving activities (Harris Ware & Benson, 2019). In this study, peer collaboration and teacher-student interaction promoted the students' success in problem solving, that in turn increased their confidence and motivation to solve more complicated clinical situations. Some students stated, *"I have practised the problem-solving during class and therefore I am more confident to solve more complicated situations and do the assignment well"*. Strelan et al. (2020) reported that students in their study were more encouraged to apply their knowledge to real-world problems in a collaborative manner, their experiences were more satisfied.

Meanwhile, Busebaia & John (2020) reported that FC students could reduce anxiety when facing challenges because there was more in-class time for collaboration and practice. One student commented, *"I feel good because I can practise, ask questions and get instant feedback during class. It is better than we find ourselves not fully understanding the content and many questions arose in the after-class assignment".*

Students are encouraged to solve more challenging problems when they experience success in flipped learning. This finding is in line with Roseberry-McKibbin (2017), Seemiller and Grace, (2017), who found that if students could complete the fundamental exercise successfully, they could be more motivated to complete other complicated problem-solving assignments. In this way, FC students can gain a sense of competence which is a common need of human beings and is satisfied once their behaviour is performed effectively (Ryan & Deci, 2000). This sense of competence is a significant intrinsic motivator (Deci et al., 1999). In this study, one student stated, *"I feel successful when I can solve a challenging clinical problem during class. After class, I am more motivated to complete other problem-solving assignment."* With greater intrinsic motivation, FC students usually demonstrate a preference for challenges and therefore have a higher level of cognitive engagement (Fredricks et al., 2004). Clearly, students' investment in learning extends beyond what happens in the classroom itself. They were more confident and readier for another complicated after-class assignment.

6.4 Students who do not prefer flipped class

The students' positive opinions were discussed in section 6.3 before and it was acknowledged that some students did not prefer the FC (See section 5.2.4 IV and Section 5.3.1).

In the student survey, 28.8% students preferred the TC. Two main concerns about the FCM identified in the open-ended responses of the student survey and student interviews were: (1) time management and (2) lack of familiarity with the new instructional approach.

6.4.1 Time Management

It should be taken into consideration that the FCM requires students to complete the pre-class work for in-class problem-solving (Busebaia & John, 2020). In a similar way to Dong et al., 2021; Harris Ware & Benson (2019), Hessler (2019) and Peisachovich et al. (2016) students in this study also have expressed their concern about the amount of preparation time. Some students commented, *"I have to schedule time for pre-work," "I feel worried when I have not completed the pre-work," "I may not be able to complete all pre-work on time if high workload".*

Elsewhere students' lack of pre-class preparation acted as a primary barrier to the FC environment (Bristol, 2014). As mentioned in Chapter 2, one should avoid assigning too much pre-work which might make students feel overwhelmed. Meanwhile, adequate time was provided for students to complete the pre-class learning in this study. Moreover, students could be overwhelmed with pre-class work if the subject area required frequent interaction or hands-on training that was difficult for students to learn independently (Cheng et al., 2018). Therefore, instructors have to be judicious with appropriate learning content and the requirements on students to understand. Furthermore, it might be helpful if the FCM was used in senior classes, especially students studying in senior-level professional degree courses, because these students were more able to manage their time effectively when compared with the novice students who were still adapting to their new college life and studies (Busebaia & John, 2020). In this study, the participants are novices and they may be still learning how to manage their time effectively. Therefore, more time and support may be required for them to adapt to their new college life and this new instructional approach.

6.4.2 Lack of familiarity to new instructional approach

In this study, this marked the first time the students underwent a non-lecture-based classroom. Student resistance to the FCM is a frequent theme in the literature (Critz & Knight, 2013; Schwartz, 2014; Choi et al, 2021; Lo & Hew, 2022). In this study, some students

commented, *"I am used to listening to lectures," "I had to work so much harder in the FC, I am not used to it".* Similarly, Hessler (2019) and Hoshang et al. (2021) indicated that students have become accustomed to the traditional lecture-based classroom, so they resisted change when a new instructional approach was employed. Student nurses usually have a traditional view of the lecture-based classroom, that when challenged, can induce frustration and a lack of security in their learning process (Hessler, 2019). Furthermore, Burke and Fedorek (2017) argued that the students did not really dislike FCM, they might not have been prepared for changes in instructional approach. Moreover, it was clear that some students were not accustomed to this type of student-centered learning, therefore their engagement have declined (Van Sickle, 2016; Burke & Fedorek, 2017).

In another study the students' attitudes towards a student-centered learning appeared to influence tensions for those who struggled as they expected a more teacher-centered learning (Bingen et al., 2020). In this study, some students commented, *"I quite depend on the instructor to guide me through every step of learning," "The active learning puts so much on me"*. Similarly, Ratta (2015) reported that student resistance to FCM was not surprising as a shift in the nursing classroom was in evolution, and students are still dependent on the lecture approach; it was familiar and required limited active student participation.

