The Effects of Concept Mapping in Student Nurses' Learning of Medical-Surgical Nursing

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by

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Acknowledgements

This 5 years of intensive learning definitely has not been an easy journey for me because it was filled with a lot of challenges and many ups and downs. I am glad to have finally reached this point, the last stage of this journey and the opportunity to write this note of thanks in my thesis.

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Abstract

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Key words: Concept map, VARK model, medical-surgical nursing, learning style, grounded theory

Many student nurses are weak in studying medical-surgical nursing because high-order and critical thinking skills are required to understand and incorporate prior knowledge with new knowledge, and they are expected to formulate a holistic nursing care plan. Concept mapping (CM) was adapted in one medical-surgical nursing course in a higher private education institute in Hong Kong to enhance their learning. This study aimed to explore the effect of CM on student nurses' learning experience and examine the difference in academic performance of students who learned this subject by using CM and those who did not. Difference in academic performance based on five sensory modalities using Fleming's visual, aural, read/write, kinaesthetic, and multimodal (VARK) model was also explored. Lastly, a substantive theory was developed by using the grounded theory approach together with qualitative and quantitative results. The quantitative results showed that the pass rate of CM and non-CM groups was 100% and 77.59%, respectively. The difference of marks between the CM group (M=77.90 and SD=8.09) and non-CM group (M=57.56 and SD=10.16) was statistically significant (p=0.000) with a large effect (Cohen's d=2.21). However, no significant difference was observed in students with different sensory modalities, thereby suggesting that students with different sensory modalities benefit from CM use. In addition, 26 student nurses were interviewed during focus group discussion. Students

from all sensory modality groups perceived CM as an effective tool to determine the relationships between nursing problems and nursing interventions in a systematic and well-organized manner via categorization. This form of presentation provides them a clear and overall picture in a short period, thereby enhancing their understanding, memorization, and retention of topic. However, some shortcomings of CM were also identified such as extensiveness, time-consuming, more confusing and too simple nature. Therefore, after the new and prior knowledge was bridged, students used their own perceived effective method to re-organize the knowledge to enhance their memory to prepare for the written examination. Both quantitative and qualitative results revealed that using CM seems able to improve the students' academic performance, and students gained a good understanding of relationships between concepts in medical-surgical nursing, particularly for students who are new in the subject. A substantive theory was finally developed which explains the relationships between teaching with an animated structural diagram and students' learning, and thus, the change of students' behaviour for attaining a better grade in the written examination.

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Statement of Original Authorships

The work contained in this thesis has not been previously submitted to meet requirements for any other award or credit at this or any institute of higher education. To the best of my knowledge, the thesis is wholly original and all material and writing published or written by others and contained herein has been duly referenced and credited.

Signature: Julia Wong

Date: 15 November 2017

List of Abbreviations

ANOVA	One-way analysis of variance
CFI	Comparative fit index
CILO	Course intended learning outcome
CM	Concept map/mapping
CT-C(M-1)	Correlated trait-correlated methods minus one
CTCM	Correlated trait-correlated method
CTCU	Correlated trait-correlated uniqueness
CTUM	Correlated-trait-uncorrelated method
GPA	Grade point average
GT	Grounded theory
HASC	Committee on the use of human and animal subjects in teaching and research
IBM	International business machine
MM	Mind map/mapping
MTMM-CFA	Multitrait-multimethod confirmatory factor analysis
NCD	Non-communicable disease
NNFI	Non-normed fit index
NFI	Normal fit index
PBL	Problem-based learning
PILO	Programme intended learning outcome
RCT	Randomized controlled trial
RMSEA	Root mean square error of approximation
sGPA	Semester grade point average
SPSS	Statistical product and service solutions
SRMR	Standardized root mean square residual
TLI	Non-normed fit index
UoL	University of Liverpool
VARK	Visual, aural, read/write & kinesthetic
VPREC	Virtual programme research ethics committee
WLSMV	Mean- and variance-adjusted weighted least squares estimator

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Chapter 1. Introduction

Over the past six years in nursing education, I have been teaching medical-surgical nursing which is a core discipline subject in all nursing programmes. I realize that no matter whether in private or public nursing schools, many student nurses are weak in studying it and the pass rates are relatively lower than other nursing courses. Generally, this subject is arranged as a series of 4-5 courses spread over their 5-year study. In the researched institute in Hong Kong, the courses are named Care of People with Non-Communicable Diseases (NCD) I, II, III and IV. It is a critical component of a bachelor nursing programme and crucial element in the nursing profession because students learn the signs and symptoms of diseases, diagnostic tests, medical treatment and corresponding nursing interventions. This body of knowledge provides foundations for their clinical practice. Many student nurses informally reflect that they encounter difficulty in constructing medical-surgical nursing knowledge. Researchers suggest that this is because higher-order thinking and critical thinking skills are required for the studying of this subject (Kaddpura, Van-Dyke & Yang, 2016). Students are first required to understand and connect their prior knowledge, such as anatomy and physiology, pathophysiology and pharmacology with the new knowledge. The new knowledge in this study means medical-surgical nursing. After that, the student nurses need to analyse the biological, psychological, and sociological impacts on patients, and implement corresponding nursing interventions. Furthermore, the nursing interventions embody a 5-step nursing process which includes assessment, diagnosis, outcome/planning, intervention and evaluation. Consequently, the students are expected to be able to formulate a nursing care plan under a holistic approach.

On average, 3-4 organ systems are taught in each medical-surgical course, and 2-3 diseases should be taught for 2-hour each lecture throughout the 14-week semester in the researched institute. The usual practice in the researched course is that nurse educators are accustomed to using conventional PowerPoint lectures in classroom teaching, and then scenario-based exercises are given to students for discussion in groups in the tutorial sessions. Tutorial sessions are arranged 1-2 weeks after the corresponding lectures. Students are required to self-study using textbook for details. Consistent low pass rate and informal students' feedback illustrated that the current teaching method may not help students to understand the relationship between prior knowledge, that is the impacts of diseases, and new knowledge which include the identification of health problem and corresponding nursing interventions. Therefore, an effective teaching/learning tool that promotes meaningful learning, that is facilitates the incorporation of new knowledge into prior knowledge, should be considered (Novak, 2010).

In order to promote critical thinking in medical-surgical nursing, nurse educators use different types of teaching methods including group discussion (Platzer, Blake & Ashford, 2000); reflective learning in the USA (Forneris & Peden-McAlpine, 2007); problem-based learning in China (Yuan, Kunaviktikul, Klunklin & Williams, 2008), USA (Jones, 2008), and Hong Kong (Tiwari, Chan, Sullivan, Dixon & Tang, 1999); simulation teaching in Korea (Shin, Ma, Park, Ji & Kim, 2015); and concept mapping (CM) in Taiwan (Lee, Chiang, Liao, Lee, Chen & Liang, 2013; Tseng, Chou, Wang, & Ko, 2011), Canada (Harrison, & Gibbons, 2013), and USA (Hinck, Webb, Sims-Giddens, Helton, Hope, Utley, Savinske, Fahey & Yarbrough, 2006). Among these teaching tools, CM is efficient and considered a valuable teaching method for incorporating prior knowledge with new concepts in nursing and other disciplines

(McMillan, 2010; Pottier, Hardouin & Hodges, 2010; Sadler, Stevens, Willingham, 2015). Hence, I intended to adopt CM in one of the medical-surgical nursing courses in my institute.

Although CM is a powerful metacognition and visual tool (Novak, 1990) to promote meaningful learning and enhance students' critical thinking and problem-solving skills (Moattari, Soleimani, Moghaddam & Mehbodi, 2014; Sarker, 2015; Samawi, 2006; Tseng, Chou, Wang, Ko, Jian & Weng, 2011; Vacek, 2009; Wheeler and Collins, 2003), I had the following enquiries. Is CM only favourable for visual learners? How about those people who dominant with other sensory modalities in their learning? Can they also benefit from CM? According to the Neil Fleming's VARK model, there are five different types of sensory modalities which include visual, auditory, read/write, kinaesthetic and mixed modality. Therefore, this study has also explored the effects of CM in visual, auditory, read/write, kinaesthetic and multimodal dominant learners with the VARK questionnaire as this is an area that no researcher has explored yet and there is no relevant study regarding the use of CM in nursing education in Hong Kong thus far.

1.1 Problem Statement

Many student nurses informally reflect that they encounter difficulty in constructing medical-surgical nursing knowledge and the pass rates are very low because it requires higher-order thinking and critical thinking skills. In addition, there are limited research studies that have explored the effects of CM on people with different sensory modalities in learning. Therefore, the problems addressed in this study are the need to enhance students' understanding of medical-surgical nursing knowledge and increase the pass rate of this subject.

1.2 Research Aims and Questions

The aims of this study are to explore the impact of CM on student nurses' learning of medical-surgical nursing and thus generate a substantive theory regarding the relationship between CM and students' learning process. Furthermore, differences in academic performance among students with different sensory modalities in learning will also be explored. Therefore, the guiding research question is 'What is the effect of CM on student nurses' learning of medical-surgical nursing knowledge? Specifically, the following sub-questions will guide the study:

1. Is there a difference in pass rate and overall grade in medical-surgical nursing course between students who were taught this subject by using CM and those who did not?

2. Of the students who were taught by using CM in medical-surgical nursing, is there a difference in pass rate and overall grade based on different sensory modalities?

3. What are the students' perceptions of using CM to learn medical-surgical nursing, and do their perceptions differ based on sensory modalities?

4. What is the relationship between CM and the students' learning process?

1.3 Background of Students

Hong Kong is part of China. Although our mother tongue is Cantonese, not Mandarin, we are Chinese. English is the medium of instruction in all of the higher education institutes in Hong Kong including the researched institute. The targeted students were the second- or third- year student nurses pursuing a 5-year Bachelor of Health Science (Honours) in Nursing programme in my institute. They will become a

Registered Nurse after completion of the programme. All of them were local (Hong Kong) people and able to communicate in Cantonese as this is the mandatory requirement for admission as student nurses. This is because Cantonese is the mother tongue of Hong Kong and over 90% of the population is Hong Kong people. Students either graduate from the secondary education or sub-degree programmes and their academic qualifications meet the minimum requirements stipulated by the Nursing Council of Hong Kong.

1.4 Justifications for Using Grounded Theory (GT) and Mixed Methods in this Study

Which type of research method to use should be determined by deciding which is the best approach to answer the research questions and thus achieve the study aims. Given that sub-questions 1 and 2 refer to some sort of numeric data, the most appropriate approach is to use quantitative methods to measure the systematic differences between groups. In particular, it is manageable with a large sample size. However, the exploration of in-depth personal feelings is required to answer sub-question 3, so a qualitative method will help to collect these narrative data, that is individuals' lived experiences in a deeper sense. To utilize both quantitative and qualitative methods in this study can take advantage of their strengths and complement each other's weaknesses, that is to display a comprehensive picture with subjective and objective data which is closer to explain the phenomenon. Using both quantitative and qualitative methods can only answer all the sub-questions and achieve one of the aims; therefore, grounded theory is used to answer the last research question and achieve the remaining aim which is to generate a theory through combining the quantitative and qualitative data. Although grounded theory is a classical method associated with qualitative research, researchers can use it with any types of data which means either

quantitative or qualitative, or even mixed data (Denzin and Lincoln, 2000; Glaser, 2002; Holton & Walsh, 2017; Walsh, 2014a, 2014b, 2014c). Thus, it is the only method that can help to generate an inductive theory about a phenomenon through systematic and rigorous data collection and an analytical procedure (Glaser, 1978; Strauss & Corbin, 1990). Although my original intention was to use the tenets of GT to develop a theory, the ethics of the situation is to introduce CM, collaborative learning, the VARK model and questionnaire as the interventions and tools of this study. Hence, it was necessary to preclude imposing a process that was untested through the research literature. I therefore used all the other processes associated with GT, that is, theoretical sensitivity, getting started, all is data, use of the literature, open coding, constant comparative method, core category, selective coding, delimiting, memoing, theoretical coding, sorting and writing up, and analytical rules developed through sorting and pacing (Glaser & Holton, 2004; Holton, 2008). I recognise that the use of a literature review to guide the choice of teaching method could, from the perspective of traditional GT, create some bias, but I tried to counter this in the interpretation of the results.

1.5 Research Positioning

The personal characteristics of a researcher may affect his/her positioning in the research study such as gender, race, age affiliation, beliefs, biases, preferences, theoretical, political and ideological stances as well as the emotional responses to participants. These may further impact their research work in different ways. For instance, the researcher may have easy access to the researched people, context and useful resources because of their known relationships, respondents may be more willing to share their experience with the researcher as they may perceive as sympathetic to their situation or the inherent relationship (Berger, 2015; De Tona, 2006). In addition, the researcher's own background and belief would affect his/her thinking, decision and

behavior. Therefore, the researcher may use his/her lens to filter the collected data as well as to shape the findings and conclusions of the study (Kacen & Chaitin, 2006; Berger, 2015).

I am a senior lecturer working under the School of Nursing in the researched institute and responsible for teaching the bachelor nursing programme. Hence, the relationship between the researched participants and me is teacher-student relationship. I may have taught them in the past and may have opportunity to teach them in future. Since I realized the potential effects of researcher's positioning in the study, I tried to separate my dual roles, that is teacher and researcher by all means. First, I have not been involved in teaching the course in order to minimize the contamination of study. Second, a member of the clerical staff was assigned to distribute the VARK questionnaires and drop-in box was provided for collecting the returned questionnaires. Third, I recruited the students for focus group interview by sending them email only. These measures further eradicate the influence of researcher-researched relationship. However, the impact of my dual roles contributing in data collection, data analysis and interpretation of findings cannot be avoided in some circumstances particularly in qualitative research because as a researcher, the researched subjects and I are occupying the same world and are mutually influencing (Cutcliffe, 2003). For instance, some interviewees may know me before, a mutual trust teacher-student relationship has already been established so that they were more willing to participate in the study and felt comfortable to share their learning experience. Nevertheless, the declaration of researcher's position in the study is necessary to allow audience to judge the researcher's objectivity. Thus reflexivity should be employed in different stages to increase the transparency and trustworthiness of the study including the research design,

data collection, data analysis and report writing (Gentles, Jack, Nicholas, & McKibbon, 2014).

1.6 Significance of the Study

According to the syllabus stipulated by the Nursing Council of Hong Kong (2014), medical-surgical nursing contributes nearly a quarter of the total number of teaching hours. Given the essential and critical role of medical-surgical nursing in the nursing profession, and the challenges students face in mastering this subject, nurse educators have the responsibility to explore teaching methods that facilitate more effective learning to students. To become a competent nurse, student nurses are required to be equipped with such knowledge and further apply it in clinical practice in order to provide appropriate, effective and holistic care to patients. Therefore, improving student learning in this subject is of paramount importance to students, the College and the nursing profession.

1.7 Conclusion

This chapter explained the background and significance of this study. To facilitate the student nurses' understanding of medical-surgical nursing and increase the pass rate, I tried to adopt CM as a means to improve their learning in this study. Hence, the aim of this study was to explore the impact of CM on student nurses in terms of their academic results, pass rates and learning experience with a mixed research method. Thus, a substantive theory will be developed finally for explaining the relationship between CM and students' learning process. The following chapter is literature review. It will provide in-depth overview about the key components of this study, that is CM, collaborative learning and VARK questionnaire.

Chapter 2. Literature Review

2.1 Introduction

Glaser (1998) emphasized that the importance of a GT-researcher is to avoid preconceptions and remain open-minded to what the data reveal about the researched field. Hence, he warned that an early overwhelming reading of the literature before conducting a study is not suggested because the pre-conceptions gained from the pre-study literature review and predetermined theoretical frameworks will damage the research by misleading the GT-researcher's direction of exploration. Therefore, I followed Glaser's suggestion. The following section is the first round of literature review which only focuses on the prevalence of CM in nursing education as well as other disciplines, collaborative learning and VARK questionnaire. A detailed understanding of these three areas is necessary because as a teacher as well as a researcher, the introduction of a new teaching method in a researched course should be evidence-based and ethically sound. Moreover, the literature review did provide some insights into the design of the CM implementation and research methodology of this study. A second literature review was conducted after the emergent theory had sufficiently been developed. It was mainly used for comparing this and other studies repeatedly in order to confirm the relationship between categories, thus developing a substantive theory. The contribution of the second literature review in developing the substantive theory will be discussed in Chapter 6.

2.2 Research on Concept Maps

From the extensive research studies, CM most likely is an effective learning method and assessment tool to promote students' critical thinking and problem-solving skills (Minitzes, Wandersee & Novak, 2000; Novak, 1990 Novak & Gowin, 1984)

particularly when used together with collaborative learning (Daley & Torre, 2010; Gokhale, 1995). In the nursing profession, critical thinking skills are very important and have been evaluated by many researchers which will be explained in the subsequent paragraphs. Although there are various definitions of critical thinking, the one introduced by Scriven and Paul (1987) can be explicitly explained with nursing practice. They defined that critical thinking is "the intellectually disciplined process of actively and skilfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action" in a draft statement for the National Council for Excellence in Critical Thinking. Hence, student nurses are required to be well-equipped with such skills so that they can apply what they have learnt in practice, through analysing and synthesizing a patient's data to inform their corresponding nursing interventions and then evaluate the outcomes. During this process, they have to observe, experience, reflect, reason and communicate with other disciplines, patients and their families. In this study, I did not adopt any assessment tool to evaluate the impact of CM on students' critical thinking skills because this was not the aim of this study. Instead, Scriven and Paul (1987) identified that application, analysis, synthesis and evaluation are the crucial elements of critical thinking and these elements are embedded in the course intended learning outcomes. It means that if the students are able to achieve the course intended learning outcomes (CILOs), it also implies that critical thinking has occurred in their learning.

CM is 'a two-dimensional schematic device for representing a set of concept meanings embedded in a framework of propositions' (Novak & Gowin, 1984, p.15). It was developed by Joseph Novak in 1972 based on David Ausubel's Assimilation Theory (1963) of meaningful learning and the concept of constructivism and scaffold

learning (Novak, 2010). Ausubel emphasizes that meaningful learning only occurs when learner is able to articulate the new knowledge into his/her existing knowledge (Ausubel, 1968) and the role of a tertiary teacher is explore ways to facilitate this learning process. The Assimilation Theory asserts that meaningful learning takes place by the assimilation of new concepts and propositions into prior knowledge under three conditions: (1) The learning materials must be conceptually clear and illustrated with understandable language and appropriate examples which are related to the prior knowledge. (2) The learner must have relevant prior knowledge. (3) The learner must be willing to learn meaningfully. A CM is structured in a hierarchical form which creates meaningful learning (Akinsanya & Williams, 2003; Novak, 1990) by linking up the relationships between concepts with arrows and connective words. The structure of a CM enables knowledge to be retained in learners' memory for long periods of time (Novak, 1990; Novak & Wandersee, 1991) as our memory organizes knowledge in a hierarchical order which helps to enhance learners' learning capacity (Bransford, Brown & Cocking, 1999). Schmehl (2014) demonstrates the application of CM in various areas of nursing education, including medical-surgical nursing. The demonstration shows that while constructing the CM, students need to acquire critical thinking skills to identify the patient's problems which will be indicated as circles or boxes in the CM and then they need to demonstrate the links and connectedness between the patient's problems and nursing interventions by adding labelled arrows or lines in between them. Teachers can also assess whether the students are able to apply the theories in practice. If the nurse educators start to use CM in school teaching, it might help to develop and enhance learners' critical thinking skills before they becoming a competent registered nurse.

In nursing education, numerous studies demonstrate that there is statistically significant improvement in student nurses' critical-thinking skills when CMs are used to develop nursing care plans (Atay & Karabacak, 2012; Lee, Chiang, Liao, Lee, Chen & Liang, 2013; Moattari, Soleimani, Moghaddam & Mehbodi, 2014; Wheeler & Collins, 2003) as well as the improvement in problem-solving skills (Tseng, Chou, Wang & Ko, 2011). Specifically, Atay and Karabacak (2012) used the California Critical Thinking Disposition Inventory to measure the differences in student nurses' critical thinking ability between control and experimental groups in Turkey. The results revealed significant differences in the post-tests between these two groups, in that, students who learned using CM scored significantly higher in critical thinking than those who did not. Lee et al. (2013) used the Critical Thinking Scale to measure student nurses' critical thinking at four different points in time for both control and experimental groups in Taiwan. The results showed that the experimental group gained a higher critical thinking score across time compared to the control group. Moattari et al. (2014) used the 17 dimensions of critical thinking to evaluate the differences between control and experimental groups among student nurses in Iran and found that the experimental group performed significantly better in five out of seven areas related to cognitive thinking skills and six out of ten areas of habit of the mind. Wheeler and Collins (2003) used the California Critical Thinking Skills Test to assess student nurses' critical thinking skills between control and experimental groups in United States and the results revealed that critical thinking skills of student nurses in the experimental group were significantly improved. In Kaoshiung, Tseng et al. (2011) showed that scores in the experimental group were higher than the control group for the Critical-Thinking Scale, Self-Directed Learning Scale and Students' Performance in the Problem-Based Learning Tutorial Sessions Questionnaire. It shows that problem-based

learning together with CM can enhance students' critical thinking skills, personal accountability for self-directed learning, skills of independent study, reasoning, group interaction and active participation. Given that this study aimed to improve students' learning of medical-surgical nursing, its relationship with critical thinking is assumed as when the students have better understanding of knowledge, it would facilitate the development of critical thinking, and eventually the students can make clinical judgments more appropriately.

In addition, student nurses also show positive learning experience from using CM (Harrison & Gibbons, 2013; Hinck et al., 2006; Kostovick, Poradzisz, Wood & O'Brien, 2007). Hinck et al. (2006) compared the difference in the CM of care plans at the beginning and end of a course by comparing the scores and also used the Student Satisfaction and Self-Assessment of Learning Questionnaire to collect quantitative and narrative data. Results revealed that the scores of the second CM were higher than the first. The students reflected that although they found it time-consuming, it became easier and faster with practice. Some students expressed that they can benefit from it with feedback but some preferred traditional care plans because they are used to writing things down instead of presenting a diagram. Harrison and Gibbons (2013) conducted 12 individual interviews and found that students who are more motivated and open-minded perceive the usefulness of CM and have a positive experience. The researchers found that workshops with constructive feedback are essential to helping students master the skills of CM. Furthermore, although students feel that it is very time-consuming and frustrating to produce a CM their negative feelings decrease as their skills increase. From the interviews, when the authors were attempting to identify the factors which contribute to successful CM, some of the participants claimed that they created CMs quicker and more effectively because they perceived themselves as visual

learners, so it was a tool which was favourable to them. This is the only study touching upon the relationship between CM and sensory modalities. Kostovick, Poradzisz, Wood and O'Brien (2007) used mixed research methods to measure the differences between the CM grades and different Kolb learning style groups which include abstract conceptualization, concrete experience, reflective observation and active experimentation because they would like to explore whether a student's learning style is an indicator of aptitude in developing CM. The authors used Learning Style Survey results to compare with the CM grades and the results demonstrated that there was no significant difference between groups. In other words, CM is effective for students with all kinds of Kolb learning styles. In addition, Kostovick and her colleagues used an author-developed survey with four open-ended questions to collect students' experience on using CM. Five codes were identified and related to the impact of CM on learning. They are comprehensive, critical thinking, organized, not relevant, and does not fit the learning style. Another five codes were related to the process of drawing a CM, that is forces me to research, creative, burdensome, inconsistent and confusing. It seems that there are positive and negative impacts to students on using CM.

These studies were implemented in teaching medical-surgical nursing where students were asked to use CM to formulate nursing care plans in in-class case study discussions or for actual patients during their clinical practice. However, the present study only focused on in-class scenario-based exercises because the ability of identifying the problem and formulating an appropriate care plan is the most significant concern when teaching medical-surgical nursing in classroom before applying such knowledge in clinical setting. Hence, the effect of CM on clinical learning was not measured.

2.3 Research on Collaborative Learning

Collaborative learning is an umbrella term describing a joint intellectual effort by learners, or learners and teachers together. Some researchers may use cooperative learning instead of collaborative learning but they share the same concept. The situation of collaborative learning is that, learners usually work in groups and mutually attempt to understand concepts, explore solutions to a problem, or create a product and such learning environment can be created in a variety of group activities (Smith & MacGregor, 1992). During the discussion, learners express their own ideas and reaching consensus through debate and negotiation (Sadler, Stevens & Willingham, 2015). Such interaction among learners would trigger their learning mechanisms (Dillenbourg, 1999) and then meaningful learning will occur when the learners actively participate in this knowledge discovery process together through peer influence. Drawing CM collaboratively can facilitate the construction of individual and shared knowledge through interaction because they need to discuss and explain the arrangement of concepts and their interconnected relationships (Ciani, Summers, Easter & Sheldon, 2008; Dillenbourg, 1999; Van Boxtel, van der Linden, Roelofs & Erkens, 2002). In addition, it also enhances students' critical thinking (Adesope & Nesbit, 2010; Coffey, Carnot, Feltovich, Feltovich, Hoffman, Cañas & Novak, 2003; Daley & Torre, 2010; Gokhale, 1995; Okebukola, 1990; Okebukola & Jegede, 1988; Roth & Roychoudhury, 1993, 1994; Stoyanova & Kommers, 2002; van Boxtel, van derLinden, Roelofs & Erkens, 2002) and a higher level of thinking (Johnson & Johnson, 1986) through active exchange of ideas and their engagement in discussion (Totten, Sills, Digby, & Russ, 1991), and it provides opportunities for students to analyse, synthesize and evaluate their ideas cooperatively (Gokhale, 1995). Furthermore, collaborative learning is found to be an effective learning strategy when compared with traditional

classroom teaching and reading text (Amer, 1994; Czerniak & Haney, 1998; Esiobu & Soyibo, 1995). In a meta-analysis examination of 168 research studies regarding the effect of collaborative learning in university and adult learning contexts, Johnson, Johnson and Smith (2013) found that collaborative learning was able to promote 1) higher individual achievement; 2) greater liking among students; 3) positive interpersonal relationships; and 4) higher self-esteem when compared with competitive and individual learning. Another systematic review of research on collaborative learning with CM conducted by Adesope and Nesbit (2010) also found that it is an effective learning strategy because when co-construction of CM compared with other learning activities, its effect was statistically detected and the mean effect size was large. In this study, given that a collaborative learning environment has already existed in the tutorial sessions of the researched course, the introduction of CM was the sole intervention in this study. I assumed that using CM together with collaborative learning would be more effective to enhance students' understanding of knowledge based on the idea of co-construction of knowledge in higher education (Ahn & Class, 2011). Students in this study were required to form groups in the tutorial sessions as usual and then they were encouraged to discuss with their group mates, identify a health problem and outline a nursing care plan with CM for the scenario-based questions.

2.4 Research on VARK Model

Regarding the learning styles, although there are controversies, I have the following perspectives. According to the systematic review conducted by Coffield et al. (2004), they identified 71 models of learning styles and critically analysed 13 major models. They also classified them into five families: 1) constitutionally based; 2) cognitive structure; 3) type of personality; 4) flexible stable learning preferences; and 5) learning approaches, strategies, orientations and conceptions of learning. The VARK

model was not included in this systematic review, which may be because the VARK questionnaire was validated in 2010. Based on the five families classified by Coffield et al., the VARK model probably belongs to the constitutionally based family as the report indicated that this family 'includes the four modalities: visual, auditory, kinaesthetic and tactile' (p.9). Thus, sensory modality emerged in two of the reviewed inventories, that is, Gregorc's Mind Styles Model (1984) and Dunn and Dunn's learning style dimensions (1978), which have been categorized under this family and VARK is considered as one of the factors that would affect the learning process. The classification of learning style is controversial because it lacked empirical evidence in support at the time.

My stance is that learning is affected by a lot of individuals' internal and external factors and they influence each other; thus, people may consider using different approaches to learn based on the nature of content, situation, environment and expected outcome, for instance, internal factors like working memory capacity (Riding, Grimley, Dahraei & Banner 2003) and cognitive style (Riding, Grimley, Dahraei & Banner 2003; Allinson & Hayes, 2012); perceptual quality and ordering ability (Gregorc, 1984); motivation, emotion and personality (Apter, 1989), gender, age and prior experience (Vermunt & Vermetten, 2004). In addition, different cultural groups have different cognitive strengths and patterns of intellectual abilities (Kleinfeld, 2006) which further influence cognition and information processing (Earley & Ang, 2003), learning preferences (Hofstede, 1997) and learning styles (Joy & Kolb, 2009; Reynolds, 1997). In Hong Kong, most of the primary and secondary students used to memorise knowledge through repetition when preparing for school and public examinations. Researchers and foreign educators call this rote learning (Sit, 2013). Such kind of learning style forms a habit and students continue to use it in their tertiary education.

However, as a professional nurse, students are required to have thorough understanding of the logics and rationales behind each nursing intervention so that they can carry out appropriate and safe nursing care according to the changes of patients' conditions. Therefore, a new learning strategy is needed to promote meaningful learning and eliminate rote learning when preparing for examinations.

External factors include sociological, environmental as well as the interplay between internal and external factors, such as doing, watching, feeling and thinking in Kolb's learning theory (1974), Vermunt's inventory of learning styles (Vermunt & Vermetten, 2004) and Dunn and Dunn's learning style dimensions (1978).

Given that learning is a continuum and the above classification of learning styles only represent different parts of the process or different dimensions of learning, researchers may have difficulty to control all these variables in empirical studies regarding the general learning process. Identification of learning styles may be feasible in the workplace as it may help employers to match up employees and job positions in order to enhance cost-effectiveness and job satisfaction. However, in higher education, students are required to complete the courses mandatorily. Therefore, my point is that educators should identify the hurdle of the taught content first and then employ an appropriate pedagogy to facilitate students to overcome the hurdles instead of designing the course delivery based on the identification of the learning styles of the class. Such approach is particularly not very feasible to employ for teaching large classes. Hence, whether to identify students' learning style in teaching practice is not the key argument in this study and I am not encouraging educators to carry out the identification before using CM in their teaching practice. The role of the VARK questionnaire in this study was just used to examine the impact of CM.

Moreover, in this paper, ‘learning style’ and ‘sensory modalities’ are frequently used. Hence, I would like to define these two terms beforehand to avoid any confusion. ‘Learning style’ is an umbrella term which is broader than ‘sensory modality’. It is the way that an individual prefers how to obtain and process the information, experiences or skills; and then forms his/her own set of concepts and principles (Jantan & Razali, 2002; Fleming & Baume, 2006; Lebar & Mansor, 2000; Othman & Amiruddin, 2010). In contrast, ‘sensory modality’ refers specifically to the subgroups which are visual, aural, read/write, kinaesthetic and multimodal under Fleming’s VARK model. The VARK questionnaire is chosen to be adopted in this study because it is the only assessment tool related to our human senses and receipt of information; thus it enables research questions 2 and 3 to be answered.

From a biological perspective, human beings have five senses, that is vision, hearing, smell, taste, and touch, and we have learned and understood our world through these five senses since childhood. The Atkinson-Shiffrin model (1968) illustrates that our senses are the first contact point such as light, sound, smell, heat, cold and so forth which brings information into our memory system. Thus the theory of multiple intelligences was developed by Gardner in 1983 who was the professor of education at Harvard University. He identified that every human understands the world through seven intelligences and further expanded these to eight intelligences in 1999. Four of them are also related to our senses, that is rhythmic (aural), spatial (visual), linguistic (read and write), bodily–kinaesthetic, logical–mathematical, interpersonal, intrapersonal and naturalistic. Both Gardner and Neil shared the same point which is that each individual has her/his own unique blend of all the intelligences/sensory learning preferences. In other words, individuals have different strength of these intelligences and sometimes humans may use different combination of them to solve

diverse problems and enhance the understanding of information. Therefore, employing the VARK model in this study is still strong and valid.

2.5 Research on VARK Questionnaire

The VARK questionnaire is used to identify the students' dominant sensory modality, that is visual, aural, read/write and kinaesthetic. Visual dominant learners prefer graphical and symbolic information, aural dominant learners prefer classroom lectures, read/write dominant learners prefer printed materials, and kinaesthetic dominant learners prefer experience and practice using multiple perceptual modes including sight, sound, and touch (Fleming & Mills, 1992). It consists of 16 questions with four choices for each question. All the questions in the VARK questionnaire are real-life scenarios and the participants are allowed to choose more than one if a single answer does not match their perception. Therefore, the answers should be highly close to the participants' authentic behaviour.

In 1987, Fleming developed a VARK questionnaire to identify people's dominant sensory modalities (Visual, Aural, Read/write, Kinesthetic and multimodal) for learning. It is a validated tool extensively used in many countries across different disciplines (Khanal, Shah, & Koirala, 2014). Its content validity is strong and consistent because during its development, the authors conducted experiments at Lincoln University for over 11 years, when it was tested against the students' perceptions of themselves – the questionnaire results highly matched their own perceptions of preferences (Fleming, 2012). Leite, Svinicki and Shi (2010) found that the reliability estimates for the scores of the VARK sub-scales were 0.85, 0.82, 0.84, and 0.77 for the visual, aural, read/write, and kinaesthetic sub-scales, respectively. They used an online 16-item VARK questionnaire to collect the data. The final sample of this study was

14,211 students in the United States and the majority of them (85%) were studying in college/university.

Some researchers have used the VARK questionnaire to simply describe and categorize students' sensory modalities in learning (Alkhasawneh, 2013; Alkhasawneh, Mrayyan, Docherty, Alashram & Yousef, 2008; Brechler, Joun & Ngo, 2009; Breckler, Teoh & Role, 2011; Dobson, 2010; Good, Ramos & D'Amore, 2013; James, D'Amore & Thomas, 2011; Lujian & DiCarlo, 2006; Meehan-Andrews, 2008; Murphy, Gray, Straja, Bogert, 2004; Prithishkumar & Michael, 2014; Slater, Lujan & DiCarlo; 2007; Sinha, Bhardwaj, Singh & Abas, 2013; Urval, Kamath, Ullal, Shenoy, Shenoy & Adupa, 2014), while others used it to compare learners on certain variables based on learning styles, including academic performance (Alkhasawneh et al., 2008; Dobson, 2010; Good et al., 2013; Horton, Wiederman & Saint, 2012; Leung, McGregor, Sabiston & Vriliotis, 2014; Nuzhat, Salem, Al Hamdan & Ashour, 2013; O'Mahony, Sbayeh, Horgan, O'Flynn & O'Tuathaigh, 2016; Ramirez, 2011; Urval et al., 2014) and the effect of teaching methods (Alkhasawneh et al., 2008; Baskaran, Applanaidu, Ng, & Ramakrishnan, 2015; Meyer, Stomski, Innes & Armson, 2015).

Although a lot of studies have explored the pattern of students' sensory modalities in learning, the results of above studies showed that there is no standard pattern among learners pursuing post-secondary education. The phenomenon is explainable as we are human beings, and people's thinking and behaviour are affected by their culture, beliefs, background, education, ethnicity, etc. Furthermore, individuals' learning preference may change over time because of the accumulated life experience and widened exposure to different teaching and learning methods.

Some researchers have also used the VARK questionnaire to explore the relationship between the sensory modality groups and academic performance, with varying and contradictory results. For example, Nuzhat et al. (2013) found that among 146 fourth and fifth-year medical students, multimodal students contributed over 70% of the sample and they attained the highest grades in the course. Alkhasawneh et al. (2008) revealed that among 92 third-year student nurses, 58% of them had a multi-modal preference and the rest had single dominant preference. They also found that the grades of multimodal learners are significantly higher than those of others. In contrast, Leung et al. (2014) revealed that none of the sensory modality groups showed a statistically significant relationship with the overall grades in microeconomics but a kinaesthetic group had a significant positive relationship with the overall grade in principles of macroeconomics. O'Mahony et al. (2016) showed that no VARK modality score was significantly correlated with the anatomy and clinical skills assessment marks in medical students. Dobson (2010), Good et al. (2013), Horton et al. (2012), Leung et al. (2014) and Urval et al. (2014) did not have statistically significant relationship between academic performance and sensory modality groups in mixed cohorts such as science, engineering, business, nursing, physician's assistant, physical therapy and health science. The results of research question 2 in this study will help to clarify this finding in nursing education with a larger sample size.

Some researchers also explored the relationship between VARK subgroups and teaching methods, Alkhasawneh et al. (2008) found that after teaching with problem-based learning (PBL), students with a multimodal preference increased from 54% to 68% which may suggest that PBL strengthened their multi-modal learning ability. The majority of the students in Baskaran et al.'s (2015) study expressed that in-class face-to-face teaching is better than online teaching and learning platforms, that is Moodle.

The authors commented that this may be due to the delivery mode of conventional classes being able to cater for students with different sensory modality groups. In Meyer et al.'s (2015) study, they found that there are no relationships between different types of sensory modality groups and the time students spend on using mobile apps for learning anatomy.

In Breckler et al. (2009), Lujian and DiCarlo (2006) and Urval et al.'s (2014) studies, more than one-third of physiology students and medical students had multimodal and the rest single sensory dominant preference, respectively. In Alkhasawneh et al. (2008), Alkhasawneh (2013), Meehan-Andrews (2009), Murphy et al. (2004), Sinha et al. (2013) and Slater et al.'s (2007) studies, over 50 percent of student nurses, dental students and medical students were multimodal sensory modality group. These researchers used the VARK questionnaire to distinguish students' sensory modality for learning because they asserted that the data could help them facilitate students' learning through developing a more student learning preference-centred teaching strategy.

2.6 Conclusion

The literature review enhanced my understanding of the VARK model, collaborative learning and concept mapping. It provided detailed information in relation to the feasibility and effectiveness of CM in nursing education overseas. Moreover, it gave me insights into different ways of incorporating collaborative learning with CM. This information sheds light on the logistics and research design of this study. In addition, the review also helped to identify the gap in literatures, which is the effect of CM on learners with different sensory modalities and the relationship between CM and learning. In the following chapter, it will delineate my philosophical worldview

assumptions, research paradigms of mixed methods and grounded theory, and explain the research design and ethical consideration of this study.

Chapter 3. Methodology

3.1 Introduction

The purpose of this study is to explore the effects of CM on student nurses' learning/comprehension of medical-surgical nursing in terms of their academic performance and lived experience. To this end, a mixed-methods approach has been utilized for this study. CM has been implemented in the teaching of medical-surgical nursing. Quantitative data has been used to explore the differences in pass rate and students' overall grade between non-CM and CM groups as well as different sensory modality groups in CM group. Qualitative data has been used to explore student nurses' perceptions about the effects of CM in their learning process through focus group interviews. Lastly, a substantive theory has been developed which is generated by converging the quantitative and qualitative results. Hence, the following sections describe the philosophical worldview assumptions, research paradigms of mixed methods and grounded theory, followed by the research design of this study as they are inter-related.

3.2 Philosophical Worldview Assumptions

Philosophical worldview assumptions refer to "a basic set of beliefs that guide action' (Guba, 1990, p.17). Creswell (2009) shared that some scholars named them as epistemologies and ontologies (Crotty, 1998); research methodology (Neuman, 2000) or paradigms (Lincoln & Guba, 2000) and the set of beliefs are shaped by the researcher's discipline and past research experience. According to Creswell (2009), there are four different worldviews which include post-positivism, constructivism, advocacy/participatory and pragmatism. The assumptions of post-positivism identified by Philips and Burbules (2000) are: 1) There is no absolutely truth because the research

evidence is always fallible and imperfect; 2) research is used to test a theory; 3) knowledge is shaped by data, evidence and rational considerations; 4) research is used to explain the situation of concern or describe the causal relationships among variables; and 5) researchers must use objective data without bias. The assumptions of constructivism (Crotty, 1998) are: 1) human beings engage with their world they are interpreting and the meaning is constructed by themselves; 2) this world is constructed by humans' historical and social perspectives. In addition, constructivists asserted that human beings understand the reality depending on their visual, olfactory and auditory sensitivity so the interpretation of reality of each individual varies from each other and it would be influenced by their experience of sights, smells and sounds (Denicolo, Long & Bradley-Cole, 2016). Hence, researchers seek to understand the phenomenon through visiting the context and collecting information using more personal methods. Then, the researchers use their experience and background to interpret the findings; and 3) the research is largely inductive. The assumptions of a pragmatic worldview (Cherryholmes, 1992; Creswell, 2009; Morgan, 2007) are: 1) pragmatism is not committed to any one of the research philosophies; 2) researchers are free to choose and use multiple methods, different worldviews and different assumptions to collect the data and analysis in order to best meet their needs and purposes; 3) they do not see the world as an absolute unity; 4) truth is what is happening at that time; 5) the researchers focus on what and how to research; and 6) research always happens in historical, social, political and other contexts. The assumptions of advocacy or the participatory worldview (Kemmis & Wilkinson, 1998) are: 1) researchers aim to create a political debate and discussion and believe that change will then occur in their practice and 2) the research is practical and collaborative.

Given that I am a nurse, I have been influenced by both post-positivism and constructivism over the past 20 years. In clinical practice, nurses need scientific evidence to support the medical and nursing interventions, such as how long should an intravenous line be kept in order to minimize the infection of blood vessels and how long should an opened antiseptic solution be kept in order to reduce contamination by bacteria, etc. Hence, scientific studies can help to prove or improve this area of study. However, patients and their families' psychological and social health are also a key concern in nursing practice because we are also expected to provide psychological and social support to our clients which is something related to human feelings and their interaction with society. To understand an individual or a group of people's experience or feelings or to understand a phenomenon, the scientific method definitely cannot provide all the answers. Hence, my teaching practice is influenced by both post-positivism and constructivism that is rooted in the nursing profession. As a result, I am progressively inclined towards pragmatism and employed this worldview starting from my master thesis which utilized a mixed research method in relation to the quality of life of spinal cord injury patients. In this study, the research intended to employ concept mapping to enhance students' understanding of the subject which is the research problem and the research questions focus on the measured impact on their academic performance and explore their learning experience with CM; hence it is underpinned by pragmatism.

3.3 Research Paradigm of Mixed Methods

I utilized mixed methods, that is using both quantitative and qualitative research methods to conduct this study because it can help to answer the research questions by collecting both numeric and text information. The diverse types of data, both objective and subjective data, that is academic performance and students' lived experience, can

provide a more comprehensive picture of the phenomenon from different perspectives and sources (Creswell, 2014). Thus, it can complement each other's weaknesses and strengths in single research studies and across studies (Johnson & Onwuegbuzie, 2004). In other words, using this approach can aid to get closer look at the impact of CM on students' learning.

Creswell and Plano Clark (2007) define mixed method as "a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides an understanding of research problems that either approach alone" (p. 5) and it is underpinned by the philosophy of pragmatism (Tashakkori & Teddlie, 1998; Johnson & Onwuegbuzie, 2004; Morgan, 2007; Greene, 2008). The paradigm of pragmatism is influenced by John Dewey's theory of knowing in which he posits that knowledge is generated from the analysis of relationships between actions and consequences. This theory implies that living creatures live in an interplay with the environment and their actions will change according to changes in the environment. This close connection between doing and suffering or undergoing forms is called 'experience' (Dewey, 1920). Since human beings are not robots, the 'experience' provides meaningful explanation of the process between actions and consequences. It further explains that reality is constituted by the interaction of connected parts. Therefore, by doing research to investigate the relationship between actions, situations and consequences we can find out what works and the solutions to problems (Creswell, 2009; Patton, 1990; Tashakkori & Teddlie, 2003).