For many students, the FCM does not just represent a different learning method, but it also involves changes in study habits which led to student resistance (Hessler, 2019). Garver and Roberts (2013) revealed that in the TC, students learned how to progress successfully through coursework without enormous effort and thus, usually assumed a more passive role. Such passivity bred a dependency on the instructors as well as caused students to want instruction throughout every step of their learning, even including what to know for the exam. When required to apply knowledge, analyze, synthesize and evaluate information, students usually struggled, and some resisted it (Ge et al., 2020).

Opening up communication to prepare students upfront for this kind of teaching method is necessary. Clear explanations and expectation of pre-work, in-class problem-solving and time management to ease transition in subsequent classes is important (Strategy 1 in Chapter 2). Students were often more open to change if given an explanation about the new learning format and how they benefited from it (Matsuda et al., 2017). To encourage pre-class learning, some follow-up exercise was also used.

The FCM is not yet the dominant instructional approach at associate degree level, therefore it took time for students to buy-in to this new instructional approach (Gilboy et al., 2015). In view of the resistance to new instructional approach, instructors could demonstrate

patience and accept students' negative feelings (Cheon et al., 2018). Instructors could provide more guidance and extra consultation time to assist students in alleviating their concerns related to course content and instructional change (Hoshang et al., 2021).

6.5 Develop a Set of Design Principles for Flipped Learning

In sections 6.1 to 6.4 the findings were discussed, and we now take these findings forward as a set of design principles. This study provided a set of design principles for future practices of FCM. Design principles can give instructors a framework to design and implement their own flipped courses. These design principles are established to promote student learning and engagement. Our set of design principles is based on adult learning theory (Knowles et al., 2005) and the research findings (Table 6.1) and we will now talk about each in more detail.

Table 6.1 Design Principle for supporting student engagement in flipped classroom

Engagement	Design Principle	Action
Behavioral	Provide students orientation and instruction of flipped class	Good communication with students about the expectations of pre-class work Provide a clear course structure and instructions
	Provide clear connections between pre-class and in-class learning.	Provide students an opportunity to apply their pre-class learning in class
Cognitive	Facilitate peer-collaboration in in-class group activities	Encourage students to use their knowledge to share ideas and work together in the group activities
	Provide opportunity of knowledge application.	Design real-world applications and problem-solving within class
Emotional	Provide instructor feedback on individual or group work	Provide timely feedback to assist student problem-solving

6.5.1 Design Principles for flipped classroom

1. Provide students orientation and instruction about the flipped class

As mentioned in section 6.4.2, students normally are more familiar with the traditional lecture-based classroom, that when changed, can bring up feelings of frustration. Students initially may be resistant to a new instructional approach which requires them to engage in the out-of-class learning to prepare for in-class participation. According to adult learning theory (Knowles et al., 2005), adults need to understand the "why" of learning.

First, the instructor could orient students about the objectives and routines of FC to reduce student frustration with instructional change (Strategy 1 in Chapter 2). For example, students are expected to complete pre-class work which builds a foundation for in-class higher-order-thinking activities. A degree of student buy-in can be necessary for successful implementation of the FC, particularly for those that have not experienced it before. Student orientation has proved effective in securing buy-in previously (Dabney & Mitchell, 2017; Gilboy et al., 2015).

Second, a clear course structure and instructions must be designed to facilitate students' preparation for participation and then success in achieving learning objectives. Students should be able to follow the instructions to accomplish the pre-class work and understand they are expected to be actively participating in in-class interactive activities, and case discussion application activities which were interspersed with lecture content. Besides, to facilitate their pre-class learning, a series of short videos which are less than 20 minutes long and created by the instructor is suggested.

2. Provide clear connections between pre-class and in-class learning

Pre-class learning should directly connect with the in-class learning. Previous studies have warned that the lack of connection of pre-class and in-class learning can distract students from engaging in the learning tasks (Oh et al., 2017; Puppe & Nelson, 2019).

Lack of preparation results in low in-class participation. It is essential to link online pre-work to in-class activities whereby students can successfully attain learning outcomes (Long et al., 2017; Puppe & Nelson, 2019). Conversely, students become less motivated in the pre-class learning when they feel it is not valuable. For example, Hessler (2019) reported that students were resistant to the FC when they found the pre-recorded videos were used to continue lecturing after the official class time was over or just giving students more work to do on their own without instructor support.

Effective pre-class learning is critical for successfully implement the flipped classroom. As

mentioned in the literature review, instructors can use different methods such as AR, SV-IVR, chatbots and mobile instant messaging app to support students' pre-class learning (Lu et al., 2021; Jong, 2022; Wut et al., 2022; Hew et al., 2020). It is vital for instructors to apply appropriate approaches to keep students in the right track of pre-class learning (Cheng et al., 2018). To motivate student's pre-class preparation, some online low-stakes assessment or exercises can be embedded after the pre-class videos (Strategy 3 in Chapter 2). During class, the instructor can design some revision exercises such as clicker questions (audience-response system) to reinforce students' learning from pre-class work. Being given an opportunity to apply their pre-class learning in class promotes students' satisfaction (Kim & Jang, 2017). When students find what they learn outside of the classroom is related to the in-class activities, this can increase their learning motivation. Adults learn better with intrinsic motivators (Knowles et al., 2005). When students found the pre-class work was worthwhile, they can be more willing to have pre-class preparation rather than being forced to do so. This increases the students' intrinsic learning motivation, and students could positively take part in the learning tasks (Sergis et al., 2018).

3. Facilitate peer-collaboration in in-class group activities

As mentioned in section 6.2.2, the social interactions may help students connect to the learning environment. The small-group activities are crucially significant parts of the FC (Schwartz, 2014). The instructor can design some in-class group activities within the implementation of FC. In fact, adult learners come with prior experiences which influence their learning (Knowles et al., 2005). Adults bring their life experiences into the classroom, that can either promote or inhibit learning. The instructor can encourage students to use their knowledge to teach one another, share ideas and work together in the group activities. In this way, students could have a better understanding of the content. A learning community can allow students to absorb new material by learning from each other. It is important for instructors to generate learning communities which connect students and support them to collaborate well (Chiang & Chen, 2017).

However, group activities can be challenging because of learning diversity, inconsistent peer participation and discomfort with group work. Some students normally contribute more than others do, leading to inequality in division of responsibility (Chiang & Chen, 2017). One should expect that some shy students may interact less. Thus, instructors should make sure students are prepared for group activities which requires specific norms, rules, and skills. Instructors have to offer clear rules and requirements of group activities and measure individual

participation, because students who do not participate learn less than if they had interacted more (Dabney & Mitchell, 2017).

Group activities can be incredibly challenging, thus there should be well-prepared facilitation and guidance for peer collaboration. Students will expect the instructor to have expertise in facilitating group activities and managing those students who may be disengaged, coming to class unprepared (Koch et al. 2020). As documented in the literature, in-class group activities require the instructors to be knowledgeable of the content, to have honed skills of facilitation in order to promote their understanding of group dynamics (Critz & Knight, 2013; Schwartz, 2014; Jia et al., 2022; Ng, 2021). Students will value the effect of peer collaboration and conduct an effective group work when some guidance is provided.

4. Provide opportunity of knowledge application.

Based upon adult learning theory (Knowles et al., 2005), adults prefer learning that is directly relevant to their lives (Knowles et al., 2005). As mentioned in section 6.2.4, students are more engaged in learning when they find the learning material is relevant to real-world applications. Learning is enhanced when students are engaged in solving real-world problems which they would encounter in their career.

Problem-solving activities which encourage student in-class participation and real-world application of course content can be designed. First, recall that prerequisite knowledge is a foundation of applying new knowledge (Busebaia & John, 2020). Based on student performance in the follow-up exercise, the instructors can clarify students' misconceptions by providing a short review or have a brief discussion with the students at the start of the class.

Second, the advanced topics can be introduced inside the classroom whereby instructors can monitor whether students can follow the presentation in a face-to-face session (Serafim & Meireles, 2019). In this way, instructors can respond to students' questions immediately and elaborate further on difficult topics if needed.

Third, students are provided with an opportunity to applying the new knowledge in solving a sequence of different problems inside the classroom. The problem-solving activities begin with some fundamental exercises and progress to other challenging problems. When students attempt to work on advanced problems at the beginning, any difficulty students encountered might reduce their interest inside the classroom (Van Sickle, 2016). Some fundamental exercises are first provided to strengthen student learning from pre-class work (Strategy 4 in

Chapter 2). For in-class activities, the instructor should plan activities which built on the primary principle students had gained in the pre-class work.

More importantly, the in-class activities have to strengthen and extend the learning in pre-work and in-class lectures. Some advanced problem-solving activities require students to develop skills of application, analysis, synthesis and evaluation. For example, students could participate in group work in which they can discuss aspects of care for more complicated scenarios or assigned problems. In this way, the class activities become a means to engage students in higher-order-thinking.

5. Provide instructor feedback on individual or group work

As mentioned in section 6.3.1.2, students appreciated instructor's feedback. Many students mentioned the need for instructor feedback for different reasons including clarification of content and connection with the in-class problem-solving activities with the out-of-class preparation. The instructor is no longer portrayed as the fount of all nursing knowledge. Instead, they respond to student questions and guide in-class problem-solving (Schwartz 2014). Instructors can generate a positive learning environment where students feel comfortable to ask any questions and where they can expect to get instructor response to their questions.

At the same time, timely feedback should be provided for students' improvement (Hall, 2018). However, the instructor's face-to-face feedback in TC is minimal due to a tight class schedule. In contrast, timely feedback can be provided inside the classroom in the FC. During class, instructors give timely feedback to support learning and act as students' guide on the side throughout their learning process (Post et al., 2015; Puppe, & Nelson, 2019). As a result of shifting direct lecturing outside the classroom, this allows more in-class time to monitor students' work, discussion, question and clarify their misunderstanding. Similar to Puppe and Nelson (2019), instructor feedback is provided to reinforce or clarify students' understanding of the content.