Based on Dewey's theory of knowing stated above, actions can be interpreted in two ways in this study. One is the intervention of CM in this study and the other refers to the students' behaviour. The consequence is their academic performance because the assessments have an outcome-based design. Their academic performance reflects whether the students are able to complete the course and programme with the intended learning outcomes. In other words, at course level, academic performance is assumed to be able to reveal students' understanding of medical-surgical nursing. Therefore, the only way to explore the relationships between actions and consequences is to use a qualitative approach to explore the students' experience of using concept mapping in their learning and a quantitative approach to investigate the outcomes, that is whether concept mapping is able to enhance their understanding, and thus achieve the course and programme intended learning outcomes.

Creswell and Planco Clark (2007) identified six types of mixed method designs, that is convergent, explanatory, exploratory, embedded, transformative and multiphase. This study is a convergent design because the quantitative findings (overall grade) are explained side by side with the qualitative results (focus group interviews). Two forms of data are collected and analysed separately under a similar timeframe and then merged together to explain and interpret the phenomenon (Fetters, Curry & Creswell, 2013). Creswell and Plano Clark (2007) identified two types of strategies for data collection in mixed method research, that is concurrent and sequential designs. Concurrent design is employed when one form of data is needed to be validated by another form, or used for transforming the data for comparison, or for addressing different types of research questions. On the contrary, sequential design is employed when the data collected in one phase will provide information for collecting the data in the subsequent phase. Creswell and Plano Clark (2007) explained that data collected with this design is able

to "provide more data about results from the earlier phase of data collection and analysis, to select participants who can best provide that data, or to generalize findings by verifying and augmenting study results from members of a defined population" (p. 121). In this study, given that the collection of overall academic performance and focus group interviews are conducted in a similar timeframe which is after the semester. Therefore, this is a mixed method with convergent and concurrent designs.

3.4 Research Paradigm of the Grounded Theory

Grounded theory was first developed by Glaser and Strauss (1967) and its goal is to construct theory 'grounded' in data (Charmaz, 2014; Corbin & Strauss, 2015) which "accounts for a pattern of behaviour which is relevant and problematic for those involved" (Glaser, 1978, p. 93). From 1967 to now, grounded theory has been modified and classified into four most cited forms of grounded theory models (Evans, 2013) which are classic grounded theory (Glaser, 1978), Straussian grounded theory (Strauss & Corbin, 1990), constructivist grounded theory (Charmaz, 2000) and feminist grounded theory (Wuest, 1995).

Although Glaser and Strauss (1967) did not explicitly state the key assumptions of grounded theory (Aldiabat & Le Navenec, 2011; Eaves, 2001), Strauss and Corbin later addressed it in 1998 thereafter, many researchers advocating that grounded theory is underpinned by symbolic interactionism (Aldiabat & Le Navenec, 2011; Annells, 1996; Charmaz, 2014; Heath & Cowley, 2004; Jeon, 2004; Wuest, 2007). Blumer (1969) identified three assumptions of symbolic interactionism and they are all about the importance of 'meaning' in humans. Humans' behaviour is based on the subjective meanings they impose on people or things, which is derived from interaction with others and the meanings are constantly changed through an internal interaction with him/herself and social interaction with others in order to make sense of and cope well

in the social context. Snow (2001) further expanded these three assumptions into four principles of symbolic interactionism, that is interactive determination, symbolization, emergence and human agency. In sum, symbolic interactionism emphasizes that individuals' meaning and social context influence human's behaviour; thus society is created and maintained through continuous interactions among individuals (Carter and Fuller, 2015; Wuest, 2007). In 2011, Aldiabat and Le Navenec (2011) listed and compared seven assumptions of symbolic interactionism and grounded theory. They found that they are in line with each other.

Many scholars support that grounded theory is underpinned by pragmatism but Holton & Walsh (2017) clarified that grounded theory is a general research methodology which is suitable for both quantitative and qualitative data; therefore, "it is not confined to any one philosophical perspective. It is ontologically and epistemologically flexible, accommodating any philosophical perspective as espoused by the researcher" (p. 12).

Different schools of grounded theory reflect different positions of researchers in a study. For instance, in classic grounded theory, Glaser is a positivist and promotes objectivity as he was influenced by the quantitative method which was dominant in the 1960s. He believes researchers should remain unbiased and act as a passive scientific observer in data collection and analysis; therefore, his systematic coding procedure was designed for discovering an emergent theory (Glaser & Strauss, 1967; Glaser & Holton, 2004). In contrast, Strauss and Corbin (1998) assumed that a researcher collects and analyses data from participants through one or more different data collection methods, such as interview and observation until the theory is formed. Glaser opposed their coding procedure as being too rigid in which the theory is forced to be created rather than being discovered from the data (Kenny & Fourie, 2015). Charmaz believes in

constructivism and claims to be a social constructivist. She asserts that researchers in grounded theory should collaborate with participants as knowing and learning are embedded in social life and she "chose the term constructivist is to acknowledge subjectivity and the researcher's involvement in the construction and interpretation of data" (Charmaz, 2014, p.14). However, her emphasis on descriptive/interpretative understanding of human phenomena was opposed by Glaser as he asserts that grounded theorists should explain the relationship between humans and the social context in theory (Kenny & Fourie, 2015). During the exploration of GT, I was confused at the beginning because it seemed that the methods of analysing the data are similar but with different terminologies. The confusion drove me to read more reviews from different dimensions. Later, I realized that the degree of the researcher's involvement in data collection is significantly different and it affects the outcomes. Hernandez and Andrews (2012) concluded that using classic GT, an explanatory theory will be generated whereas constructivist grounded theory will create a descriptive theory.

The principles of classic grounded theory were used in this study because it can help to provide deep insights, understanding and a meaningful explanatory theory about students' learning experience with CM throughout the 14-week semester instead of creating a descriptive theory. Although I concur that society is constructed by the interaction between people, as a researcher, my role is to uncover the relationships or underlying causes behind a phenomenon or situation. To minimize contamination of the data, I tend to support researchers avoiding active participation in data collection procedures so that the reliability of data can be maintained. Moreover, I agree with Glaser that too rigid a coding procedure hinders the discovery of concepts and further limits or misleads the creation of theory.

In sum, I have followed the guiding principles of grounded theory in the conduct of this study and when interpreting data; and eventually developed a substantive theory. They are: 1) theory emergence from data, 2) avoid preconceptions, 3) be theoretically sensitized, 4) constant comparison for data analysis; and 5) iterative research progression (Glaser, 1967; Ng & Hase, 2008). Theory emergency from data means letting the theory emerge from the data rather than preconceiving it or forcing its creation. Avoiding preconceptions and remaining open minded can help researchers to be theoretically sensitive so that conceptualisation and formulation of theory can be easily achieved without bias. Theoretical sensitivity is a prerequisite conceptual ability for transcending the data from description to conceptual theory. To enhance the researcher's theoretical sensitivity, Glaser (1992, 1998, 2005) has identified nearly 50 theoretical coding families in his three different books since 1992, for instance, the 6Cs (causes, context, contingencies, consequences, covariances, conditions), process, degree, dimension, type, strategy, interactive, unit, models, basics, etc. He suggested the GT researcher to be familiar with them because it can help to increase his/her theoretical sensitivity, and recognize the theoretical code by linking up the categories. Constant comparison is a non-linear and iterative process which means that the researcher needs to continuously go back and forth for data collection and data analysis. In this process, the researcher keeps exploring the similarities and differences within the collected data and this guides further rounds of data collection. Concepts will emerge after several rounds of comparison between groups with categories (Glaser, 2001; Glaser, 1967; Ng & Hase, 2008; Martin & Turner, 1986).

Substantive and formal theories can be developed from data through utilising the grounded theory method. Substantive theory is developed from a substantive area of inquiry and does not attempt explanations outside the existing area of inquiry,

whereas formal theory has explanatory power which makes the substantive findings become more meaningful on a larger scale across different contexts or situations (Kearney, 2007). Normally substantive theory is first developed and then its core category is extended to build a formal theory (Holton & Walsh, 2017; Ng & Hase, 2008). In other words, the level of formal theory is higher than that of substantive theory. The area of inquiry of this study was confined to the impact of concept mapping in learners with different sensory modalities in the study of medical-surgical nursing and it would not be compared with students in other disciplines. As such, the theory generated from this study is a kind of substantive theory.

3.5 Data Collection

3.5.1 Research Context

This study has been conducted at a private higher education institute in Hong Kong. The targeted population for this study are students pursuing the Bachelor of Health Studies in Nursing and who have enrolled on the NUR3011 Care of People with Non-Communicable Diseases (NCD II) course during the spring and summer 2016 semesters. NCD II is one of the four medical-surgical nursing courses. Given that students learn the etiology of diseases and corresponding nursing interventions in NCD series which is crucial for backing up their clinical practice. Hence, students are required to complete NCD I & II before the first clinical practicum and NCD III & IV before the second clinical practicum. This nursing programme and courses are designed with the concept of outcome-based education that means course's assessment methods, learning and teaching activities are constructively aligned with its intended learning outcomes. Thus, the courses' intended learning outcomes are able to achieve the programme objectives. In other words, students should be able to achieve the

following learning outcomes after completed NCD II as well as the following programme objectives 3, 4, 8, 9 & 10 (Tung Wah College, 2015).

Course intended learning outcomes of NCD II:

1. assess and identify major concerns and common problems of people with non-communicable diseases of the gastrointestinal, hepatobiliary, pancreatic, endocrinal and metabolic systems
2. apply corresponding pathophysiological knowledge when caring for people with these non-communicable diseases
3. address the physiological, psychological, emotional, social, cultural and spiritual needs of people with these non-communicable diseases through appropriate communication skills and nursing interventions
4. develop integrative care plans (nurturing and restorative health) for people with these non-communicable diseases
5. explain the rationales for the care offered and optimize their interventions according to people's dynamic health states

Programme objectives 3, 4, 8, 9 & 10:

- develop communication skills, in both Chinese and English, as well as good social and interpersonal skills and the teamwork spirit required for effective and professional interaction with individuals, families and members of other disciplines
- utilize critical and creative thinking and analytical skills in problem-solving and decision-making
- provide competent and safe health services through assessment, planning, implementation and evaluation for people of all ages and in diverse healthcare settings
- uphold the ethical, legal and professional standards of the nursing

profession

- promote, support and advocate lifestyle choices that enhance the health and well-being of individuals and society in partnership with other healthcare providers, family and the community in the changing environment

In the researched NUR3011 course, majority of the students are the second and third year students. They learn non-communicable diseases of gastrointestinal, hepatobiliary, pancreatic, endocrinal and metabolic systems in this course and it is a pre-requisite course before proceeding to the first clinical practicum. In other words, majority of the students enrolled in this course did not have any clinical experience but there had some re-takers who had failed this course in preceding semester and re-took it after their first clinical practicum. The sequence of data collection is illustrated at Table 1.

Table 1

Sequence of data collection

Timeline	**Action**	**Type of Data**
First week of semester	• Distribute VARK version 7.8 questionnaire to students • Categorize the students into different sensory modality groups	Quantitative Data
During the semester	Implement the intervention: • The course coordinator will be responsible for introducing the use of CM to the students in the lectures • Relevant learning materials will also be delivered to students • After the lecture, students will be required to do scenario-based exercises with CM and discuss them with their classmates in all the tutorial sessions • Tutor will debrief the students with CM at the end of tutorial session	-
At the end of semester	Send email to recruit students for focus group interviews	-
After the semester	Students from different sensory modality groups will be interviewed in focus groups	Qualitative Data

After the School released the academic results	Compare the pass rate and overall grade: • Between different sensory modality groups • Between the CM and non-CM groups	Quantitative Data

3.5.2 Implementation of CM

Students enrolled in the same course in the previous semester, that is the winter semester in 2015 (non-CM) group was retrospectively used for comparison instead of randomized controlled trial (RCT) because there are some constraints. If RCT is used, I have to divide the class into control and experimental groups. However, in view of the cost-effectiveness of allocating the resources, the institute only allows to split the lecture into two classes when the class capacity exceeds 300. Moreover, it is difficult to gain the teachers' assistance because they may not willing to run the lectures twice every week as it will increase their teaching load. Second, even though the lecture can be split into two classes, students may walk-in and out or swap the class. Since it is difficult to restrict the students and the environment is difficult to control, it may result in contamination of data, thus the reliability of results. Third, the students may not willing to participate in the study if they learn that there is difference in teaching method between groups and sense of unfairness may arouse. The justification for choosing this winter semester as the non-CM group was because it was the closest group to the CM group. The course coordinator, course content and teaching arrangement are the same and the social, political and learning environments are the most similar. Hence, minimal variation between non-CM and CM groups could be assured.

Teaching with CM eventually was conducted in the spring and summer 2016 semesters for the NUR3011 course. At the beginning, there were only 109

students in the spring semester so the difference of sample size between the CM (n=109) and non-CM groups (n=251) was quite large. To increase the reliability of the results, the students enrolled in the same course in the summer semester were also recruited as the CM group finally (n=90). As a result, the total number of students in CM and non-CM groups were 199 and 251, respectively. The course syllabus, design and assessment methods are the same but some of the teachers and examination questions are not. The course coordinators of NUR3011 who are also experienced in using CM are responsible for delivering the lectures with traditional PowerPoint supplemented with animated CM to the students. The teacher displays the CM with the animation function embedded in the PowerPoint slide. The animation helps to show the flow of lines and the concepts pop-up when the line is reached. Relevant learning materials have been delivered to students as usual. Corresponding 1-hour tutorial session was held after 1-2 weeks after the lecture. Each tutorial had around 25 students and corresponding teacher designed 1-2 scenarios-based questions (Appendix 1) in student and tutor versions. There was only question inside the student version whereas model answers were provided in tutor version. All the tutorial groups used the same set of questions. The questions disseminated to the students one week before the tutorial session as usual. In the tutorial session, students were asked to form groups of 5-6, use 20 minutes to identify the patient's problem in the scenario, and then use CM to outline the corresponding nursing interventions with their classmates. The collaborative learning environment occurred at this point. Tutors then selected one group of students to present their CM. After that, the tutor showed the model answers with a pre-constructed CM in PowerPoint with animation to the students. When the tutor showed the CM

in the class, she played the CM with slideshow function, animated arrows and text boxes. Then the students could see the flow of arrows from one concept to the others as well as from the central to peripheral concepts. In order to maintain the consistency of tutors involved in the tutorial sessions, the following measures have been taken: 1) pre-constructed CM was prepared by me based on their provided information, 2) model answers in written form and pre-constructed CM have been distributed to them one week before the tutorial and 3) briefing sessions on the use of CM have been held by me with the tutors.

In order to maintain the reliability of data and minimize the contamination of data, I have not participated in teaching the NUR3011 course. Instead, I have provided support to the teaching team in terms of the use of CM and conducted the focus group interviews. In this course, students have been divided into around 4-5 tutorial groups (that is, maximum 25 students each), as stipulated by the institute. Each tutorial session lasted for an hour and a total of 4 one-hour tutorial sessions carried out throughout the semester. These tutorial groups were led by three tutors respectively. In order to minimize the discrepancy between tutors, NUR3011 course coordinator has held meeting with the other two tutors before each tutorial session and model answers of scenario-based questions have been given to tutors for debriefing with the students.

3.5.3 Data Collection and Data Source

Data used in this study were retrieved from primary and secondary sources. The VARK questionnaires were distributed to students in the first lecture which aimed to classify the students' sensory modalities. Focus group interviews were conducted after the semester. These two kinds of information

are primary data because they were collected by myself, whereas the students' academic performance is secondary data because they are official data which already exist and are stored in the College database.

3.5.3.1 VARK Questionnaire

At the beginning of the semester, a 16-item VARK questionnaire version 7.8 (Appendix 2) with four answer options was used to collect data from students regarding their dominant sensory modalities in learning. Students were asked to choose one or more of the answers which matched their perception or leave the question blank if it does not apply. This data was solely used to identify and categorize the student nurses into the five different types of sensory modalities, that is visual, aural, read/write, kinaesthetic and multimodal. Students were also asked to provide their student ID number on the questionnaire because it helped to facilitate the comparison of student performance based on different sensory modalities.

At the beginning of the first week lecture, questionnaires with participant information sheets (Appendix 2) were distributed to the students by a clerical staff. Students were given one week time to read and complete the questionnaire. A drop-in box were placed in the lecture theatre for collecting the returned questionnaires in the second week lecture. Ten to fifteen minutes are required to complete the questionnaire. After receiving the returned questionnaires, I entered the data into a spreadsheet and then sent it to Dr. Neil Fleming for identification of sensory modality groups in terms of his VARK model. After the students' sensory modality were identified, I informed the students about the results via email and the relevant learning strategies in

relation to their corresponding groups provided on the VARK official website which were also shared with the students in the emails.

3.5.3.2 Focus Group Interviews

After the semester, students from different sensory modality groups have been interviewed in groups. The purpose of focus group interviews is to explore students' learning experiences regarding the use of CM in learning medical surgical nursing, and the data was used to answer the third research question "*How do students who used CM to learn medical-surgical nursing feel about CM as a learning tool, and do their perceptions differ based on sensory modalities?"*.

I have chosen the focus group approach because focus groups can provide in-depth information about "how people think about an issue – their reasoning about why things are as they are, why they hold the views they do" (Laws, 2003, p. 299). Multiple interviewees can provide a cross-check effect, that is one can complement the other with additional points which helps to provide a more complete and reliable record (Arksey & Knight, 1999). The interviews lasted for 30-45 minutes and they were semi-structured with the following questions:

1. Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
2. When your view was different from that of your classmates, what did you do?
3. Could it help you in learning NUR3011? If yes, how? If no, why?

4. Could it help you in preparing for the mid-term test/exam? How?
5. Could it help your thinking in terms of your study and daily life? How did this happen?

The same set of questions were used for all interview groups. I have digitally video recorded all the interviews after obtaining consent from the interviewees so that I could concentrate on the process of the interviews, maintain appropriate eye contact with the interviewees, and focus on their responses (Blaxter, Hughes & Tight, 2010). Thus, video can help to record the participants' non-verbal responses and identify who is speaking precisely, it further facilitates the verbatim transcription process and makes the analysis of verbatim more accurate and reliable when compared with audio. Every interviewee was encouraged to share their experience, including their thoughts, feelings, images, sensations and memories.

Recruitment for focus groups was commenced in week 14 and the interviews were arranged after the examination period (week 15 & 16) and before the announcement of examination results. Invitation letters for group interviews were sent to the students by email together with the participant information sheet and informed consent form (Appendix 3 & 4). Informed consent was obtained from each participant in person before the interviews. Since the focus group interviews were held during the semester break, all the students would not stay in the institute, HKD100 (approximately USD13) cash were given to each interviewee for acknowledging their contribution of time and as reimbursement for travelling expenses in order to facilitate the recruitment progress. The total number of interviewees for each focus group

interview was capped at 8 (Krueger & Casey, 2015) and they were held in a private meeting room of my institute.

3.5.4 Student Academic Performance Data

With the support of my Department Head and the Head of Registry, they approved me to use the students' academic result in this study. First, I provided a spreadsheet with student IDs and their sensory modality groups to the Registry. Second, the Registry entered the overall grade of each student into the spreadsheet. Third, the Registry deleted all the student IDs from the spreadsheet and then returned it to me. Hence, I received de-identified data for analysis eventually after the overall grades were endorsed and released to students. This data aided to answer the research question 1 & 2, that is the difference of pass rate and overall grade between CM and non-CM groups as well as the differences between students in different sensory modality groups.

3.6 Data Analysis

After completing the VARK questionnaire, everyone has visual, aural, read/write and kinaesthetic scores respectively. Higher scores is interpreted as the way that the learner prefers to learn. In contrast, lower scores, even zero score, indicates that the learner has little preference to use that mode for learning. The VARK questionnaire can also identify people who may not have a standout mode in which case they will be classified as multimodal. Since the participants can answer more than one answer for each question, the scoring is not a simple matter of counting. Therefore, the dataset was sent to the author of the VARK questionnaire, Dr. Neil Fleming for data processing to ensure the reliability.

3.6.1 Quantitative Method

IBM SPSS Version 24.0 was used to run the statistical data analysis. Standard procedures to check for coding and data entry error were implemented. Frequency count and descriptive statistics such as mean, standard deviation were used to present the characteristics of variables. In addition, independent t-tests were used to compare the pass rate and overall grade between the test groups (spring and summer students) and the previous intake of last semester (winter students) to compare the differences in overall grade between with and without CM groups. If the p-value is less than 0.05, it means that there is a statistically significant difference between these two groups. In addition, one-way analysis of variance (ANOVA) was used to compare the overall grade between five different sensory modality groups (Cohen, Manion & Morrison, 2011). If the p-value is less than 0.05, it means that there is a statistically significant difference between the groups. Moreover, Cohen's *d* was used to measure the effect size based on the differences between means. It can help to explain the magnitude of a treatment/intervention effect and further indicate the strength of a phenomenon. When *d* is .20, it means the effect size is small. When *d* is .50, it means the effect size is medium. When *d* is .80, it means the effect size is large (Cohen, 1988).

3.6.2 Qualitative Method

The audio-taped records taken from the focus group interviews were transcribed verbatim. After that, the transcriptions were analysed in two phases. The first phase was to identify the impacts of CM on students' learning in different sensory modality groups. Therefore, the transcripts were printed in different colours. Each colour represented one sensory modality group. Only

open coding and selective coding were used in this phase. The identified codes were used to compare between groups. The second phase was to generate a substantive theory based on the following coding principles: 1) open coding, 2) selective coding, 3) theoretical coding, 4) theoretical memos and 5) theoretical sorting (Ng & Hase, 2008; Glaser, 1967, 1978, 1992; Breckenridge, 2014).