As mentioned in section 6.3.1.2, the students in the FC appreciated that the instructor feedback promoted their understanding of the content and, most importantly, they were willing to complete more challenging learning tasks. Earlier studies have further revealed that well-designed activities which promote peer collaboration and teacher-student interactions have good potential for enhancing students' higher-order-thinking and collaborative skill (Cho et al., 2021; McDonald & Smith, 2013; Philips & O Flaherty, 2019).

6.6 Summary of the Main Finding

In sections 6.2 to 6.3, five main findings of this study were discussed. First, Pre/post-test knowledge, Assignment, Quiz and Final Exam were used to assess the students' learning outcomes. Though there was no significant difference of quiz scores between the two groups, other results revealed that the FC enhanced student achievement compared with the TC. Students identified five major benefits that contributed to the positive result:

1. Flexibility of online learning materials (students could repeatedly watch the materials, use them for revision, use them anytime and anywhere and at their own speed)
2. Peer-collaboration (students could share idea, seek assistance from their peers and work together)
3. Teacher-student interaction (students could discuss with instructors, ask questions and clarify content) in the flipped class
4. Application of knowledge (connecting pre-class and in-class learning) in the flipped class
5. Active learning in the flipped class

Second, a student survey was conducted to investigate the students' self-reported engagement in the flipped class. The results indicated that the students' overall behavioural, cognitive and emotional engagement were positive. There was also a positive correlation between assignment scores and behavioral, cognitive and emotional engagement, as well as between post-test scores and behavioural and cognitive engagement.

The students in this FC had increased interest and satisfaction in the flipped class, suggesting a higher level of emotional engagement in the FC. Two main reasons for their increased emotional engagement were:

1. The FC released more in-class time for problem-solving activities and group work which increased students' degree of enjoyment of the course and interest in participation

2. The FC produced increased teacher-student interaction which allowed more support and feedback by the instructor

The students in the FC were overall willing to invest in learning, indicating a higher level of cognitive engagement in the FC. Two main reasons for their increased cognitive engagement were:

1. The FC increased peer collaboration, which encouraged them to think more in-depth about challenging questions.

2. The FC allowed more opportunity to apply knowledge, which increased their ability to solve challenging problems.

Some students in the student survey did not prefer the FC. Two main concerns associated with FCM were identified:

1. There is a time burden for the prework.
2. There was a lack of familiarity to new instructional approach

For these two concerns, three recommendations for future practices were provided:
1. Give adequate time for students to complete the pre-class learning.
2. Give more time for students to buy in to the FC.
3. Provide extra consultation time to support their learning

Chapter 7 Conclusion

7.1 Introduction

First, this chapter will describe an overview of this study (Section 7.2). Then, the main findings (Section 7.3) and implications for future practices of flipped nursing courses (Section 7.4) are presented. Next, the limitations of this study are acknowledged (Section 7.5). Lastly, it will conclude with some recommendations for future research (Section 7.6).

7.2 Overview of this Study

This study aimed to examine student achievement and engagement under two instructional approaches: (1) Traditional classroom, (2) Flipped classroom. A set of design principles were designed in order to implement the flipped nursing class. The main study was conducted in a 12-week nursing foundations course (total 12-week course) in a local Hong Kong community college. In 2019-2020, 141 students were involved in the traditional class. In 2020-21, 130 students participated in the flipped class.

To promote the implementation of the main study, a literature review of the flipped classroom and a pilot study were carried out. The literature review focused on student academic achievement and student engagement in a flipped classroom setting generally and with focus on nursing education. Five recommendations were provided to guide the practices of the different stages of the FC. For example, Strategy 1 in Chapter 2 suggested that instructors should explain the objectives and routines of the flipped class to reduce student frustration with instructional change. Prior to the main study, a pilot study was conducted with first-year associate nursing students enrolled in the Health Assessment course. In 2018-2019, 179 students were in traditional class. In 2019-2020, 121 were in flipped class.

Building on experiences gained in the pilot study, some implications were drawn for the main study with regard to the design of the flipped class and research methods to be used. For example, for the research methods, it was realized that the way of collecting the data in the pilot was unable to relate the engagement with the academic outcome. Therefore, the author planned to correct this in the main study.

In the main study, a mixed methods approach was employed. The mixed methods

approach was an explanatory sequential design in which qualitative data were used to explain the quantitative results. The quantitative data included pre/post-test scores, assignment, quiz and examination scores and student engagement survey with both closed and open-ended questions that were then categorized. The qualitative data included student semi-structured focus group interviews. To evaluate student achievement, the pre/post-test scores, assignment scores, quiz and examination scores served as objective measurements of student learning outcomes. To investigate student engagement, the student survey and student interviews were the main data sources for investigation.

7.3 Main Findings

This study indicated five main findings. First, assignment and examination scores demonstrated that the flipped class group outperformed the traditional class group. Whereas the pre/post-test demonstrated that the students in the flipped class improved to a greater degree than those in the traditional class. A demonstrated improvement was evident for both groups but across the term the improvement was greater in the flipped class.