3.6.2.1 Open coding

Open coding is the first step of data analysis in grounded theory (Glaser, 1978; Walker & Myrick, 2006). The researcher reads the transcripts line by line and highlights the phrases, words, sentences or paragraphs that s/he thinks may indicate the importance of a phenomenon. After the first round of open coding, Glaser (1992, p.51) suggested to compare all codes by asking the following four questions; then the concepts will emerge after constant questioning.

- Which study is the data related to?
- What category or property does the incident indicate?
- What is actually happening in the data?
- What is the basic social psychological process or social structural process explaining the relationships of actions in the scene?

3.6.2.2 Selective coding

The purpose of selective coding is to identify the properties and dimensions of the core category (Holton & Walsh, 2017). After open coding, many concepts merge but not all of them are related to the core category which later helps to shape the theory. At this stage, the researcher groups the codes in similar patterns into categories and then label them with a conceptual name. As such, several categories will be formed. Among these categories, the researcher should be able to distinguish the core category and subcategories based on their

properties and relationships. This process delimits the coding process around a core category and from this stage onwards, the emergence of core category notions the analysis to move from descriptive towards a conceptual level (Glaser, 1992). Glaser (1978), Glaser and Holton (2004) and Holton and Walsh (2017) suggested five characteristics of a core category, that is centrality, frequency, relevance, grab and variability.

3.6.2.3 Theoretical coding

Holton and Walsh (2017) stated that 'theoretical coding refers to the modelling of the relationships between and among the core category and related concepts as a fully integrated theory' (p.86). In this final stage, the researcher is trying to link up the causal relationships between concepts and the overall shaping of theory takes place.

3.6.2.4 Theoretical memos

In fact, memoing is a vital skill when using grounded theory. Glaser (1978) defined memos as 'the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding' (p.83). He encourages the researcher to use memos to record his/her thinking starting from the open coding to the very end and to keep reading the memos as they finally help the researcher to develop ideas with complete freedom into a memo fund which is highly sortable and essential in developing the theory. There is no standard format in terms of writing style, grammar and spelling, and it can be a sentence to a few pages in length (Glaser, 1978; Holton & Walsh, 2017). When the researcher comes to the stage of generating theory, theoretical memoing takes place. At this stage, the researcher develops the theory through derivation of meaning by memo construction.

3.6.2.5 Theoretical sorting

After coding becomes saturated, the next essential step is theoretical sorting. It is an essential step because the researcher needs to formulate a presentable theory in words or writing through sorting the memos. It produces a generalized and integrated model through connecting the categories and properties (Glaser, 1978, p.117).

3.7 Validity and reliability of the study

The validity of data in quantitative research means 'the score received from participants are meaningful indicators of the construct being measured' (Creswell & Plano Clark, 2011, p.210) and it includes external and internal validity, whereas the reliability in quantitative research means that 'scores received from participants are consistent and stable over time' (Creswell & Plano Clark, 2011, p.211). Several measures were taken to maximize the reliability and validity of data in this study. First, the VARK questionnaire version 7.8 used in this study has been validated by confirmatory factor analysis (Leite, Svinicki & Shi, 2010). Since Leite et al. (2010) asserted that 'Cronbach Alpha would underestimate the reliability of the VARK scores (p.33)', I followed their work and tested the data of this study with multitrait-multimethod confirmatory factor analysis (MMTM-CFA) which includes four models. They are correlated trait-correlated method (CTCM), correlated trait-correlated uniqueness (CTCU), correlated-trait-uncorrelated method (CTUM) and correlated trait-correlated methods minus one (CT-C(M-1)). The aim was to test the reliability of VARK in the studied group as the students in Leite et al. (2010) were students in the United States. No study has been done with a Chinese population.

The analysis was conducted by Mplus Version 7 (Muthén & Muthén, 2012). Since the items of the VARK scale are dichotomous, the mean- and variance-adjusted

weighted least squares estimator (WLSMV) was used. For the assessment of model fit, researchers use numerous goodness-of-fit indicators to assess a model. Some common fit indexes include Chi-square test, Comparative Fit Index (CFI), Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). However, chi-square test as a measure of fit in a structural equation model is not recommended due to its sensitivity to sample size (Hair et al., 1998; Tabachnick & Fidell, 2007). Instead, the relative chi-square which equals the chi-square index divided by the degrees of freedom is recommended. This index might be less sensitive to sample size. The criterion for acceptance varies across researchers, ranging from less than 2 (Ullman, 2001) to less than 5 (Schumacker & Lomax, 2004). Regarding the criteria of the Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI), a value of at least 0.90 is required to accept a model, while a value of at least 0.95 is required to judge the model fit as 'good' (Holmes-Smith, Coote & Cunningham, 2004). Another approach to test the model fit is to accept a model that approximates the true model through the index, Root Mean Square Error of Approximation (RMSEA). RMSEA of less than 0.05 indicates a close fit, and values between 0.05 and 0.08 indicate an acceptable fit, while Standardized Root Mean Square Residual (SRMR) with a value below 0.08 is indicative of acceptable fit. As the models cover four traits and 16 testlets, agreement on the fit from many fit indices is difficult to obtain with large multifactor models (Marsh, Hau & Grayson, 2005). All statistical tests were two-tailed and variables were considered significant at a level of 0.05. The results are as follows.

Model 1: Correlated trait-correlated method (CTCM)

The model includes both traits and methods factors, and allows for correlations among traits and among methods. The initial model was not generated as a non-positive

definite latent variables covariance matrix was found. The source of the problem was a perfect linear dependency between some latent variables. Therefore, the CTCM model should be modified. In the modified CTCM model, one factor loading of some method factors were fixed to 1 and error correlation between some method factors were fixed to zero, in addition to the factor variances which were fixed to 1 to set the scale of the latent variables (Figure 1). This modified CTCM model was achieved with the fitness indices of $\lambda^2(1840) = 2058.436$, $p<0.001$, relative chi-square (λ^2/df) =1.12, CFI=0.687, NFI=0.657, RMSEA=0.026 and SRMR=0.129. Given that the value of relative chi-squares was less than 2 and the value of RMSEA was less than 0.05, this indicated that it is an acceptable model.

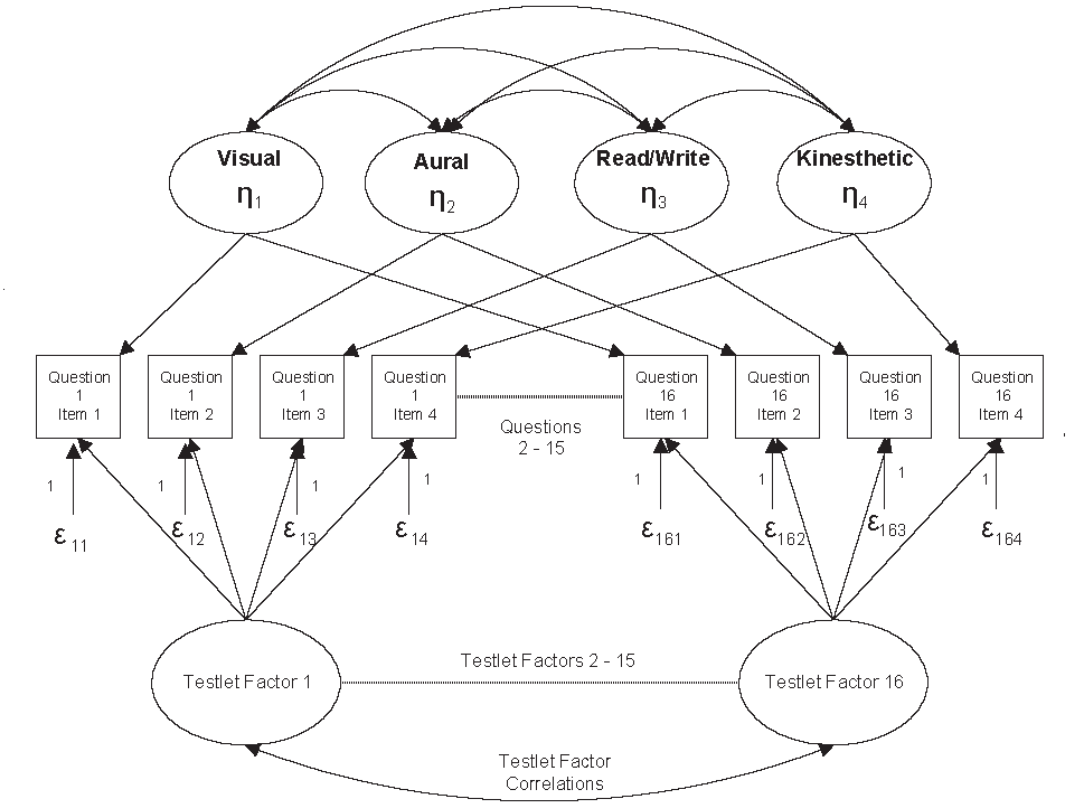

Figure 1. Correlated trait-correlated method (CTCM)

Model 2: Correlated trait-correlated uniqueness (CTCU)

CTCU was proposed by Marsh et al. (2005) in which no latent factor for methods was specified. This implies that the method effects are confounded with the correlated errors. In addition, correlations between methods are not allowed (Figure 2). However, the correlated residuals for each set of observed variables measuring the same method of measurement are considered to reflect these method effects. The initial model cannot be generated as a non-positive definite residual covariance matrix was found. The source of the problem was a perfect linear dependency between some errors of items of the kinaesthetic scale. To solve the problem, the model was revised by fixing the error correlations. Among 96 error correlations of items within testlets, 29 were fixed. The revised model was achieved with the fitness indices of $\lambda^2(1883) = 2021.625$, $p<0.05$, relative chi-square (λ^2/df) =1.07, CFI=0.802, NFI=0.788, RMSEA=0.020 and SRMR=0.125. The results showed that the value of relative chi-square was less than 2 and the value of RMSEA was less than 0.05. Hence, it is an acceptable model and is better than the CTCM model, because the values of CFI, NFI were higher than that of the CTCM model and the value of SRMR was smaller than that of the CTCM model.

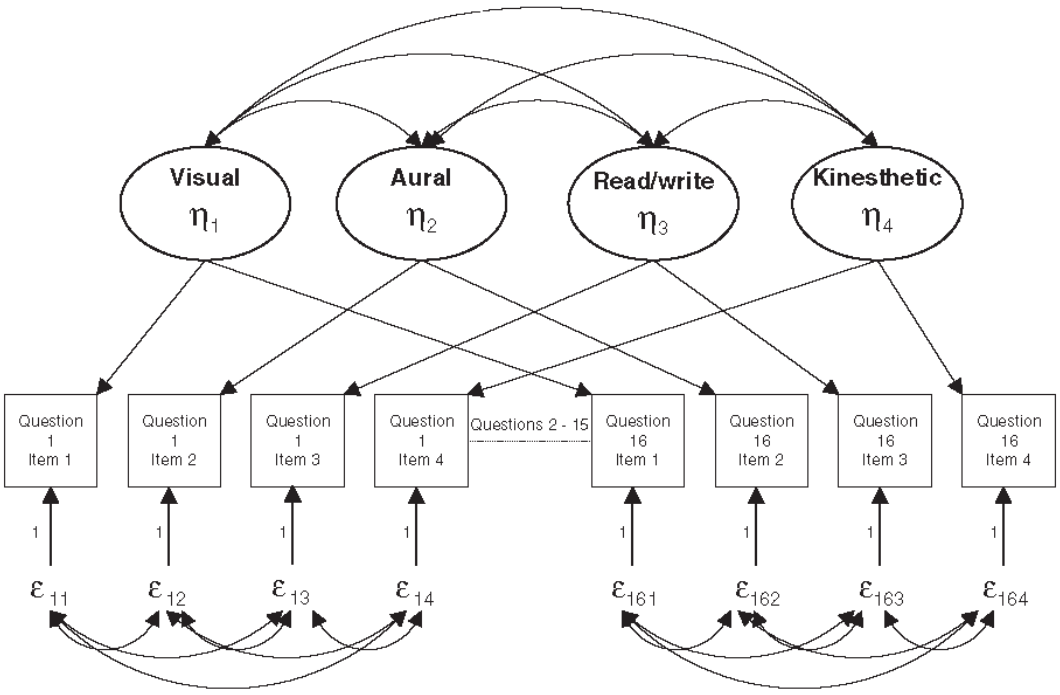

Figure 2. Correlated trait-correlated uniqueness (CTCU)

Model 3: Correlated trait-uncorrelated method (CTUM)

CTUM is similar to CTCM, except that it did not have any specified correlations among the method factors (Figure 3). Goodness-of-fit results for this mode l were $\lambda^2(1898) = 2117.381$, $p<0.001$, relative chi-square (λ^2/df) =1.12, CFI=0.686, NFI=0.666, RMSEA=0.026 and SRMR=0.133, which was similar to the CTCM model. As a result, the model was not as good as the CTCU model.

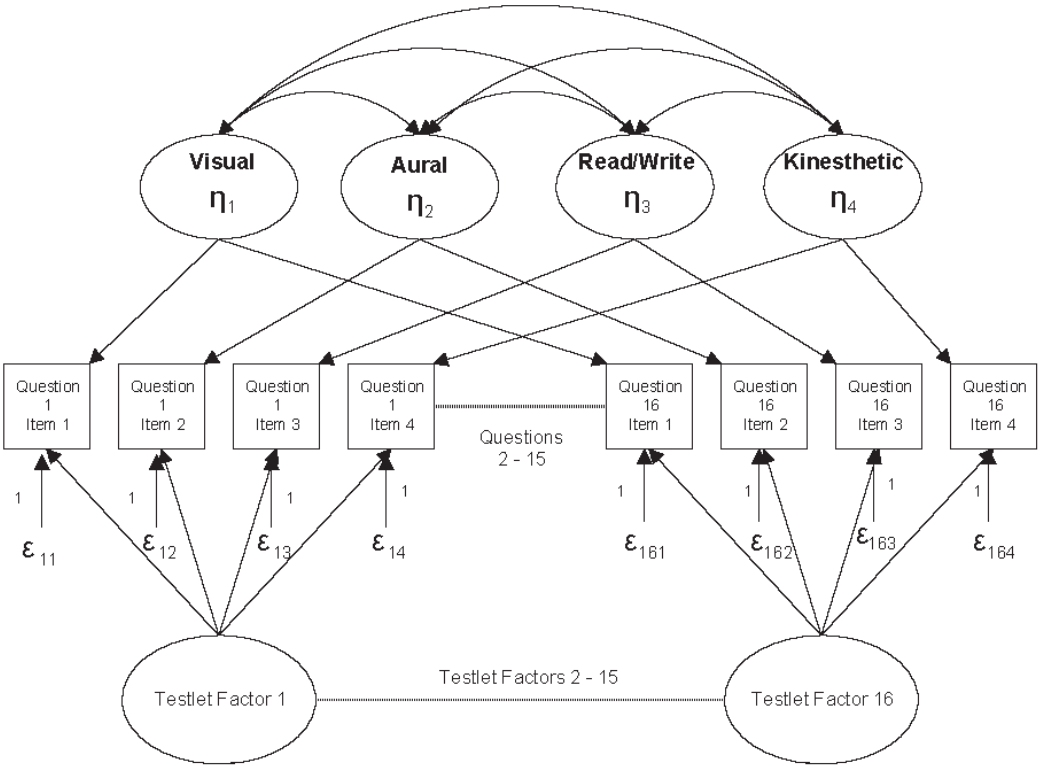

Figure 3. Correlated trait-uncorrelated method (CTUM)

Model 4: Correlated trait-correlated method minus one (CT-C(M-1))

CT-C(M-1) was proposed by Eid (2000) in which the number of method factors is specified to be m-1, where m is the number of methods in the design (Figure 4). We ran the model one by one by switching the reference method at each run. The results show that using the first question as a reference method gave the best goodness-of-fit indices

with $\lambda^2(1837) = 2058.579$, $p<0.001$, relative chi-square (λ^2/df) =1.12, CFI=0.683, NFI=0.652, RMSEA=0.026 and SRMR=0.129. As a result, the model was not as good as the CTCU model too.

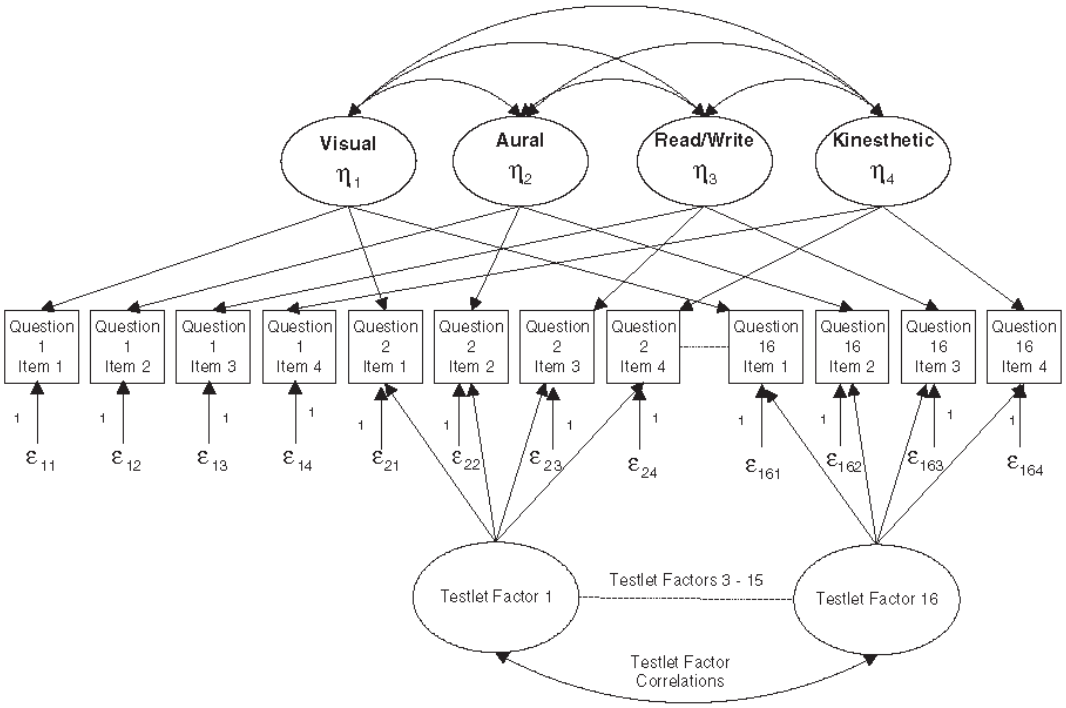

Figure 4. Correlated trait-correlated method minus one (CT-C(M-1))

A summary of model fit information for the above four MTMM-CFA models is shown in Table 2. It is found that the relative chi-square, RMSEA and SRMR, but not TLI and CFI, support the fit of the four models. Among them, the CTCU model is the best fit to the data, which is consistent with the result reported from Leite et al. (2010). In order to show the consequences of inappropriately modelling scores of testlets by failing to account for method effects, a CFA model with a diagonal residual covariance matrix was conducted. The goodness-of-index is $\lambda^2(1837)=2259.625$, $p<0.001$, relative chi-square (λ^2/df) =1.16, CFI=0.551, NFI=0.535, RMSEA=0.030 and SRMR=0.140, which is a poor fit model compared with CTCU. Since this model is constructed within the CTCU model, the resulting chi-square difference test is $\lambda^2(63)=648.826$, $p<0.001$,

Table 2

Summary of Goodness-of-Fitness Statistics for CFA-MTMM Models

Model	λ^2	Degree of Freedom (df)	p	λ^2/df	Comparative Fit Index (CFI)	Tucker-Lewis Index (TLI)	Root Mean Square Error of Approximation (RMSEA)	RMSEA 90% Confidence Interval (CI)	Standardized Root Mean Square Residual (SRMR)
1. CTCM	2058.436	1840	<0.001	1.12	0.687	0.657	0.026	0.019 - 0.032	0.129
2. CTCU	2021.625	1883	<0.05	1.07	0.802	0.788	0.020	0.010 - 0.027	0.125
3. CTUM	2117.381	1898	<0.001	1.12	0.686	0.666	0.026	0.018 - 0.032	0.133
4. CT-C(M-1)	2058.579	1837	<0.001	1.12	0.683	0.652	0.026	0.019 - 0.032	0.129

which indicated that the CTCU model is statistically significant in the improvement in fit with the data when compared to a CFA model ignoring method effects.

The results of the CTCU model show that the standardized loadings of the items on the VARK factors ranged from 0.063 to 0.643, with mean loadings of 0.375, 0.432, 0.408, and 0.346 for the visual, aural, read/write, and kinaesthetic factors, respectively. The loadings for all items of VARK are listed in Table 3. The correlations between the VARK factors were moderate to strong in magnitude. These correlations are shown at Table 3. The reliability estimates for the scores of the VARK subscales were 0.73, 0.79, 0.84 and 0.69 for visual, aural, read/write, and kinaesthetic subscales, respectively, which means the reliability of VARK questionnaire in this population group is acceptable.

Apart from using a validated questionnaire, the following actions were also taken to strengthen the validity and reliability of this study. The total number of students enrolled in the researched course is 109 and 90 in spring and summer semesters respectively. Eventually, 92% of the spring students and 86% of the summer students returned the questionnaires. The high return rate is valid to represent the studied population. Moreover, I was not involved in teaching the researched course and did not have direct contact with the researched students, and the stringent data collection method enhanced the reliability of data without contamination.

Table 3

Standardized Factor Loadings and Factor Correlations for the VARK[+]

Factor Loadings	Visual	Aural	Read/Write	Kinesthetic
Q1	0.104[b]	0.540	0.197[b]	0.074[b]
Q2	0.333	0.421	0.575	0.242
Q3	0.198[b]	0.369	0.513	0.254
Q4	0.439	0.392	0.353	0.432
Q5	0.249	0.441	0.270	0.004[b]
Q6	0.606	0.352	0.316	0.571
Q7	0.594	0.643	0.512	0.444
Q8	0.181[b]	0.590	0.503	0.063[b]
Q9	0.298	0.609	0.339	0.334
Q10	0.423	0.268	0.469	0.515
Q11	0.253[b]	0.483	0.170[b]	0.266
Q12	0.354	0.464	0.267	0.374
Q13	0.597	0.450	0.546	0.581
Q14	0.565	0.202	0.551	0.373
Q15	0.446	0.452	0.391	0.595
Q16	0.366	0.242	0.555	0.417
Factor correlations				
Visual	-	0.574	0.539	0.570
Aural	-	-	0.706	0.744
Read/write	-	-	-	0.416

[+]Correlated trait-correlated uniqueness (CTCU) model

[b] Not statistically significant ($p<0.05$)

3.8 Trustworthiness of the study

Trustworthiness in qualitative research shares the same ideas as the reliability and validity in quantitative research (Stiles, 1993; Roberts, Priest & Traynor, 2006) but with the use of different terminology. Lincoln and Guba (1985) posited that trustworthiness involves credibility, transferability, dependability and confirmability. To ensure the trustworthiness of the qualitative data in this study, using GT systematic procedure to analyse the data could ensure that the emergency of theory was not forced (Hussein, Hirst, Salyers & Osuji, 2014; Strauss & Corbin, 1990). Furthermore, the use of mixed methods strengthened the credibility of this study through data triangulation. Each method compensates for their individual limitations and takes advantage of their respective benefits (Bowen, 2009; Brown, Richard, Troiano & Schneider, 2002; Jacelon & O'Dell, 2005; Shenton, 2004; Sikolia, Biros, Mason & Weiser, 2013).

In fact, GT is more complex than qualitative, quantitative and mixed research studies because it is a package of research methods which includes a continuous cycle of constant comparative analysis and data collection (Elliott & Lazenbatt, 2004; Glaser, 1998). Hence, other than the above-mentioned common criteria for assessing the quality of research, Glaser and Strauss (1967) maintain that the substantive theory finally generated from a study should be assured by the concepts of 'fit', 'work', 'relevance' and 'modifiability'. Fit means that the conceptual codes and categories should be grounded from the data instead of using preconceived codes or categories. Work means that the substantive theory should be able to explain and interpret the human behaviour in a particular area as well as predict future human behaviour. Relevance means that the theory should focus on a core concern or process of that particular area. Modifiability means that the theory should be able to be revised or extended when new data produce new categories, properties or dimensions in the future (Holton, 2008). The

abovementioned characteristics of GT guided me in developing a substantive theory later on.

3.9 Ethical Considerations

3.9.1 Researcher and teacher roles

Given that the research venue of this study was my workplace and the participants of this study are my students, I had dual roles, that is researcher and teacher in this study. This dual role may cause some ethical issues to arise which are commonly seen in teacher research (Hammack, 1997). To minimize the conflicts between these two roles, several measures have been taken. First, I did not involve myself in teaching the researched course. Second, I invited my office clerk to distribute the VARK questionnaires instead of me and a drop-in box was used to collect the questionnaires. Thus, I only used email for recruiting participants for focus group interviews. Third, although I might have taught some of the students in other courses, I was not able to identify them because their student number was their sole identifier. The above measures limited my direct contact with the students in this course.

Furthermore, students may worry that their participation will affect their academic results because they may think that I am the teacher who is superior in the course and have authority to control the marks. Therefore, on the participant information sheet, I clearly stated that ‘students who participated in the interviews would not gain any credit in the course in order to maintain the fairness among students in the same course’ and I undertook that this research study was to fulfil the requirement of my doctoral thesis at University of Liverpool (UoL); therefore, my role as lecturer was separated from that of researcher.

3.9.2 Ethical issues relating to conducting interviews

Before commencing the focus groups, I explained the research verbally to the participants in order to ensure their understanding of the study purpose, video recording permission, and confidentiality. Participants were invited to ask questions. An information sheet about the study was provided and consents were obtained in written format. In order to provide privacy, interviews were conducted in a closed meeting room where nobody could see the interviews from outside. Before the implementation of the study, I foresaw that the participants may experience psychological discomfort in the interviews while sharing their learning experience. Hence, I sent the interview questions to the participants before the interviews and a counselling service was available in my workplace to provide psychological support when needed. Eventually, no participant complained of psychological discomfort during the interviews.

3.9.3 Rights of participants

Researchers have responsibilities to preserve participants' rights and protect their identities. In this study, students' participation was voluntary. After they received the participant information sheet and the VARK questionnaire from my office clerk, they had one week time to read the details and return the questionnaires. The returned VARK questionnaires implied that the participants agreed to participate in the study. My contact details were provided on the participant information sheet for them to contact me if there were any enquiries and the information about the ethics committees of both UoL and the researched institute were also provided it for them to make complaints where necessary. Thus, they had the option to withdraw from the study at any time without explanation and without incurring a disadvantage. To protect their identities, the VARK

questionnaire is anonymous and I informed the participants in the focus groups that their names or characteristics would not be disclosed in the report. I used numbers or letters to name them instead. All data were double locked in a cabinet in my office and all the electronic files were encrypted and stored in a password-locked computer. My supervisors and I have the only right to access the data. All the data will be destroyed 5 years after completion of the data analysis. The hard copies will be shredded and the electronic files will be permanently deleted from the computer. All these were clearly stated in the participant information sheet.

3.9.4 Approvals

Ethical approval of this study from both the Virtual Programme Research Ethics Committee (VPREC) of the UoL (Appendix 5) and the Committee on the Use of Human and Animal Subjects in Teaching and Research (HASC) of the researched institute (Appendix 6) together with the Registrar's approval of using students' academic results (Appendix 7) were obtained before its implementation. Regarding the VARK questionnaire version 7.8, I also obtained the author's permission before using it (Appendix 8).

3.10 Conclusion

After obtaining ethical approval from both the UoL and the researched institute, data collection commenced in January 2016. It was conducted within a medical-surgical nursing course named NUR3011 in spring semester 2016. All the participants were student nurses enrolled in this course. In the first week, VARK questionnaires were distributed to the students and they were asked to return them on a voluntarily basis one week later. VARK questionnaires were used to categorize their dominant sensory modalities. The NUR3011 teachers delivered lectures with PowerPoint and CM with

animation. In the tutorial sessions, students were asked to answer the scenario-based questions with CM in groups and the teachers provided de-briefing with CM at the end of tutorials. Lastly, after the 14-week semester, students were interviewed in different sensory modality groups after the NUR3011 written examination. Given that quantitative and qualitative data were used in this study, it was a mixed methods research study. Most of the principles of classic grounded theory were used eventually to develop a substantive theory by analysing and incorporating both the quantitative and qualitative data.

Chapter 4. Quantitative Results

4.1 Introduction

Given that this was a mixed methods study, two types of findings were generated. This chapter mainly presents the quantitative results followed by the qualitative findings. The quantitative data in this study included types of VARK learners and de-identified students' overall grades of non-CM and CM groups in the researched course. The collection of VARK data was conducted by me whereas the academic results were provided by the Registry of the researched institute after the end of semesters. These data provide objective numerical results with a large sample size in relation to the differences between different sensory modality groups and this set of results can supplement the qualitative results collected from focus group interviews.

4.2 Results of Quantitative Data

There are one control group (non-CM) and two test groups (CM) in this study. Non-CM group is the students who enrolled in NUR3011 in winter semester and they did not receive teaching with CM in this course. In contrast, CM groups are the students who enrolled in NUR3011 in spring and summer semesters. These two groups of student have received teaching with CM in the same course. The total number of students was 241 in winter semester, 109 in the spring semester and 90 in the summer semester. Finally, one hundred completed questionnaires (91.7%) were received from the spring students and 77 (85.6%) from the summer students.

The spring and summer students' overall academic results of NUR3011 were analysed by using International Business Machine (IBM) Statistical Product and Service Solutions (SPSS) for Windows version 23.0 (IBM Corp, Armonk, N.Y.). A total of 199 students (M=55, F=144) experienced CM in learning medical-surgical

nursing, 109 (M=31, F=78) are spring students and 90 (M=24, F=66) are summer students (Table 4).

Table 4

Frequencies of Gender in Each Semester

Group	*N*	*n*	%
Winter Semester (non-CM)	241		
Female		192	79.7
Male		49	20.3
Spring Semester (CM)	109		
Female		78	71.6
Male		31	28.4
Summer Semester (CM)	90		
Female		66	73.3
Male		24	26.7

Among the spring students, there were 28 (25.7%) visual learners, 15 (13.8%) aural learners, 2 (1.8%) read/write learners, 12 (11%) kinaesthetic learners and 43 (39.4%) multi-modal learners. Nine students (8.3%) did not participate in the VARK questionnaires and six (5.5%) students were re-takers. Among the summer students, there were 18 (20%) visual learners, 12 (13.3%) aural learners, nine (10%) read/write learners, nine (9%) kinaesthetic learners, 29 (32.2%) multi-modal learners. Thirteen (14.4%) students did not participate in the VARK questionnaires (Table 5) and 83 (92.2%) of them are re-takers. When spring and summer students combined together, there were 56 (26%) visual learners, 27 (15%) aural learners, 11 (6%) read/write learners, 21 (12%) kinaesthetic learners and 72 (41%) multimodal learners. The total of students who have not experienced CM in the same course in previous (winter) semester is 241 (M=49, F=192) (Table 4) and 36 (14.9%) of them are re-takers.

Table 5

Frequencies of VARK in Spring and Summer Semesters

Group	*N*	*n*	%
Spring Semester	109		
Visual		28	25.7
Aural		15	13.8
Read/write		2	1.8
Kinaesthetic		12	11
Multimodal		43	39.4
Did not complete the VARK questionnaire		9	8.3
Summer Semester	90		
Visual		18	20
Aural		12	13.3
Read/write		9	10
Kinaesthetic		9	10
Multimodal		29	32.2
Did not complete the VARK questionnaire		13	14.4

In this institute, the pass marks is 50 and the failure rate is aimed to be less than 15%. Teachers are required to submit marks to the Registry but the students receive a grade, such as A, B, C, D and grade point average (GPA) finally in their transcripts. In this study, overall grade refers to the marks submitted to the Registry. The pass rate of this course was increased from 77.6% in winter semester to 100% in both spring and summer semesters. In terms of marks, the average academic performance were 57.56 (*SD*=10.16), 79.72 (*SD*=7.07) and 75.69 (*SD*=8.72) in winter, spring and summer semesters respectively. In terms of GPA, the average were 1.39 (*SD*=0.92), 3.32 (*SD*=0.57) and 2.98 (*SD*=0.70) respectively (Table 6 & 7).

Table 6

Descriptive Statistics for Marks and GPA in Each Semester

List of	*N*	*M*	*SD*	*Skew*	*Kurt*
Winter Semester (Non-CM)	241				
Marks		57.56	10.16	-.14	.31
GPA		1.39	.92	-.10	-.67
Spring Semester (CM)	109				
Marks		79.72	7.07	-.26	-.58
GPA		3.32	.57	-.41	-.59
Summer Semester (CM)	90				
Marks		75.69	8.72	.12	-.58
GPA		2.98	.70	-.11	-.73

Note. *M* = mean; *SD* = standard deviation; Skew = skewness; Kurt = kurtosis.

One-way ANOVA test (Table 7) shows statistical significance with large differences between winter and spring (p=0.000; Cohen's d=2.532) as well as winter and summer groups (p=0.000; Cohen's d=1.915) at the .05 level, and less statistical significance (p=0.006) with medium difference (Cohen's d=0.508) between spring and summer groups. The results suggest that average grades in both CM groups are statistically significantly higher than the non-CM group and the magnitude of differences is large. Furthermore, although students' overall grade in spring CM group is statistically significantly higher than summer CM group, the magnitude of difference is medium (Bartolucci, Tendera & Howard, 2011; Coe, 2012). When spring and summer groups were combined as one CM-group and compared with the non-CM group, the pass rate was 100% and 77.59% respectively. The difference of marks between the CM group (M=77.90 and SD=8.09) and non-CM group (M=57.56 and SD=10.16) was statistically significant (p=0.000) with a large effect (Cohen's d=2.21).

Same comparisons were also conducted in terms of GPA, results were the same (Table 8). In sum, CM likely can help to improve students' academic performance.

Table 7

Differences in Marks between Semesters

	N	*M (SD)*	[95% CI]	*p*	Cohen's *d*
Winter Semester (non-CM)	241	57.56 (10.16)	[56.27, 58.84]		
Spring Semester				0.000	2.532
Summer Semester				0.000	1.915
Spring Semester (CM)	109	79.72 (7.07)	[78.38, 81.06]		
Winter Semester				0.000	2.532
Summer Semester				0.006	0.508
Summer Semester (CM)	90	75.69 (8.72)	[73.86, 77.52]		
Winter Semester				0.000	1.915
Spring Semester				0.006	0.508

Note. M = mean; *SD* = standard deviation; CI = confidence interval.

Table 8

GPA Differences between Semesters

	N	*M (SD)*	[95% CI]	*p*	Cohen's *d*
Winter Semester (Non-CM)	241	1.39 (0.92)	[1.27, 1.51]		
Spring Semester				0.000	2.522
Summer Semester				0.000	1.945
Spring Semester (CM)	109	3.32 (0.57)	[3.20, 3.43]		
Winter Semester				0.000	2.522
Summer Semester				0.009	0.533
Summer Semester (CM)	90	2.98 (0.70)	[2.83, 3.12]		
Winter Semester				0.000	1.945
Spring Semester				0.009	0.533

Note. M = mean; *SD* = standard deviation; CI = confidence interval

When compared the differences in overall grade regarding gender in each semester using independent sample t-test, there is a statistical significance with medium difference in spring semester (p=0.005; Cohen's d=0.627) in that female students

performed better than male students (Table 9). The results may not be reliable because the number of female students is 2.5 times of male students.

Table 9

Differences in Marks re Gender in Each Semester

	n	*M (SD)*	[95% CI]	*p*
Winter Semester (non-CM)			[-2.97, 3.14]	0.956
Male	49	57.63 (9.41)		
Female	192	57.54 (10.37)		
Spring Semester (CM)			[-7.23, -1.36]	0.005
Male	31	76.64 (6.94)		
Female	78	80.94 (6.78)		
Summer Semester (CM)			[-6.09, 2.25]	0.359
Male	24	74.28 (8.62)		
Female	66	76.20 (8.77)		

Note. *M* = mean; *SD* = standard deviation; CI = confidence interval

The average grade of spring students are: visual=80.80 (SD=7.30), aural=81.49 (SD=4.19), read/write=81.16 (SD=8.69), kinaesthetic=78.27 (SD=7.56) and multimodal=79.56 (SD=7.65). The ranking of mean grade from highest to lowest in this group was aural, read/write, visual, multimodal and kinaesthetic. Whereas, the means of overall grade of summer students are: visual=74.68 (SD=8.59), aural=78.79 (SD=9.38), read/write=74.89 (SD=3.87), kinaesthetic=77.10 (SD=9.69) and multimodal=75.96 (SD=9.74). The ranking of mean grade from highest to lowest in this group was aural, kinaesthetic, multimodal, read/write and visual. When compared the average grades between different sensory modalities groups in both spring and summer semesters using One-way ANOVA test, there is no statistically significant differences found (Table 10) even combined the overall grades of both semesters (Table 11). The ranking of mean grade from highest to lowest in the combined group was aural, visual,

multimodal, kinaesthetic and read/write. These results suggest students with varying sensory modalities performed similarly, and that student performance in this course does not differ based on sensory modality. In addition, the students classified as aural learners performed the best.

Table 10.

Differences in Marks for Sensory Modalities in Spring & Summer Semesters

	Spring Semester (N=100)				Summer Semester (N=77)			
	n	*M (SD)*	[95% CI]	*p*	*n*	*M (SD)*	[95% CI]	*p*
Visual	28	80.80 (7.30)	[77.90, 83.64]		18	74.68 (8.59)	[70.41, 78.95]	
Aural				1.000				.810
Read/write				1.000				1.000
Kinaesthetic				.902				.984
Multimodal				.978				.997
Aural	15	81.49 (4.19)	[79.18, 83.81]		12	78.79 (9.38)	[72.83, 84.76]	
Visual				1.000				.810
Read/write				1.000				.916
Kinaesthetic				.845				.998
Multimodal				.943				.936
Read/write	2	81.16 (8.69)	[3.14, 159.18]		9	74.89 (3.87)	[71.92, 77.86]	
Visual				1.000				1.000
Aural				1.000				.916
Kinaesthetic				.995				.995
Multimodal				1.000				1.000
Kinaesthetic	12	78.27 (7.56)	[73.46, 83.07]		9	77.10 (9.69)	[69.66, 84.55]	
Visual				.902				.984
Aural				.845				.998
Read/write				.995				.995
Multimodal				.993				.999
Multimodal	43	79.56 (7.65)	[77.21, 81.92]		29	75.96 (9.74)	[72.26, 79.67]	
Visual				.978				.997
Aural				.943				.936
Read/write				1.000				1.000
Kinaesthetic				.993				0.999

Note. M = mean; *SD* = standard deviation; CI = confidence interval.

Table 11

Differences in Marks for Sensory Modalities in Combined Spring & Summer Semesters (N=177)

	n	*M (SD)*	[95% CI]	*p*
Visual	46	78.41 (8.30)	[75.94, 80.88]	
Aural				.928
Read/write				.950
Kinaesthetic				1.000
Multimodal				1.000
Aural	27	80.29 (6.97)	[77.54, 83.05]	
Visual				.928
Read/write				.675
Kinaesthetic				.889
Multimodal				.835
Read/write	11	76.03 (5.09)	[72.61, 79.45]	
Visual				.950
Aural				.675
Kinaesthetic				.992
Multimodal				.967
Kinaesthetic	21	77.77 (8.32)	[73.98, 81.56]	
Visual				1.000
Aural				.889
Read/write				.992
Multimodal				1.000
Multimodal	72	78.11 (8.67)	[76.07, 80.15]	
Visual				1.000
Aural				.835
Read/write				.967
Kinaesthetic				1.000

Note. M = mean; *SD* = standard deviation; CI = confidence interval.

The comparisons of average grades between the first and second takers within groups using independent sample t-test were also conducted (Table 12). The total number of first takers and second takers in non-CM group are 205 (85%) and 36 (15%), and their mean overall grade are 55.78 (SD=9.56) and 67.70 (SD=7.13). Whereas, the total number of first takers and second takers in CM group are 110 (55.3%) and 89 (44.7%) and their mean overall grade are 79.14 (SD=7.46) and 76.36 (SD=8.60). The results shows that there is statistically significant with very large difference in non-CM groups (p=0.000; Cohen's d=1.413). It explains that the re-takers performed

significantly better than the first taker and the magnitude of difference is very large. However, the results may not be able to reflect the truth because the number of first takers in non-CM groups is more than six times of re-takers. Moreover, there is statistically significant with small difference in CM groups (p=0.016; Cohen's d=0.344). It means that the first takers' academic performance in CM group is significantly better than the re-takers but the magnitude of difference is small.

Table 12

Differences in Marks for First and Second takers within Semesters

	N	*M (SD)*	*p*	Cohen's *d*
Winter Semester (non-CM)				
First taker	205	55.78 (9.56)	0.000	1.413
Second taker	36	67.70 (7.13)		
Spring & Summer Semester (CM)				
First taker	110	79.13 (7.46)	0.016	0.344
Second taker	89	76.36 (8.60)		

Note. M = mean; SD = standard deviation; CI = confidence interval.

When compared the overall grade of the first and second takers between non-CM and CM groups, the first takers' mean overall grade in non-CM and CM groups are 55.78 (SD=9.56) and 79.14 (SD=7.46). Thus the second takers' mean overall grade in non-CM and CM groups are 67.70 (SD=7.13) and 76.36 (SD=8.60). The results reveal that there is statistically significant with very large difference in the first taker groups (p=0.000; Cohen's d=2.723). It means that the first takers in CM group performed significantly better than the non-CM group and the magnitude of difference is very large. There is also statistically significant with large difference in re-taker groups (p=0.000; Cohen's d=1.096). It suggests that the re-takers in CM groups also performed significantly better than the non-CM group and the magnitude of difference is large

(Table 13). However, the discrepancy of sample size between two groups should be taken into account.

Table 13

Differences in Marks for the First and Second takers between Semesters

	N	*M (SD)*	*p*	Cohen's *d*
First taker				
Winter semester (non-CM)	205	55.78 (9.56)	0.000	2.723
Spring & Summer Semester (CM)	110	79.13 (7.46)		
Second taker				
Winter semester (non-CM)	36	67.70 (7.13)	0.000	1.096
Spring & Summer Semester (CM)	89	76.36 (8.60)		

Note. *M* = mean; *SD* = standard deviation; CI = confidence interval.

4.3 Conclusion

The quantitative results showed that the majority of the students in this study were multimodal learners and the aural learners performed the best in terms of overall grade. The students' overall grade in both CM groups were significant higher than non-CM group either in marks or GPA. Same phenomenon was also identified when compared the first and second takers' overall grade between non-CM and CM groups. Among the two CM groups, students' overall grade in spring semester was significantly higher than summer semester in which the number of re-takers in spring semester was much less than summer semester. Moreover, female students' overall grade was significantly higher than male students in spring semester but no statistically significant difference in the other groups. In addition, re-takers' overall grade was significantly higher than the first takers in non-CM group, however, the phenomenon was reversed in CM group.