Because the majority of existing studies were conducted in undergraduate nursing courses, the current study can provide additional evidence that flipped classroom methods can increase student achievement in associate nursing courses. The benefits which led to such an improvement were in line with the literature on flipped nursing course (Greenwood & Mosca, 2017; Joseph et al., 2021; Kim & Jang, 2017; Oh et al., 2017; Hu et al., 2018; and Tan et al., 2017). These benefits include flexibility of online learning material, more peer collaboration, more teacher-student interaction, greater application of knowledge and active learning. The ability to pace their learning, in-class group discussion, concept clarification, learning problem-solving skills were also commonly reported as positive experiences gained from the FC.

Second, overall student engagement (e.g., behavioral, cognitive and emotional engagement) was positive. There was also a positive correlation between assignment scores and behavioral, cognitive, emotional engagement. For cognitive and emotional engagement, both correlations had a medium effect sizes while a small-to-medium effect size for behavioural engagement. A positive correlation was also found between quiz and total engagement. There was also a positive correlation between post-test scores and behavioral and cognitive engagement. This study provides further evidence that flipped classroom methods can promote students' behavioral, cognitive and emotional engagement in the in-class learning and after-

class assignment.

Third, this study indicated there was a positive correlation between assignment score and emotional engagement in the FC. Emotional engagement refers to satisfaction and feelings of interest in the course (Fredricks et al., 2004). The students in the flipped class had increased interest and satisfaction. The reasons for increased emotional engagement included releasing more in-class time for problem-solving activities and group work which increased students' degree of enjoyment of the course and interest in participation, as well as increasing teacher-student interaction which allowed more support and feedback by the instructor.

Fourth, this study revealed there was a positive correlation between cognitive engagement and assignment score, quiz score as well as post-test score in the FC. Cognitive engagement refers to investment in learning (Fredricks et al., 2004)**.** The students in the flipped class were generally motivated to complete other complicated problem-solving assignment. The reasons for increased cognitive engagement included increasing peer collaboration. This supported them to think more deeply about complicated scenarios as well as allowed more opportunities to apply knowledge. In this way, the FC helped to increase students' ability to solve challenging problems.

Fifth, some students in the student survey did not prefer the flipped class. This was explained by the time burden for the pre-class work and a lack of familiarity with the new instructional approach. This finding suggested that the instructors have to collaborate with students to prepare their transition from traditional to flipped learning. In future practices, instructors should allow more time for students to buy in to flipped class and give adequate time for students to accomplish the pre-class learning.

7.4 Implications for Future Practices

It takes time for students to adopt to instructional change. Instructors should anticipate student resistance and take measures to support their students for transition from traditional lecture-based classroom to flipped classroom. Instructors can reduce student frustration with instructional change by providing student orientation of the objectives and routines of flipped class. A set of design principles to guide future practices of flipped class is suggested in this study. Based upon Adult Learning Theory (Knowles et al., 2005), 5 design principles aim to support student engagement in flipped classroom. Design principle 1 suggested that some students take time to adopt to the instructional change. Instructors have to support their students

in transitioning from traditional lecture-based classroom to flipped classroom. Instructors should provide an orientation and a clear instruction of flipped classroom. To facilitate students' pre-class learning, a series of short videos which is less than 20 minutes long and created by the instructor was suggested. Design principle 2 is to motivate students to engage in the learning tasks by connecting pre-class and in-class learning. Design principle 3 is to facilitate peer-collaboration in in-class group activities. Design principle 4 is to engage students in the class by real-world application. Design principle 5 suggests that instructor feedback is given in timely manner to help students problem-solving.

7.5 Limitations

Several limitations of this study are acknowledged. First, this study was conducted in one 12-week semester course in one institution. Thus, the generalizability of this study is limited due to one course and one institution studied. Second, as a teacher-researcher, the researcher was responsible for teaching and conducting the study such as the interviews. Students may give socially desirable response during the interview as a result. The interviewees were however given the opportunity to review the transcripts and final report (member checking) to reduce this risk. Besides, the researcher professionally works with students and therefore no preconceived biases to the result of the study were found. Furthermore, the engagement survey was not given to the TC group, and so the study cannot make any specific conclusions about whether the FC increased engagement in comparison to the TC. Finally, data collection was taking place in the pandemic. The face-to-face class was changed to flipped virtual classroom for the first two classes and to mixed mode afterwards. The virtual element in the flipped classroom may affect student learning. The researcher tried to investigate the effect of the virtual element in the flipped classroom through the student interviews.

7.6 Recommendations for Future Research

Because the flipped classroom method has begun to be implemented more widely at this community college, there are many potential areas for future research. The following items are recommended as components of further data collection. First, additional ways to measure in-class participation objectively could provide more data to examine the effectiveness of the

flipped classroom. Second, one-month delayed assessment data could be collected for longitudinal analysis to investigate the long-term effects of FC regarding knowledge retention. This includes individual program or multiple program analysis, comparing flipped class and traditional class. Finally, this study had the limitation of involving only one community college and one flipped course. It is recommended that future research include comparisons of several health-related flipped courses from more than one institution.

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Appendix 1 Student Survey

Student Learning Survey

Many thanks for filling out the survey! This research relies on the data gathered through this survey for understand your perceptions of teaching methods. The survey collects data about learning experiences and learning outcomes on this course. All students are invited to participate.

Personal Data Protection:
The identity of all students completing the survey will be kept strictly confidential, and any reports generated from the data will not carry any personal details. The Personal Data (Privacy) Ordinance will be strictly complied with.

Participation:
Participation in this survey is on a voluntary basis and will take about 10-15 minutes. You can choose to terminate your participation at any time without negative consequences. If you understand and agree to participate in this survey, please complete the survey.

Age: ____ Gender: ____
DSE best five score: _____ Other academic result: _____
Do you have any experience of the flipped classroom? Yes ○ No ○
How comfortable do you feel to virtual element? Very comfortable ○ Neutral ○ Not comfortable ○

Strongly disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6	7

	1	2	3	4	5	6	7
Q1. When I'm in this class, I listen very carefully	○	○	○	○	○	○	○
Q2. I pay attention in this class	○	○	○	○	○	○	○
Q3. I try hard to do well in this class	○	○	○	○	○	○	○
Q4. In this class, I work as hard as I can	○	○	○	○	○	○	○
Q5. When I'm in this class, I participate in class discussion	○	○	○	○	○	○	○
Q6. When I study for this class, I try to connect what I am learning with my own experience	○	○	○	○	○	○	○
Q7. I try to make all different ideas fit together and make sense when I study for this class	○	○	○	○	○	○	○
Q8. When doing work for this class, I try to relate what I'm learning to what I already know	○	○	○	○	○	○	○
Q9. I make up my own examples to help me understand the important concept I am studying for this class	○	○	○	○	○	○	○
Q10. When we work on something in this class, I feel interested	○	○	○	○	○	○	○
Q11. This class is fun	○	○	○	○	○	○	○
Q12. I enjoy learning new things in this class	○	○	○	○	○	○	○
Q13. When I'm in this class, I feel good	○	○	○	○	○	○	○

Q14. When we work on something in this class, I get involved	○	○	○	○	○	○	○
Q15. I let my teacher know what I need and want	○	○	○	○	○	○	○
Q16. I let my teacher know what I am interested in	○	○	○	○	○	○	○
Q17. During this class, I express my preferences and opinions	○	○	○	○	○	○	○
Q18. During class, I ask questions to help me learn	○	○	○	○	○	○	○
Q19. When I need something in this class, I'll ask the teacher for it	○	○	○	○	○	○	○
Q20. I adjust whatever we are learning so I can learn as much as possible	○	○	○	○	○	○	○
Q21. I try to make whatever we are learning as interesting as possible	○	○	○	○	○	○	○

1. Do you have any additional feedback/ comments about the teaching method of video lecture before class and in-class activities?

2. Anything (e.g. suggestion, thoughts) would you like to add about your experience?

3. Which are your favorite aspects of the teaching method of video lecture before class and in-class activities?

4. Compare the following two teaching methods which do you prefer? Give the reason

Method A: The majority of class time is spent on content presentation by the lecturer and a relatively short amount of time is spent on assignments and other activities.
Method B: A relatively small amount of class time is spent on content presentation by the lecturer (because content presentation takes place in video) and most of the time is spent on individual and group assignments, exercises and other activities.

Appendix 2 Student interview guide

Student Semi-structured Interview guide

Introduction

1. Explain the aims and nature of the study to the interviewees
2. Reassurance participants' names will be changed in recording and reporting of data to maintain confidentiality
3. Ensure all participants can speak honestly and openly, without fear of punishment if raising negative comments. The study only interested in their opinions and learning experiences
4. Ensure all participants are free to clarify with the interviewer if they have any concerns
5. Ask for permission to record the interview. Explain that it is for research purpose only. If the participants do not want to be audio-recorded, the interviewer will take notes instead.
6. Remind all participants will have a chance to review the transcripts and final report.

Part 1: Student Engagement

a) Behavioral
   - Effort (e.g. pre-class activities, homework, classwork)
   - Attention (e.g. pre-class video, face-to-face class)
   - Contribution to learning activities (pre-class preparation, in-class participation, group discussion and interaction)

b) Cognitive
   - Self-regulated learning (e.g. study strategies, coping strategies of new teaching method, active learning rather than passive learning)
   - Investment in learning (e.g. desire to go beyond requirements)
   - Preference for challenge (e.g. preference of traditional or flipped classroom)

c) Emotional
   - Satisfaction (e.g. pre-class learning materials, in-class learning activities)
   - Interest or boredom
   - Feeling (e.g. individual out-of-class learning, peer interaction, sense of belonging, happiness, excitement, sadness, anxiety and frustration in the course)