To answer research questions 1 & 2, the quantitative results of this study showed that the overall academic performance between non-CM and CM groups was statistically significantly different and the effect size was large. Given that all the courses in the researched institute have an outcome-based design, the overall academic performance reflects whether the students could achieve the course's intended learning outcomes. Thus the course's intended learning outcomes correspond to the programme objectives and further align with the required core competencies stipulated by the Nursing Council of Hong Kong (2012). Therefore, the findings can be interpreted that CM is able to improve the students' understanding of medical-surgical nursing so that all the students are competent to perform the nursing skills and interventions on patients with gastrointestinal, hepatobiliary, pancreatic, endocrinal and metabolic problems.

Furthermore, the results also revealed that there is no statistical significant difference in the overall academic performance between different sensory modality groups. It can be interpreted as CM sounds suitable for visual, aural, read/write, kinaesthetic and multimodal learners alike. In other words, it is not only favourable for visual learners. To conclude, from the objective perspective, CM can enhance students' learning in medical-surgical nursing and increase their professional competencies despite any sensory modalities. The quantitative results of this study are briefly illustrated in the following concept map (diagram 1).

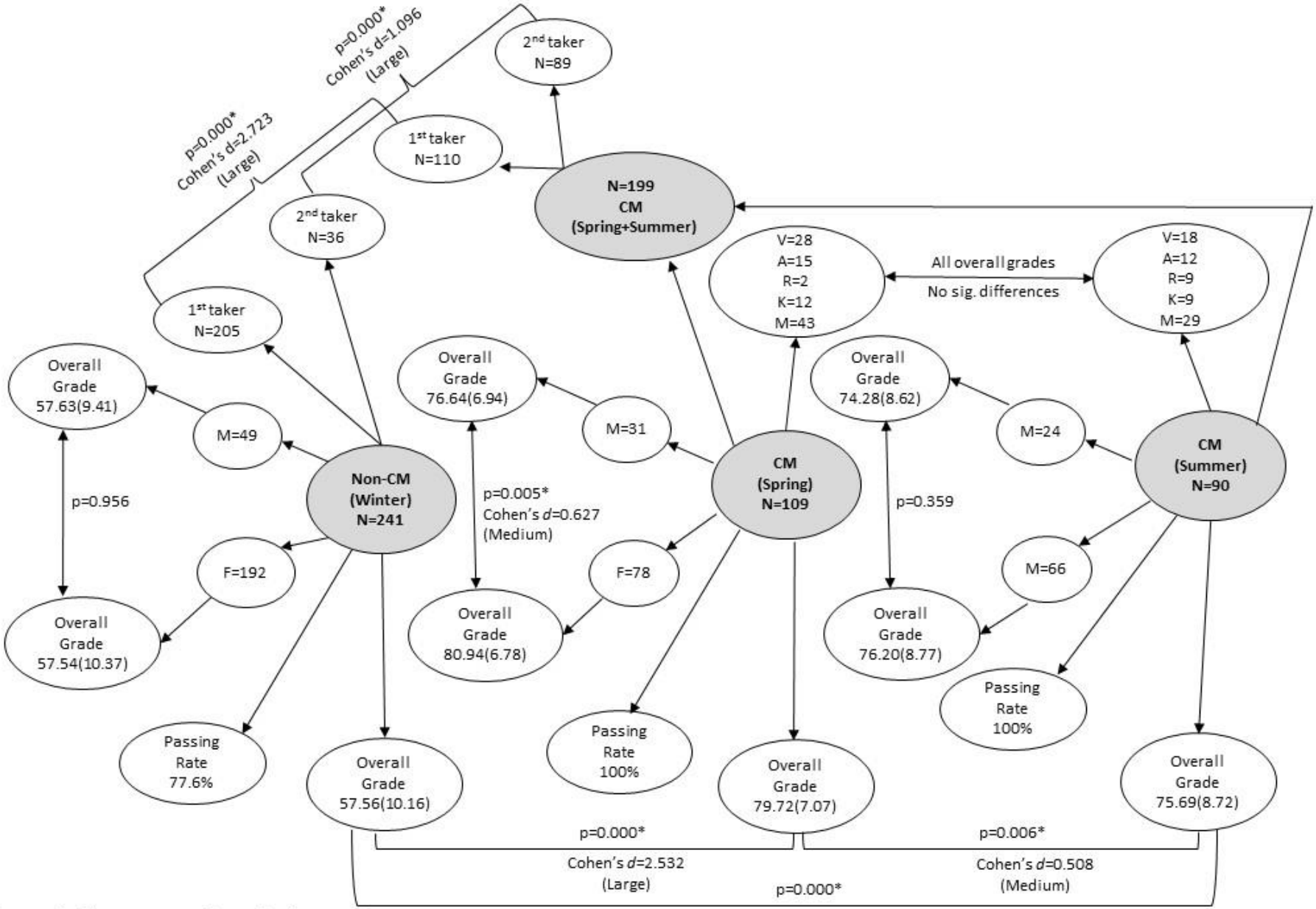

Diagram 1. Concept map of quantitative results

Chapter 5. Qualitative Findings

5.1 Introduction

Given that a mixed method is utilised in this study, the quantitative results have been revealed in last chapter. Hence, this chapter will disseminate the qualitative results which comprises two parts. The first part is about the impact of student's learning experience with CM and the second part is the generation of substantive theory regarding the relationship between CM and human's learning process. Students with same sensory modality formed groups and have been interviewed after spring and summer semesters respectively. A total of 26 students have been interviewed (spring = 16, summer = 10). Five were visual learners, four were aural learners, one was read/write learner, three were kinaesthetic learners, and 13 were multimodal learners. All of the participants in spring semester are the first time to enrol this course but eight out of nine participants in summer semester are re-takers as they have failed once in previous academic year. After transcribing all the audio records, the transcripts of each sensory modality group were printed in different colours, such as blue represented visual learner, purple represented multimodal learners and so forth. I read the transcripts line by line and when a meaningful code was identified, the dialogue was cut into strips. After the initial coding was completed, it resulted in a pile of strips and then I went for categorisation by grouping the similar codes (strips) together (Table 14). Finally, the students' experience of using CM was categorized into five areas. They are: 1) advantages of using CM, 2) impacts on group work, 3) stimulation of thinking, 4) disadvantages of CM and approach for written examination preparation, and 5) optimal way of using CM.

Table 14

Codes and categories

Code	**Category**
Provide concept	Advantages of using CM
Provide overview	
Full picture	
Categorize the content	
Summarize the content	
Easy to understand	
Enhance memorisation	
Easy to recall	
Good for brainstorming	
Drive further thinking	
Promote a clear way of thinking	
CM likes the way of thinking in our brain	
Widened my way of thinking	
Drawing CM with classmates enhanced memory	
Classmates' input enhance my understanding	
It serves as a reminder	
Simple	
Too brief	Disadvantages of using CM
Time-consuming	
More confusing	
Cannot write more words	
Can be very big, difficult to read	
Cannot arrange the concepts in sequence	
Not suitable for examinations	
Prefer to write in table form	Preparation for written examination
Prefer to write from top downwards	
Write in conventional care plan format	
Use it just before the examination	
Other memorisation methods	
Helped by learning in clinical practicum I	
Set meal memorisation method	
Memorized by systems	
By imagination	
Must have de-briefing after asking us to draw the CM	
Cannot replace conventional PowerPoint	
Cannot use CM alone	
Better to use conventional PowerPoint supplemented with CM	
Further elaboration under the concepts	Effective way to use CM
Standard paper size	
Black and white colour	
Debriefing after asked to draw CM	
Prefer conventional PowerPoint supplemented with CM	

5.2 The advantages of using CM

Students from different sensory modalities agreed that CM is able to show the relationships between nursing problems and interventions in a comprehensive, systematic, and well-organized manner via categorization and summarization. This form of presentation provides them a clear and overall picture in a short period, so students find it easy to grasp the relationships between concepts because it simplifies the complicated concepts into a simple and understandable diagram. In light of these advantages, CM enhances students' understanding of topics, facilitates their learning, and promotes good memorization regardless of any sensory modality groups.

First intake	*'A CM presents the relationship between concepts in short form which is easy to read and memorize.' (Visual learner)* *'The CM categorizes the nursing problems in different aspects which helps me to understand it easily.' (Aural learner)* *'The CM used in NCD II helps me to understand the topic more systematically.' (Kinaesthetic learner)* *'For preparing for the examination, I also read the CM first because I am not good at memorising a lot of words. CMs enhance my understanding so I can write the nursing interventions with my own words. CM is workable for me.' (Multimodal learner)*
Second intake	*'CM helped me to categorize the problems and interventions so when I went back to the textbook, it would be easier for me to understand the content and easy to memorize it.' (Kinaesthetic learner)*

	'The teacher used it at the end of lecture. The CM helped me to consolidate what I have learnt in the 2-hour lecture.' (Multimodal learner)

5.3 The impacts on group work

During group discussions, students learned from their classmates because they would help provide information, despite missing some points while drawing the CM. Thus some misconceptions can be clarified through arguing with classmates and further be verified with the tutor in the tutorial sessions. However, the degree of groupmates' engagement is also a key component to determine the outcome of learning from the group activity because some of the students reported that some of their groupmates did not actively participate in drawing the CM or made no input to the discussion. In this area, feedback was mainly received from the first takers. It seems that CM in group work is ineffective for the re-takers as they reported that they had learnt the content in their first intake and their understanding of knowledge had been further enhanced during their first clinical practicum. Hence, their engagement in group discussion was less than the first takers.

> *'The discussions with classmates in drawing the CM in tutorial sessions help my memorisation because conversation is stored longer in my memory.' (First intake: Aural learner)*

> *'The discussions in tutorial sessions help me to learn deeper about the topic because everybody has his/her own thinking and learning styles…we may miss some points, then through the discussions, we can supplement each other.' (First intake: Kinaesthetic learner)*

'I like group discussion with CMs rather than studying alone because the CM provides plenty of room for discussion. The arguments among classmates help to clarify my misconceptions and I can learn the right concepts and more than when alone.' (First intake: Multimodal learner)

5.4 Stimulation of thinking

A few students shared that it let them know there is another way of thinking, it broadens their way of thinking and the keywords and lines drive them to think further. In addition, they also expressed that the drawing of CM is like the way of thinking of their brain. Positive feedback was received from first takers and re-takers regardless of the sensory modalities.

First intake	*'Drawing a CM just likes our way of thinking in the brain...It provides more directions to think particularly one direction thinker.' (Kinaesthetic learner)* *'The keywords drive me to write the corresponding nursing interventions easily and it makes my thinking clearer.' (Visual learner)* *'It is a very good tool, it drives me to think more.' (Multi-modal learner)*
Second intake	*'CM is good for memorising complex knowledge, the lines of CM helped stimulating my thinking such as if the complication is peritonitis, the line will lead me to think of the use of antibiotics. It made me easy to remember.' (Multimodal learner)*

5.5 Disadvantages of CM and approach for written examination preparation

In this area, students shared their approaches for preparing the written examination which was held at the end of semester. In their sharing, few disadvantages of CM were also identified, such as extensiveness, time-consuming, more confusing and too simple.

Visual learners used CM in learning the new knowledge, doing revision and preparing the examination, however, many of them only used it at the end of revision or just before the examination. Instead, conventional nursing care plan format was preferred, that is they re-organized the content from PowerPoint and textbook into table and point forms instead of CM, because it is relatively not time consuming. Furthermore, students could easily prioritize the nursing interventions from specific to general in a top-down format as the format of CM likes a spider-web which cannot fulfil their needs. Thus, they think that the prioritization of nursing interventions is very important in nursing profession. Hence, table or point forms layout were displayed from top downwards so it only confined to a standard paper size and can be stored in piles. In other words, they can read the notes page by page. By contrast, the CM coverage can be considerably extensive, which easily confused them. The extensive CM can only be read by a tablet or computer, which caused further inconvenience. From the preceding section, CM seems to be workable for all types of sensory modality groups when they first encounter new knowledge. However, after they understood the relationships of concepts, the students would re-arrange them in their preferred order to steady the information in their memorisation to attain a better grade in the written examination.

First intake	*'I tried to use CM before this semester but I gave up very soon because the size of paper was not big enough for me to write, even*

	though I used A3 paper, therefore I went back to use point form writing from top to down.' (Visual learner) *'I have tried to draw a CM for revision but I found it very troublesome because it is too big, larger than A4 paper and not enough space. Therefore, I finally wrote the nursing interventions in point form, from top downwards which I found more convenient for doing revision and easy to memorize them.' (Aural learner)* *'I would not use it for studying because it is very time-consuming to draw a CM and it can be very big. I prefer to write the nursing interventions one by one and then prioritize them by numbering each intervention…the lines in CM causes my thinking jump here and there, and I feel it is very messy.' (Kinaesthetic learner)* *'The CM is very big…quite confusing sometimes and we cannot prioritize the interventions in CMs…and there are keywords only….too short…no elaboration of the nursing interventions.' (Multimodal learner)*
Second intake	*'At the beginning of learning the new knowledge, CM is useless to me but I used to draw it out after I memorized all the content. It helped me to express my understanding of knowledge.' (Visual learner)* *'For me, one-way thinking (traditional 5-column care plan format, from left to right) is better than CM.' (Multimodal learner)*

In addition, students were concerned about the rationales behind nursing interventions. However, only keywords were provided in CM. Consequently, students

did revision by reading the PowerPoint notes provided by lecturers and textbooks for the written examination held at the end of the semester. Some students even re-wrote them in table form for revision because they thought that the effect of using CM and table forms is similar to writing a nursing care plan but only in a different layout. A few of the students expressed that numerous lines in CM caused confusion. Hence, they used their own structured methods to memorize nursing interventions and rationales as they thought that this is the best strategy to attain a pass or good grade in the examination. Such findings were commonly found for both first takers and re-takers.

First intake	*'Sometimes too many lines feel messy so I write the nursing interventions in list form for revision.' (Visual learner)* *'I like to use CMs in class but I like to write the nursing interventions in essay form while doing revision because CMs are quite fragmented. I need to lay out things one by one.' (Multimodal learner)*
Second intake	*'In revision, I made my own notes in table and point forms after reading the textbook and PowerPoint. I only read my own notes for the written exam.' (Aural learner)* *'I tried to use CM before but I found that it made me more confused. I really could not handle the lines and it does not allow us to write many words on it.' (Read/Write learner)* *'Drawing a CM is waste of time. I prefer to read and rote the textbook, think about their connection rather than draw it out. But now the teacher has provided it to us so I used it at the last.' (Multimodal learner)*

Some students were re-takers, and they underwent the first clinical practicum after their first admission to the course. Therefore, when they retook this course, they found that their clinical experience, instead of CM, helped them to understand topics. These re-takers also expressed that CM is not an important tool. They only used it for consolidation after the revision and had a quick look just before the examination. Thus, they thought that their last failure was not related to their understanding of knowledge, instead they prepared not well for the examination. Although the re-takers did not need CM to bridge the knowledge for them, instead CM helped them with better memorisation. To conclude, CM is likely suitable for all types of learners as learners use it in different stages of their learning process. It all depends on the learners' needs.

> *'Last time I have not started my clinical practicum yet but after coming back from the first clinical practicum, I found that I am easy to understand the NCD II...practical experience helped my understanding of diseases and corresponding interventions.' (Second intake: Aural learner)*

> *'During the examination, after I read the scenario, I would imagine if I was the patient, how s/he would be. Thus the previous experience in clinical practice helped my understanding of the patient in the scenario.' (Second intake: Kinaesthetic learner)*

> *'Since I have already understand the relationships very well, I would only use CM at the last for revising the whole concept.' (Second intake: Multimodal learner)*

5.6 Effective way of using CM

The CM tool only provides keywords, and students suggested that lecturers should add short sentences to elaborate the rationales of nursing interventions. CM colours should only be black and white and confined to printable paper size. In addition, students, as learners, showed uncertainty about the accuracy of their work when they were asked to draw a CM in tutorial sessions. Hence, lecturers were suggested to provide a debriefing on CM again at the end of tutorial sessions. Detailed model answers should also be provided. PowerPoint presentations should be used as the primary learning tool by lecturers, and CM with animation should be used as a supplementary teaching tool.

> *'A few phrases listed under the key concept can provide guidance for us to look up the relevant areas in the textbook...at least then we have some ideas to follow.' (First intake: Multimodal learner)*

> *'The size of CM would be better confined to a standard paper size…not too big…some key points as the elaboration of the key concept…that's perfect!' (First intake: Multimodal learner)*

> *'Only using CM is not workable I think…but it is good when the teacher provides the detailed model answers after de-briefing with CM as this method provides me a clear train of thought.' (First intake: Visual learner)*

5.7 Conclusion

The only one read/write learner in this study is a re-taker so that the findings cannot reflect the impact of CM in bridging the prior and new knowledge on read/write learner. The above findings show that when students first encounter new knowledge, CM facilitates students' learning process through tying up relevant concepts together

and providing a comprehensive, systematic and well-organized structure in a short period. Thus, CM is able to break down a complicated construct into a simple and understandable diagram which enhances their understanding of the topic, just like a picture built up by many pieces of a jigsaw puzzle. In addition, asking students to draw a CM with their classmates in tutorial sessions created an opportunity for them to express and exchange their inherent understanding of topics. Their understanding would finally be expanded and deepened by learning from classmates; and such experience is then firmly stored in their memory. From their sharing, it seems that the lines in CM drive them to think deeper. However, when they came to prepare their written examination at the end of the semester, they used their own methods to re-organize what they had learnt and chose what they thought was the best strategy to enhance their memorisation of knowledge because the disadvantages of CM such as its extensiveness, time-consuming and simple format could not meet their examination needs. Moreover, the findings also revealed that there are differences regarding the use of CM between new takers and re-takers in this course, that is CM tends to be less useful for re-takers. This may be due to the knowledge not being new to them and their understanding of this course had been consolidated by their clinical experience; therefore, they did not need to tie up the relationship between concepts. On the contrary, the new takers did not have clinical experience, so they could only learn from the lectures and textbooks; thus, they could connect the concepts through CM. Lastly, they also provided some insights to the educators regarding the effective use of CM in learning and teaching.

In fact, I tried to use NVivo version 11.0 (QSR International Pty Ltd, Melbourne, Australia) which is software for analysing the qualitative data. However, I finally gave up. I turned to doing coding manually because the participants speak in Cantonese

which is a kind of dialect so it is different from the written form and they speak translingually, that is adding English in between Cantonese. Since they used different sets of words or several sentences to describe their feelings or situations, frequency count for particular words or phrases was not helpful to me. I had to interpret the meanings from their words instead which I think NVivo is not able to distinguish. Difficulty was also encountered when generating the substantive theory in the following chapter because the software was not able to explain the relationships between categories, but heavily relies on the researcher's theoretical sensitivity and his/her own understanding of the researched area.

Chapter 6. Generation of Substantive Theory

6.1 Introduction

Having described the advantages of using CM, how the students prepared for the written examination and their perspectives of the best way to use CM, this chapter will report the generation of substantive theory regarding the relationship between CM and the students' learning process which is also the core category of this substantive theory. To allow the categories to emerge from the raw data spontaneously, I cleared my mind and wiped away the findings in the preceding chapter. I started new coding all over again from the beginning and followed the coding principles of classic grounded theory.

6.2 The emergence of categories

Open coding, selective coding, theoretical coding, and constant comparison were conducted according to Glaser and Holton's suggestions. During the initial coding, Glaser (1978) suggested comparison of incidents with other incidents. Hence, in stage 1, after I identified the codes (Table 15), I compared them between different sensory modality groups as well as between first and re-takers. The findings showed that a similar phenomenon occurred in each sensory modality group but there were differences between first and re-takers. Lack of statistically significant differences in academic performance between different modality groups found in the quantitative data also echo to such findings.

Table 15.

Samples of verbatim and codes

Samples of verbatim	**Code**
'The discussions in tutorial sessions help me to learn deeper about the topic because everybody has his/her own thinking and learning	Listening

styles…we may miss some points, then through the discussions, we can supplement each other.'	
'The bonding between concepts in CMs facilitate my understanding of the diseases and nursing interventions.'	Watching
'Drawing a CM can easily let me know if there are any missing points in short form rather than writing in essay form.'	Drawing
'CM divided the knowledge into small groups. Summarised and categorised the content. It made it easy for me to understand.'	Increased understanding
'The lines of the CM drive me to think what the next is, so it seems to provide me more directions to think.'	Thinking like our brain
'Concepts are inter-related (not one way). The network-like CM can illustrated this correlation.'	Connecting the concepts
'After I read the CM, I'll re-think several times until I am able to speak out (to myself) the relationship between concepts.'	Providing concepts
'The CM provides a comprehensive and systematic picture'	Providing a full picture
'The teacher used it at the end of lecture. The CM helped me to consolidate what I have learnt in the 2-hour lecture.'	Providing an overview
'CM helps me to categorize the problems, such as psychological, physiological problems. It makes it easy for me to memorize it.'	Enhanced memorisation
'The image of the CM was stored in my memory which was easily recalled in the examination.'	Easy to recall
'The discussions with classmates in drawing the CM in tutorial sessions help my memorisation because conversation is stored longer in my memory.'	Classmates' inputs strengthened my impression
'I tried to use CM before this semester but I gave up very soon because the size of paper was not big enough for me to write, even though I used A3 paper, therefore I went back to use point form writing from top to down.'	Rewrite in table form/top downwards
'For me, one-way thinking (traditional 5-column care plan format, from left to right) is better than CM.'	Use conventional care plan format
'In revision, I made my own notes in table and point forms after reading the textbook and PowerPoint. I only read my own notes for the written exam.'	Use other memorisation methods
'You know….we are examination oriented.' *'Examinations are for scoring.'*	Get pass in examinations

'Learning and examinations are different; we aim to get the most marks as we can.' *'I am a re-taker, I cannot fail again.'*	

In stage 2, given that the core category was the students' learning with CM, selective coding was then used to identify the categories around it. Finally, five categories were identified, that is senses, building of knowledge, storage of information, consolidation of knowledge by reorganising information and goal (Table 16). The identification of core categories was in accordance with the five criteria suggested by Glaser and Holton (Glaser, 1978; Glaser & Holton, 2004; Holton & Walsh, 2017), that is centrality, frequency, relevance, grab and variability. Centrality means that the core category is central to the main concern. The main concern of this study was the relationship between CM and students' learning process. Frequency means that the codes occurred frequently in the data with a stable pattern. Relevance means that the core category had a relationship with other categories. Grab means that the category had imagery and explanatory power with general implication. Lastly, variability means the essential meaning remained constant although there were varying conditions. The varying conditions in this study represented different sensory modalities.