Part 2: Student perceptions of flipped classroom

a) Students' opinion toward the flipped classroom
b) Students' opinion toward the virtual element. How comfortable do you feel to virtual element?
c) Benefits
d) Challenges
e) Advice for improvement
   - Instructional video (e.g. video styles, duration, contents)
   - Online follow up exercises or quiz (e.g. format, quantity, level of difficulty)
   - In-class activities (e.g. problem solving and collaborative learning activities, student response and open questions, mini-lecture, peer interaction, teacher-student interaction)
   - After-class activities (e.g. discussion, project)
   - Hardcopy learning materials
   - Learning management system

Appendix 3 Consent Letter

Informed Consent Form

[redacted]

Flipped classroom method in Associate Degree of Nursing

Dear students,

I am Emily Ng, a researcher from the Faculty of Education at the University of Bristol, in the United Kingdom. I am now conducting a study on the flipped classroom method in Associate Degree of nursing and would like to invite you to participate. The purpose of this study is to examine the effect of the flipped classroom method on students' academic performance and engagement in Associate Degree nursing students. You will be placed in a flipped classroom (a type of E-learning). The course activities will be different approaches to meet course objective, but the content of the courses will be the same.

If you agree to join this study, you will be invited to

1. Complete a survey to provide your perceptions of the teaching methods.
2. Complete a pre-, post- and delayed post-test.
3. Participate in an interview, to express your opinion of the teaching methods. The interview will be audio-recorded. If you do not want to be audio-recorded, the researcher will take notes instead. Your opinion will not affect any of your school grades or teachers' perception of you.

Final examination scores will be also analyzed anonymously to determine if difference exist in academic performance between the two teaching methods. There are no known risks in this study. There are no direct benefits for you participating in this study. However, your participation will contribute to the knowledge about student learning and best practice teaching method.

Your participation is voluntary. You can choose to withdraw from participation at any time without negative consequences and we will erase all the data collected from you. You will remain in the same learning environment, however your assessment scores will not be analyzed, and you will not be required to fill out the survey/interview. You have the right to review and erase the audio records. All information obtained will be kept strictly confidential and used for research purpose only. To ensure confidentiality, all identifiers will be coded. Participant's name or any personal information will not be identified in any publications and public dissemination activities. For the audio recordings, all files will be password protected. The information collected will be securely stored in a locked cabinet at the researcher's office, and will be destroyed 3 years after publication of first paper of the study.

Participants must be 18 years of age or older to participate in the research study. If you have any questions about research, please feel free to contact Emily Ng [redacted]. If you have any concerns about the conduct of this study, please contact the Human Research Ethics Committee for Non-Clinical Faculties, [redacted]

If you understand the contents described above and agree to participate in this research. Please sign below. Your help is very much appreciated.

Yours sincerely,

Emily Ng
[redacted]

Student Reply Slip

Signing this consent form, I have:
-read and understood the information provided
- been given the chance to ask any questions I may have
- understand that my participation is voluntary.
- understand that I have the right to withdraw without consequence
- understand that my opinion will not affect any my school grades
- understand that the information obtained will be kept strictly confidential and used for research purpose only

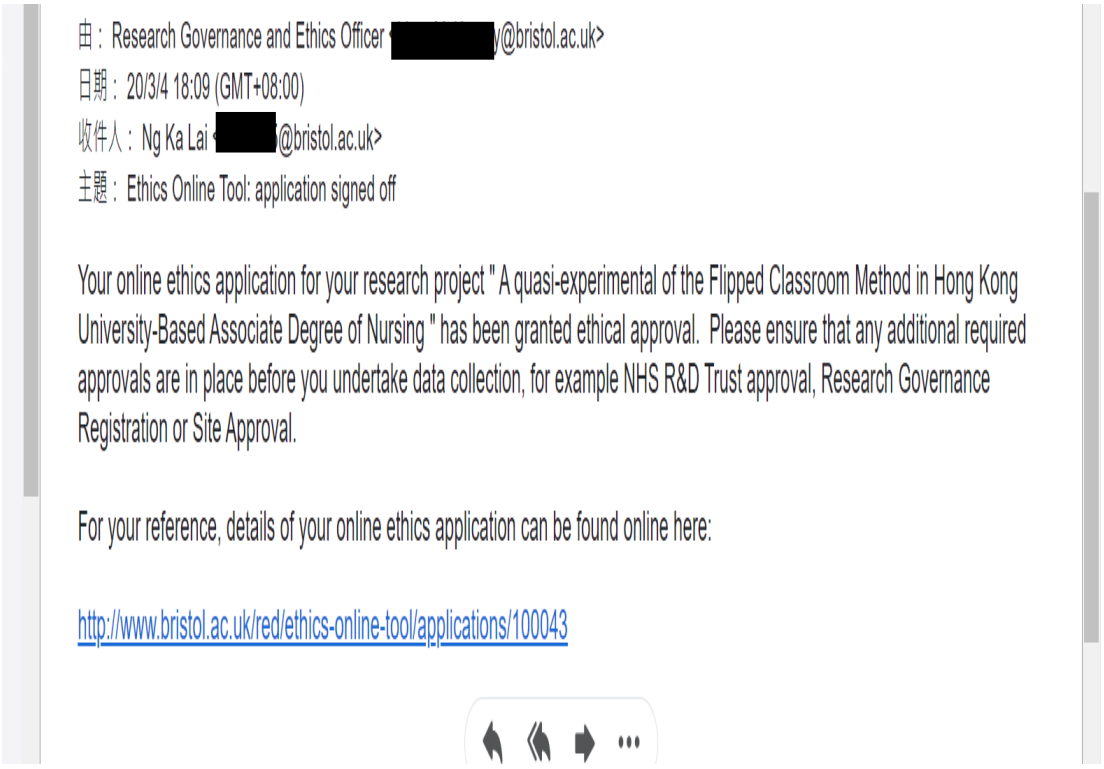
I _____ (Name of Participant)

understand the procedures described above and agree to participate in this study.

_____
Signature of Participant

_____
Date

Appendix 4 Permission to Conduct Study



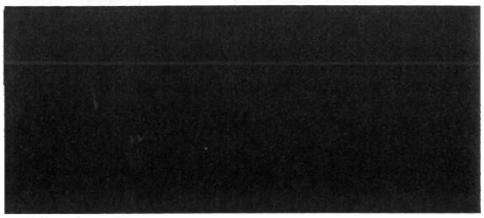
由：Research Governance and Ethics Officer <[redacted]@bristol.ac.uk>
日期：20/3/4 18:09 (GMT+08:00)
收件人：Ng Ka Lai <[redacted]@bristol.ac.uk>
主題：Ethics Online Tool: application signed off

Your online ethics application for your research project " A quasi-experimental of the Flipped Classroom Method in Hong Kong University-Based Associate Degree of Nursing " has been granted ethical approval. Please ensure that any additional required approvals are in place before you undertake data collection, for example NHS R&D Trust approval, Research Governance Registration or Site Approval.

For your reference, details of your online ethics application can be found online here:

http://www.bristol.ac.uk/red/ethics-online-tool/applications/100043

Appendix 5 IRB Approval Letter Study Site



25 February 2020

Dear Emily,

Application for Research Ethical Approval

Research Proposal: Flipped Classroom in Hong Kong Associate Nursing Students

I am pleased to inform you that your application for the ethical approval of the above research has been approved-in-principle by the Research Ethics Committee (REC) of [redacted] on the following conditions:

1. Three years may be too long for the retention of data. If it is not a requirement from the British university where the Principal Investigator (PI) is studying for a degree, the PI should explain the reason behind this retention period.

2. On the proposed consent form, students are told they will be placed in either a traditional classroom or a flipped classroom. However, the consequence is not stated clearly if a student placed in a traditional class wishes to be in a flipped class and vice versa. It appears they have no choice.

3. The PI should prepare a full list of guidelines for the students to be clear about the research. The guideline list should be sent to the Committee for retention purpose later when they are ready.

4. If the PI insists on conducting focus group discussion, she should ensure that she will not teach the focus group participants again in any other courses in the future and conduct the focus group discussion after the end of the semester (as she suggested). If she will teach the participants in any other courses in the future, she should conduct the focus group discussion in an anonymous manner, such as inviting an independent person to do the subject recruitment, and conducting the discussion through VC/Zoom without the participants' faces and names being disclosed. The PI is also required to submit to REC a revised informed consent for the focus group discussion, stating clearly her measures to ensure that the participants can freely express their views without any negative consequences.

5. In relation to the potential risks caused by limitations/disadvantages of flipped classes, it might be better if the PI could include an Emergency Preparedness Plan although the PI suggested several strategies to minimize the risks.

6. The PI should consider whether some actions will be taken to help the students if the coursework marks in the flipped class group are significantly lower than the traditional class group.

You are kindly reminded to submit, as appropriate, a report for research progress or amendment of an approved project, if there are significant changes to your research, or an adverse incident, or when the report for annual progress is due.

Yours sincerely,

Chairman

Research Ethics Committee

Appendix 6 Sample of Pre-class Video

Case Scenario

Client Name	**Mr. Li**	
Age/Gender	75/M	
Hospital	KEC Hospital	
Ward	Surgical ward	
Date of admission		
Reason of admission	Clinically admitted for right eye cataract extraction and intraocular lens implantation	
Medical diagnosis	Right eye cataract	
Past medical history	PR bleed due to haemorrhoids in 11/2010	
Allergy	No Know food and drug allergy	
Mental state	Oriented	
Conscious level	Alert	
Physical Assessment	Blood pressure	171/95 mmHg
	Pulse	104 beats per minute
	Body temperature	37.5°C
	SpO_2	97% RA
	Weight	58kg
	Height	160cm

Goals & Expected outcomes

Acute Pain related to tissue trauma secondary to surgery as evidenced by increased blood pressure and pulse

Goals (general)

- Goals: Mr. Li will experience less pain.

Expected outcomes (measurable, realistic in achievable time frame)

- Mr. Li will rate less than 3 out of 10 for the intensity of pain after 3 days.
- Mr. Li will be able to identify one pharmacological and one non-pharmacological to relieve pain immediately after health education.