Table 16

Codes and categories

Code	**Category**
• Listening • Watching • Drawing	Senses
• Increased understanding • Thinking like our brain • Connecting the concepts • Providing concepts • Providing a full picture • Providing an overview	Building of knowledge
• Enhanced memorisation • Easy to recall • Classmates' inputs strengthened my impression	Storage of information
• Rewrite in table form/top downwards • Use conventional care plan format • Use other memorisation methods	Consolidation of knowledge by re-organisation
• Examination oriented	Goal

• Need to get a pass in the examination • Examinations are for getting marks	

When new knowledge is introduced with animated CM in lectures and used in tutorial sessions, senses are the means to bring the new knowledge into their memory. Students listened to and watched the teachers explaining the knowledge with CM in lectures and listened to their groupmates' opinion while they are drawing CM in the tutorial session. After they receive the information, building of knowledge takes place. Given that CM is able to provide a full picture of knowledge by tying the concepts together, its relational structure helps the students to think deeper and thus increase their understanding of knowledge. After understanding knowledge, storage of information occurs. The simple structure of CM allows students to memorize the knowledge easily and also it is easy to recall it. Moreover, the inputs from groupmates while drawing the CM in tutorial session provides them a deep impression so that they can further store it firmly in their memory. Since the students' ultimate goal was to pass or attain a good grade in the written examination, the first takers consolidated the knowledge by reorganizing the knowledge in their own ways to achieve the goal (Figure 5). However, for the re-takers, CM seemed to help them build up knowledge and enhance storage of information. Only consolidation of knowledge by their habitual methods to achieve the goal was noticed (Figure 6). At this stage, a preliminary theory is emerged after the core categories were found and Glaser (1992) called it emerging theory (Figure 7).

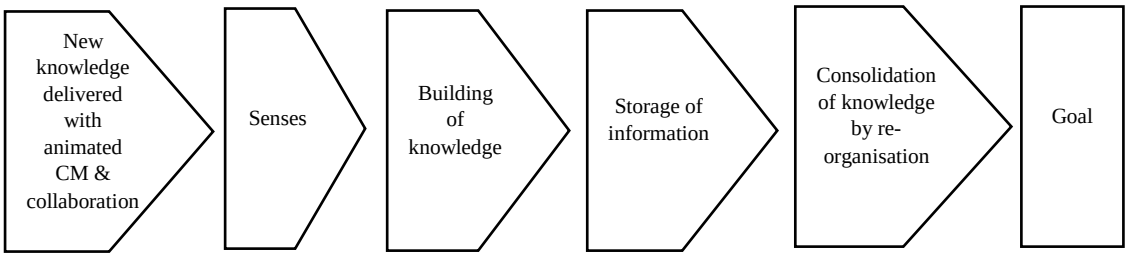

Figure 5. New takers' learning process with CM

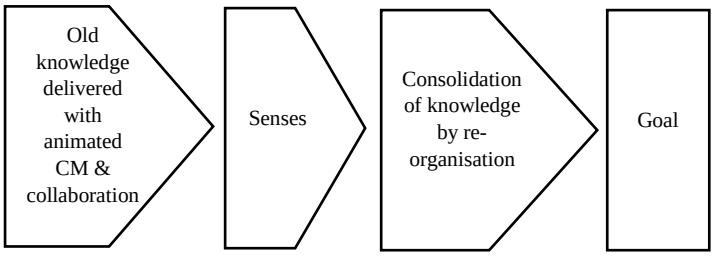

Figure 6. Re-takers' learning process with CM

	Category				
	Senses	**Building of knowledge**	**Storage of information**	**Consolidation of knowledge by re-organising information**	
CM with animation and collaboration	<u>Codes:</u> *Visual, aural, read/write, kinaesthetic*	<u>Codes:</u> *Increased understanding, thinking like our brain, connecting the concepts, providing concepts, providing a full picture, providing an overview*	<u>Codes:</u> *Enhanced memorisation, easy to recall, classmates' inputs strengthened my impression*	<u>Codes:</u> *Rewrite in table form/ top downwards, use conventional care plan format, other memorisation methods,*	Goal (written examination)

Figure 7. Emerging theory

After the open and selective coding, I started to use memoing to record my enquiries about the underlying meanings of the concepts and the possible causal relationships between subcategories. Glaser (2014), Holton and Walsh (2017) advocated free style memoing which means that ideas can be recorded in different styles as it is a personal record without restriction of writing style, grammar and spelling. Hence, my memoing style has two forms. One is in written format and the other is a drawn diagram. The written format was mainly used to record my enquiries and ideas that emerged from the data, and diagram drawing helped me to link up the concepts or findings from further literature searching. I went back and forth between the data and

several rounds of data searching. The questions below are some of my enquiries that arose during the analysis.

1. Knowledge organized in table or CM forms. Does it matter? It seems that both of them can serve the purpose of categorisation of information.
2. Are there any other forms of visual or graphic organizer that have similar effects?
3. What is the relationship between senses and the entry of information?
4. How does the human process the information?
5. How will the information be stored and retrieved from the memory?
6. Why do the students have such behavioural change when they are preparing for the examination? Can any existing theory explain this phenomenon?
7. Students use different strategies to consolidate their knowledge. Is there any relationship between their ways of thinking? Does an individual's level of thinking capability matter?
8. What is the difference between linear and non-linear thinking? Does it matter in an individual's learning?

To ensure the trustworthiness of this study, after the initial causal relationship between CM and students' learning process emerged, I searched for other studies and compared this study with others. Given that there are limited studies about the learning experience of CM and I assumed that CM is a kind of graphic organizer, the literature search was extended to other graphic organizers such as mind map and other advanced organizer for further comparison.

6.3 Constant comparison of studies

Constant comparison is a core step of qualitative analysis in GT (Glaser & Strauss, 1967) and the dominant principle of data analysis in qualitative study (Boeije, 2002). According to Glaser (1978, 1982), comparison between studies is a non-linear and iterative process because the researcher will repeatedly go back and forth in order to foster the development of the core categories of a theory. After the second round of the literature search, a comparison with the following literature was made and similar results were found across different contexts. In the United States, Daley (2002) found that CM is able to increase adult graduate students' understanding, facilitate knowledge construction and enhance their memorisation as it provides linkages between concepts and a comprehensive picture of what they had learnt but its time-consuming nature is still a key shortcoming of CM. Most of the participants in this study also reported that it was difficult to switch from using their own learning strategies to new learning method (CM) as they were their old habits. However, when the researcher followed up the participants one year later, it was found that CM can foster a long-term change in learners' thinking and learning strategies as nearly two-thirds of the participants continued to use CM in subsequent courses and even adopted it in their workplace. Trehan (2015) revealed that students had positive, negative and neutral experiences of using CM as their learning tool. Some students expressed that CM is able to enhance their understanding of the important statistical concepts, some of them expressed that CM wastes their time and is not able to affect their motivation and effort in class as well as doing assignments, and some of them viewed it as an extra 'add-on', which was not very helpful to them. Trehan's thesis also found that students' perceptions of using CM are affected by their own learning styles, habits and time.

In Taiwan, Hsu, Pan and Hsieh (2016) showed that using group discussion with CM could facilitate student nurses' understanding of concepts, ideas clarification, application of knowledge and identification of patients' health problems and corresponding nursing interventions by relieving their cognitive load. Furthermore, this approach is also effective in developing a deeper impression and enhance thinking. In addition, in physics education, Lin, Chang, Hou and Wu (2015) found that both the drawing CM on a shared electronic platform and pencil-and-paper groups with their peers had positive effects on learning achievement. Thus, most of the participants agreed that the discussion with peers facilitated their understanding of the learning content.

In Africa, Luchembe, Chinyama and Jumbe (2014) revealed that when introducing CM to students in physics education, most of them enjoyed using it because it was simple to understand and summarisation enhanced their understanding of topics even though agreement on their CMs could not be reached in group work. Thus, I found that after they learnt CM, they would use it in revision, other physics topics and their further teaching career. In Ireland, the physics students also expressed that CM was simple, easy to read and a good visual aid for revision and memorisation as it is like a summary linking ideas together (Broggy & McClelland, 2008).

In Pakistan, medical students reported that CM was helpful in understanding the topics, organising their thoughts and enhancing their creativity. Thus, it was a good tool for quick revision of the topic. However, some of them also found that it was time-consuming and confusing (Baig, Tariq, Rehman, Ali & Gazzaz, 2016). In Ireland, the physics students' feedback in open-ended questions of a survey was almost the same as the findings in this study (Broggy & McClelland, 2008). They expressed that CM was a good visual tool, good form of revision and good reflection tool to evaluate their

learning. The students easily remembered the content because it linked ideas together just like gathering their thoughts, providing a comprehensive summary that was easy to read and understand. Given that most of the literature comprising quantitative studies and in-depth learning experience on using CM is limited, constant comparison was extended as follows.

Some researchers have argued that although CM, mind maps (MMs), flow charts and some kinds of advance graphic organizers have differences in terms of their structure, all of them are composed of keywords or short phrases and lines, and even images. That may result in the same outcomes because all of them can display the relationships between concepts and are able to link up the new knowledge with prior knowledge. Compared with MM, CM is a hierarchical "tree" structured with super-ordinate and subordinate parts but MM starts from the centre. There are verbs and prepositions/prepositional phrases written in the lines linked up between concepts in CM but there is no such wording in the lines of MM. Thus, cross-linking among the sub-concepts may be present in CM but absent in MM (Davies, 2011; Thompson, 2017). In view of the popular use of MM in higher education and I assumed that it may have similar effects as CM because they share similar characteristics, constant comparison was extended to the studies using MM in teaching practice. Many studies show that MMs also have positive effects on learners and are able to facilitate their understanding and retention of knowledge (Akinoglu & Yasar, 2007; Dhindsa, Makarimi & Anderson, 2011; Eppler, 2006; Tanriseven, 2014). In Turkey, pre-service teachers expressed that MMs help them to recall what they have learnt in the class, connect the concepts learnt in class together, evaluate their own learning progress and provide them a whole picture with key points in a well-organized format (Tanriseven, 2014). MMs are also popular in nursing education. Rooda (1994), Boley (2008) and Rosciano (2015) found that MMs

are able to help student nurses to attain higher scores, recall a large volume of complex information, have a clearer understanding of concepts, expand their thinking and promote student engagement and collaborative learning in group discussions. Eppler (2006) used CM, MMs, conceptual diagrams and visual metaphors one by one in lecturing, take-home assignments, and in-class discussions and found that students favour these visual tools as their memorisation of content was better than usual but they required a teacher's assistance, feedback and a lot of time to draw a high-quality CM.

In summary, most of the studies focused on the general learning experience of using CM but no exploration of different sensory modality learners has been performed. Therefore, the second round of literature review aimed to find out the similarities and differences of general learning experience of using CM in different disciplines and countries. The results show that CM seems to be effective for most learners in understanding and constructing new knowledge, as well as retaining information longer in their memory. Furthermore, among different kinds of advanced organizers, the students' learning experience of using MMs and CM are more similar than others.

6.4 Literature review regarding the relationship between categories

Apart from the literature search for the comparison between studies, I also searched for theories to explain the phenomenon because Glaser (1978) asserted that 'all basic social processes are core variables but not all core variables are basic social processes (p.96)' and 'when the theory seems sufficiently grounded in a core variable and in an emerging integration of categories and properties, the researcher can begin to review the literature in the substantive field and relate the literature to his own work in many ways' (Glaser, 1992, p.32). This round of literature review provided me some insights about the relationship between senses and learning, knowledge construction in the memory and the interaction between the external environment and human behaviour.

As a result, I identified the following theories that helped to explain the relationships between categories. They are dual-coding theory (Paivio, 1971), cognitive theory of multimedia learning (Mayer, 1997), and social cognitive theory of self-regulation (Bandura, 1991).

6.4.1 Dual-coding theory

Dual-coding theory was developed by Allan Paivio in 1971 and it proposes that humans have two cognitive subsystems. One is for processing language and the other is for processing images, and both are stored in the memory separately. In other words, it processes information through two distinct channels, that is visual and auditory enters the human brain simultaneously. Although they are independent systems, they interact sometimes. The information stored in these two locations is retained longer and is easily retrieved rather than if only stored in one location. If this is the case, it can help to explain why the students reported that CM can enhance their memorisation and ease of recall because animated CM, the words in CM, the teacher's explanation with conventional PowerPoint and the conversation between students in discussions strengthened the reception and storage of new knowledge in both the visual and auditory systems.

6.4.2 Cognitive theory of multimedia learning

The cognitive theory of multimedia learning is a model which illustrates the human information-processing system (diagram 2). It was developed by Richard Mayer based on three main assumptions: dual-channel assumption, limited capacity assumption and active processing assumption (Mayer, 2005). These three assumptions illustrate the relationship between two of our senses that is auditory and visual channels that human beings usually used to receive

information, and how our brain processes information and stores it. The first assumption is based on the development of dual-coding theory. Using CM in classrooms, the teacher's speech, words and lines in CM together with PowerPoint animation enter a learner's brain through their vision and hearing. The dual-coding theory asserts that these two channels work and store information separately (Paivio, 1986; Baddeley, 1986 & 1999). However, after the information enters the brain, the sensory memory starts to work. Since the sensory memories only last for few a seconds and 15-20 minutes in working memory, humans have limited capacity to process them in each channel at one time (Baddeley, 1986 & 1999; Chandler & Sweller, 1991). For instance, adult learners can only manage seven plus or minus two chunks of information in their working memory each time (Miller 1956). In other words, if the amount of information coming into the brain is greater than its processing capacity, humans will be forced to select what is relevant to them and then pass it into short-term memory for connecting with their prior knowledge and finally decide whether to store it in long-term memory or delete it. In the long-term memory, information is stored in three forms, that is declarative (semantic and episodic), procedural, and mental images. The quality of information stored in working memory depends on the encoding and retrieval processes. Using CM in learning, since it is simple and able to show the overall relationships between concepts and the prior knowledge in one diagram, it won't increase learners' processing load so that learners can understand the content easily. Thus, if the complexity of CM does not exceed the processing load, learners do not need to select the information, but can store all the information as a whole in their long-term memory instead. This echoes the learners expressing that CM promotes better

memorisation and the information is easy to retrieve from memory. In contrast, CM with too many lines can make learners confused because it exceeds their processing load. The third assumption is about a human's active processing of information inside the brain. These processes include paying attention, organising information, and integrating information with other knowledge. To make it simple, humans who are willing to order their brain to process information in a meaningful sense, are active learners and meaningful learning occurs. On the contrary, humans who only store information inside their brain without making sense of it are labelled passive or rote learners.

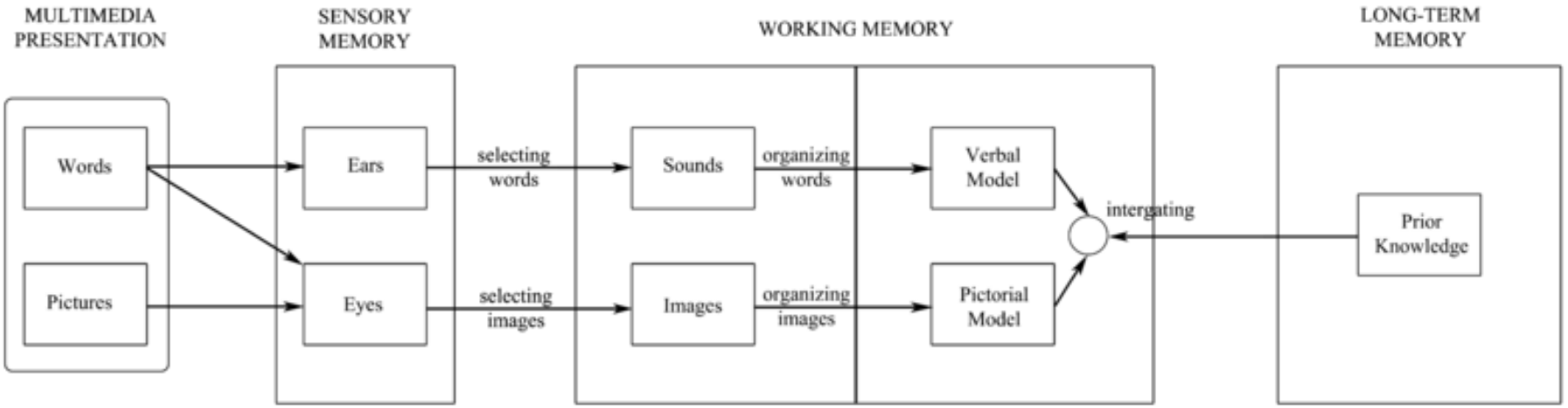

Diagram 2. Cognitive theory of multimedia learning (adopted from Mayer, 2005, p.37)

6.4.3 Social cognitive theory of self-regulation

In 1977, Albert Bandura posited that learning is a cognitive process which occurs in social context through observation and copying others' behaviour. It is correct in child development but when human has accumulated certain degree of knowledge and the cognition is able to control one's behaviour, learning is not just a kind of modelling. Hence, Bandura modified the social learning theory and renamed it as social cognitive theory in 1986 which describes how humans learn from social experiences. This theory asserts that learning occurs through a dynamic and reciprocal interplay between person, environment, and behaviour. In 1991, Bandura explained the social cognitive theory of self-regulation in detail and indicated that 'human behaviour is extensively motivated and regulated by the ongoing exercise of self-influence' (Bandura, 1991, p.248) and the self-regulative mechanism is mainly influenced by three elements, that is 1) self-monitoring of one's behaviour, its determinants and its effects; 2) judgment of one's behaviour in relation to personal standards and environmental circumstances; and 3) affective self-reaction. Thus, human behaviour is affected by one's self-efficacy and self-motivation. In sum, people, behaviour and environment are the key elements in this theory and they are inter-related (diagram 3). The change of one element influences the other two. Human behaviour is affected by different situations which produce the interaction between people, behaviour and the environment. People refer to the students. Behaviour refers to the students' responses when they learnt medical-surgical nursing with CM and how they prepared themselves for the written examination, whereas the environment refers to the lectures in which the teacher used CM to teach medical-surgical nursing and the tutorials where the students

drew CM in groups to answer the scenario-based exercises. Based on the findings of this study, it implies that students adjust their own thoughts, behaviour, and feelings to reach their goal and achieve satisfactory grades and their behaviour can be interpreted as follows.

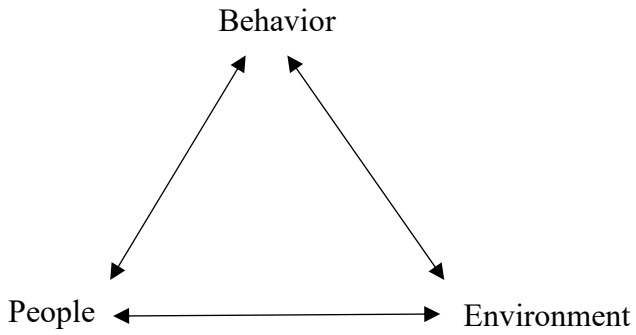

Diagram 3. Bandura's social cognitive theory (1999)

At the first stage, when students encountered new knowledge initially in a lecture, they used their senses to receive the inputs. In this stage, the teachers used CM, group discussion and scenario-based exercises to facilitate the construction of new knowledge on top of their prior knowledge. Students did not undergo an explicit behavioural change because they need time to process the information and relate the bonding between concepts. After they have grasped the framework of knowledge, their behaviour will change at the second stage. They will choose their preferred way to memorize the details of data firmly in their memories because their ultimate goal is to pass this course and attain a good grade. They understood that if they fail this course, they need to re-take it and pay for it again, and their semester grade point average (sGPA) will drop further. As a result, their study will be deferred and they may have a chance to be terminated by the School because of the sGPA for three consecutive semesters being lower than 2.0. Given that they anticipated the negative consequences as catastrophic, to avoid this, they used the best strategy

they perceived to produce the desired outcomes. In this process, students used their own self-regulatory learning strategies in different stages. For instance, using a table format care plan and special memorisation methods to enhance the storage of knowledge and used CM only for quick revision just before the examination.

Moreover, this theory emphasizes that human behaviour is influenced by one's self-efficacy and motivation. Bandura (1994) defined self-efficacy as an individual's beliefs about his/her own capabilities to produce effects. Although the students' self-efficacy was not explored in this study, their intrinsic and extrinsic motives were apparently observed in the data. There are two types of motivation, that is internal and external motivation (Ryan & Deci, 2000), and their factors are called intrinsic and extrinsic motives. They enrolled on this programme because they want to become registered nurses and attend the lectures because they need this essential and crucial knowledge to equip themselves. In addition, to pass or attain a good grade in the examination is their external motive driving them to select their perceived effective strategies to achieve their short-term goal. Through achieving their short-term goal, they can further accomplish their long-term goal which is to fulfil the graduation criteria, complete the programme and finally become a registered nurse.

6.5 Shaping the emergent theory

According to Glaser (1992), Holton and Walsh (2017), theoretical sampling, theoretical saturation and theoretical coding are required to build and shape the emergent theory with conceptual explanation. Theoretical sampling refers to a process of combining several different slices of data (Glaser & Strauss, 1971) and aims to 'discover categories, properties, and interrelationships suggestive of a theoretical whole'

(Holton and Walsh, 2017, p.100). It is done parallel with constant comparative analysis. During this process, the discovery of similarities and differences provides the variability of concepts and their properties in different contexts and conditions. It aids to elaborate the overall integration of the theory conceptually. For the theoretical saturation, it refers to 'the constant comparison of conceptual indicators in the data to the point where additional indicators yield no further specification or elaboration' (Holton and Walsh, 2017, p.103) and the criteria for determining saturation are 'a combination of the empirical limits of the data, the integration and density of the theory and the analyst's theoretical sensitivity' (Glaser & Strauss, 1967, p.62). For the theoretical coding, it occurs 'after all substantive coding has completed and the saturation of core categories and related concepts' (Holton and Walsh, 2017, p.105). Glaser (2005) suggested that reading theory in other fields can assist in building a repertoire of theoretical codes and enhance researcher's theoretical sensitivity. The above mentioned procedures have been implemented back and forth during the constant comparison with other studies and look-up of the relevant theories such as the dual-coding theory, cognitive theory of multimedia learning and Bandura's social cognitive theory explained in the last section aid to raise the conceptual level and density of the theory as follows.

6.6 The substantive theory

After conceptualisation, the substantive theory finally consists of six categories, that is troublesome knowledge, effective learning and teaching strategy, memory, active learning, perceived effective strategy and success. This theory illustrates how the teacher can help learners to overcome the troublesome knowledge, facilitate the move of knowledge from introduction, passing through the senses get into the brain and aid

them success (diagram 4). However, there is one condition to make this theory valid which is the introduced knowledge should be new to the learners.

6.6.1 Troublesome knowledge

In 1999 & 2006, Perkins describes that troublesome knowledge is a kind of knowledge which is conceptually difficult, counter-intuitive and even like an alien to learners and there are four types: conceptually difficult, ritual, inert and foreign. Conceptually difficult knowledge means concept that may be counterintuitive to the one's traditional way of thinking or it requires several different pieces of information to make it become meaningful. Ritual knowledge lacks of meaning and it becomes part of a routine particularly when the learner thinks that it is irrelevant to them. Inert knowledge is something we may know but seldom use it particularly when the learner less actively participated in the learning process on using it. Foreign knowledge also known as alien knowledge such as the terminology in medical science and the phenomenon in the past that the learner cannot understand with the current perspective. Meyer and Land (2003) further expanded the characteristics of troublesome knowledge later on. It can also refer to the tacit knowledge held by the professionals. The learners feel that it is difficult because they are not able to solve the problems when the situation is changed. In this study, medical-surgical nursing is the troublesome knowledge in nursing education because the learners are required to understand many medical terms, bridge the signs and symptoms of diseases with the anatomy and physiology, understand the concepts and their relationships, and finally use the 5-step nursing process to formulate a nursing plan. They are required to identify patient's acute and potential problems with evidence, set up the goal, implement nursing care with

sound rationales and then evaluate the effectiveness of treatment and care in this process. The variation of nursing care plan depends on the different situations of patients. In higher education, apart from nursing, other disciplines also have their own set of language and their bodies of knowledge are quite complicated such as medicine, dental, physics, chemistry, statistics and mathematics, etc. The learners are required to understand the terminology first and then acquire higher-order thinking skills to understand the conceptual knowledge, transform and apply it in different situations.

6.6.2 Effective learning and teaching strategy

Learning and teaching are interrelated; at some moments they occur separately, and knowledge construction starts to develop when they occur simultaneously. In the learning process, teaching starts at the very beginning and initiates learning a short time after the information reaches learners' working memory. To aid learners overcome troublesome knowledge and facilitate knowledge construction, teachers need to adopt an effective teaching and learning strategy which includes teaching method and optimal learning environment. As such, an effective teaching and learning strategy should embrace the following properties. An effective teaching method should be able to break down the troublesome knowledge into chunks of concepts and to deliver with a network-like diagram because human is not able to receive massive information at one time, otherwise the memory will proceed to selection of information. Thus the diagram should be able to display the relationships between concepts with keywords or phrases and linked up with lines because a network-like image mimics the way of thinking in the brain. It can reduce the cognitive load for bonding the concepts. In addition, this diagram

should be able to disseminate in a page where provides a comprehensive structure of the whole concept. Given that human receives information through vision and auditory channels simultaneously and separately, the information should be delivered by lecturing with explanation and animation to draw their attention and promote the understanding of concepts.

Furthermore, repeated instruction and practice are required to consolidate the knowledge and promote its retention in the memory. Therefore, an optimal learning environment should include providing a collaborative learning opportunity which allows students to practice the application of their learnt knowledge with this diagram because social development theory provides insights that social interaction between learners helps the construction of knowledge through conversation and reflection of their own learning process. This opportunity should be designed in small group to maintain an effective group dynamic as the learners' metacognition activity is needed to be guided and facilitated by peer verbal interaction (Brown, 1989; Choi, Land & Turgeon, 2005; Palincsar & Brown, 1984; Palincsar, Brown & Martin, 1987; Piaget, 1985; Scardamalia, Bereiter, McLean, Swallon & Woodruff, 1989; Webb & Palincsar, 1996). During the discussion, they exchange, examine and justify the shared information in order to form a common answer. The multiple perspectives raised can help them to recognize the differences of their understanding of knowledge and such recognition further helps them to fill their own knowledge gap, then articulation of knowledge occurs (Choi, Land & Turgeon, 2005; Dillon, 1994).

6.6.3 Memory

After the teacher disseminated the information, learners receive them through sensory memory, working (short-term) memory and eventually stored in the long-term memory. As above-mentioned, the cognitive load in sensory memory is short and limited, thus human will select relevant information to remember when the amount of information exceeds the cognitive load. Therefore, the teaching diagram should maintain as simple and comprehensive to avoid selection of information by learners. In other words, it would promote the reception of whole piece of information. However, when the learners first encounter new knowledge, it will temporarily be stored in the working memory; hence the teacher needs to further facilitate the storage of knowledge in their long-term memory by creating a learning environment where provides learners an opportunity to apply learnt knowledge together with their peers. A collaborative learning environment enhances the memorisation, retention and recall of information because verbal interaction among peers promotes deep impressions. The details of how to promote student engagement in a collaborative learning environment will be explained in the following section.

6.6.4 Student Engagement

After the information is received from the learner, the degree of student engagement dominates how much and depth the learner would gain as well as the outcome. Bomia, Beluzo, Demeester, Elander, Johnson & Sheldon (1997) define student engagement as student's willingness, need, desire and compulsion to participate in an activity that would make them successful in their learning process. Later, the definition of engagement is expanded as it is something more than participation or involvement and it requires sense making,

feelings and activity. When one's acting without feeling engaged, it is called involvement or compliance. If one feels engaged without acting, it is called dissociation (Harper & Quaye, 2009; Trowler, 2010). Eventually, three dimensions of student engagement are identified and commonly accepted by scholars and academics that is behavioural, emotional/affective, cognitive (Fredricks, Blumenfeld & Paris ,2004; Jimerson, Campos & Greif, 2003). Behavioural engagement means students would comply with behavioural norm such as involvement and attendance. Emotional engagement means students would experience affective reactions such as if they like the teacher, they enjoy and feel interested in the class, thus have better outcomes. Cognitive engagement means students would seek to go beyond the basic requirements and greatly enjoy the challenge.

To enhance student engagement, Coates (2007) suggests a broad construct which encompasses the following academic and non-academic elements:

- active and collaborative learning,
- level of academic challenge,
- interaction with academic staff,
- enriching educational experiences, and
- a supportive learning environment.

The course design with CM in this study fulfils three of the above elements for promoting student engagement such as the students are asked to answer the scenario-based questions by drawing a CM in groups which promotes active and collaborative learning, interaction with peers and academic staff in tutorial sessions and a supportive learning environment. Drawing a diagram seems more

effective than writing because it can be completed in a short period, easily revised or reconstructed during discussion and lines in diagrams drive them to think deeper. Thus, drawing will stimulate another human sense, that is kinaesthetic. In addition, the group activity should be designed with problem-based questions which allow room for students to argue, discuss and come up with solutions together. Although this study cannot measure the degree of individual's engagement in the lecture, students' engagement in tutorial sessions has been revealed in focus group interviews and the achievement of outcome has been proven by their academic results and 100% pass rate.

Learner's willingness to learn plays an important role in the learning process because it is one of the crucial elements in meaningful learning. Scholars such as Vygotsky's (1978) social development theory and Bandura's (1986) social cognitive theory advocates that construction of learning only occurs when an individual actively participates in the learning process such as pay attention to the lecture and actively engaged in group discussion. Once the learner gets involved in his/her learning, metacognition will then be activated. The learner will plan, monitor, evaluate and self-regulate his/her learning through self-reflection and s/he will give meaning to the knowledge. In other words, one's success depends on his/her effort of controlling such thinking as Livingston (1996 & 1997) and Mahdavi (2014) posits that metacognition plays a critical role in successful learning.

6.6.5 Perceived effective strategy

After learners understood the knowledge, this study found that learners will reconstruct the knowledge with his/her perceived effective strategy to achieve the goal. This phenomenon echoes to Bandura's (1991) social cognitive

theory of self-regulation which explains that learner's behaviour is extensively motivated and regulated by the continuous influence by him/herself and this self-regulative mechanism is mainly influenced by the interaction between people and environment (Bandura, 1991). It implies that when a learner encounters a challenge which is very important to him/her, then s/he will adopt his/her perceived effective method to overcome the challenge in order to obtain the best outcome. However, the outcome that one has hoped for would depend on his/her self-efficacy, motivation, mental and physical condition of that moment, time and so forth.

6.6.7 Success

In Cambridge dictionary, success is the achievement that one's wanted or hoped and in Oxford dictionary, it is also explained as the accomplishment of an aim or purpose. The students' academic performance of this study was used to evaluate the effectiveness of CM but it can be influenced by some internal and external variables. Hence, to conceptualize the phenomenon, one's success seems more appropriate to use as the outcome of theory because the degree of success should be determined by oneself. For instance, a student attained grade C in the overall academic performance, to him/her, it can be a success if s/he was failed in the last intake. In sum, an effective learning and teaching strategy facilitates students' learning process. However, the degree of learner's engagement in this process would affect the solidity of knowledge in their memory, thus further influencing the degree of success. The relationship between the degree of engagement and the outcome (success) should be positive.

6.6.8 Assumptions of the substantive theory

The findings of this study suggested that the above stated logic only occurs when the learner comes into the first contact with new knowledge. If the knowledge is not new to learner, s/he does not need to construct the knowledge, s/he then will directly jump to use his/her habitual or perceived effective method to overcome the challenge and achieve the goal. Another assumption of this theory is that external unpredictable factors are none. In other words, the theory only focuses on the teacher and learner's input in the process in which the teacher initiates the learning intention. After the information gets into the learner's memory through the senses and metacognition, the learner takes control of his/her learning. In this stage, the teacher keeps facilitating the absorption and construction of knowledge by creating collaborative learning opportunities. After the students have bridged the new knowledge and prior knowledge, they will take over whole control and they will re-organize the information with their perceived strategy for better memorisation. The last assumption is the environment is situated in higher education context as this study and constant comparison were conducted in a higher education institute. It may can also say that it is also apply to adult learning as only adults are able to master their cognition to re-organize knowledge.

6.7 Conclusion

This chapter explained how the substantive theory is developed by using classic GT approach. First, codes were identified from verbatim. Second, identify categories by grouping the codes. Third, line up the categories to illustrate their causal relationships and form an emerging theory. After second round of extensive literature review and repeated comparison between studies, a substantive theory was developed.

It illustrated how CM delivers the knowledge into human's memory through senses and how it improves learners' understanding and memorisation under a collaborative learning environment. After the learners' self-adjusted the learnt knowledge, CM indirectly helps the learners drive to success.

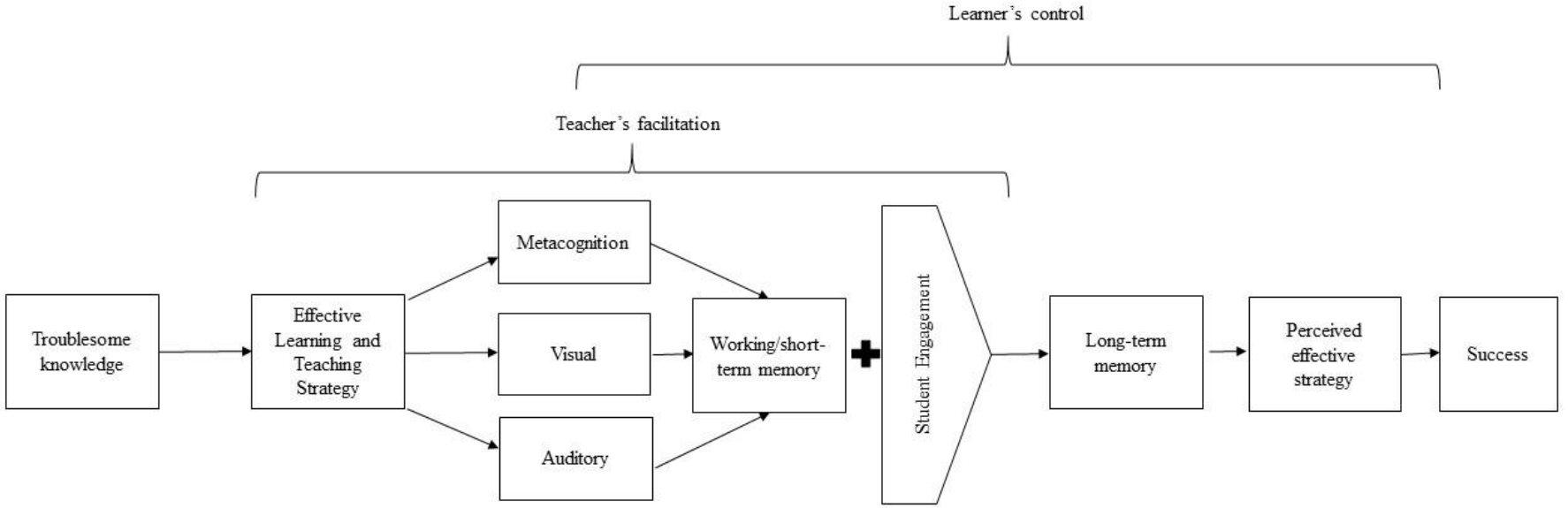

Diagram 4. The substantive theory

Chapter 7. Discussion

7.1 Strengths and limitations of the study

The majority of the studies regarding the impacts of CM on students' learning are empirical studies and many of them were conducted in foreign countries, with less contribution from regional countries, even Hong Kong. Hence, the strengths of this study are as follows. First, it provides a rich and contextualized understanding of how CM affects students' learning. Second, it manifests the impacts of CM on a Chinese population. Third, it clarifies that CM is suitable for all types of learners in terms of different sensory modalities. Fourth, both the quantitative and qualitative data strengthened the reliability of results. Fifth, it unveils the change of students' learning approach when they first encounter new knowledge and how they rearrange the learnt knowledge in their memory. Lastly, it developed a substantive theory which is able to link up the mechanism between learning and teaching.

Given that many of the educators are not neuro-scientists, they do not know how the learners' cognition works. Hence, with the aid of dual-coding theory and cognitive theory of multimedia learning, they can explain in detail the relationship between CM and PowerPoint animation, senses and memory. As well as the social cognitive theory of self-regulation, it explains why learners change their strategies to prepare for written examinations. The explanation for this phenomenon using recognised cognitive learning theories has certainly strengthened the development of substantive theory. However, only the data collected from the participants themselves can shape the phenomenon. They are unable to tell the researchers about the internal mechanisms or relationships of these unconscious actions and the researchers are also unable to observe

or measure the internal process. Hence, the cognitive learning theories themselves have a certain degree of deficit.

Other than the impacts of CM on students' learning, an interesting and important finding is about the role of memorisation in the learning process. Memorisation emerged from the data and formed one core element in the substantive theory as it was frequently mentioned by the students in the focus group interviews. While developing the theory, from the literature, many Western scholars misperceive that Chinese students often use memorisation in their learning which is misinterpreted as a kind of rote learning and related to surface learning. Kembler (1996, 2016) pointed out that this is the paradox of Chinese learners. Over 20 years, several researchers have made extensive and international comparisons between Chinese students and others in learning in different countries such as the United States of America, United Kingdom, Netherlands, Canada and Australia (Hua & Ho, 2010; Kembler & Gow, 1991; Kember, 1996, 2016; Stevenson & Lee, 1996). The analysis indicated that other than surface and deep learning, an intermediate approach may exist in which Chinese students are the representatives of this notion. Studies consistently revealed that memorisation occurs in conjunction with attempts to reach understanding (Tang, 1991; Marton, Dall'Alba & Kun, 1996; Dahlin & Watkins, 2000; Hess & Azuma, 1991; Kembler, 2016). From a large sample study in 2008, Hong Kong students were compared with Australian students (Leung, Ginns & Kember, 2008). The results showed that Hong Kong students' mean scores for both deep and surface learning were higher than Australian. As a result, they concluded that cultural differences exist and Hong Kong students seem to have a greater propensity to employ a combined surface and deep approach which latter is called an intermediate approach (Kember, 2016). Furthermore, my findings are also in consonance with Tang (1991) and Entwistle and Entwistle (2003). The students of these

three studies showed that after they understood the content, memorisation took place in revising for examinations. Lastly, Tan (2011) adopted a culturally sensitive framework in her study and verified that students from Eastern culture who employed memorisation could learn beyond "rote". Hence, this may indicate that although a memorization habit is a very well-entrenched form of learning which has been established since their early schooling (Dahlin & Watkins, 2000), it is an important element in learning and success which result in a great difference between Eastern and Western learners.

Of course there are also some limitations. First, some of the sample sizes in subgroups were small so that this may affect the reliability of results. Second, only one non-CM group was used for comparison, not randomized controlled trial or any experimental study design at all so some uncontrollable factors existed, such as few of the teachers and examination questions in the CM and non-CM groups were different. Hence, the degree of influence on outcomes could not be measured. Third, other than the previously mentioned external factors, numerous individual/internal factors may also affect students' academic performance, such as motivation, self-efficacy, stress and study time. Lastly, constant comparison between incidents is a key step in GT, but comparisons between studies as well as different sensory modalities can only form the first part of the substantive theory, that is knowledge coming from the external environment into the working memory in the brain, and finally stored in the long-term memory. Due to the limited similar studies that exist, only the comparisons between different sensory modality groups in this study can help to develop the latter part of the theory, that is the students re-organized the learnt knowledge in their preferred way to prepare for the written examination. Hence, the substantive theory developed in this study is only able to explain the situation in the researched venue. In view of these

limitations, further study with a larger sample size in medical-surgical nursing is recommended.

The validation of VARK questionnaire version 7.8 in Hong Kong nursing undergraduates was conducted with confirmatory factor analysis and resulted in acceptable reliability. The results strengthened the formation of substantive theory in this study. The theory explained that no matter which sensory modality groups that the students were classified into, it would not affect the students' learning because they would re-regulate and re-organise the knowledge themselves using their preferred ways. If for teaching purposes in higher education, this finding suggests that classification of students' learning styles may not be necessary before introducing new knowledge to them.

7.2 Implications for future research

This was a local study and only confined to one course in a local higher education institute and only one previous non-CM group was used for comparison. To further prove the effectiveness of CM and conceptualize the substantive theory to become a formal theory, I suggest extending the exploration with a larger sample size in other medical-surgical courses, other local higher education institutes or even other disciplines as further constant comparison can be undertaken under the same educational system in Hong Kong. Kearney (2007) suggested that larger-scale studies across different contexts or situations would help to increase the explanatory power in formal theory. In addition, further exploration behind the strategies that the students used in preparing for the examination is suggested which will enable researchers to understand more about students' learning behaviour. Furthermore, there are differences in higher educational systems between countries; therefore, the outcomes may have differences. Hence, the insights gained in this study denote the need for additional

grounded theory research in the future. Lastly, the intervention was conducted in a 14-week semester so that the short-term effect of CM could only be examined and the key programme objective is to nurture students who are able to carry out appropriate, effective and holistic nursing care safely and competently. Therefore, a longitudinal study is suggested to explore the long-term effect of CM on theoretical learning, clinical learning, and even after the completion of the programme as learning is lifelong and required in different contexts. Furthermore, only students in this study preferred black and white CM instead of colourful. Given limited similar findings reported in the literature, further exploration may be needed because CM is commonly used in helping dyslexic learners who have difficulties to express their thoughts by writing, acquire knowledge by reading as well as in communication (Louredes & Bueno, 2008). Lami (2008) and Sellers (2008) pointed out that the colour of CM can trigger dyslexic learners' ideas, categories or subjects in order to facilitate memorisation. Therefore, it is doubtful that such finding is sensitive to culture, age or particular groups of learners. Lastly, a cross-sectional survey is also recommended to investigate the students' perception of using CM in their learning as a survey can help to collect data from a larger sample size although it may not provide in-depth understanding of a phenomenon.

7.3 Implications for practice

Regarding the implications for teaching practice, there are three levels, that is personal, local and global and two dimensions, which are teachers and students. As I mentioned in the first chapter, it was my decision to adopt CM in a medical-surgical nursing course as I am responsible for teaching it in my institute. Personally, I support evidence-based practice in both nursing and education; and it is one of my teaching philosophies. The results of this study provide me evidence in my teaching practice and boost my confidence in using it.

To enhance learning, many educators introduce new teaching methods in their teaching practice. However, each country has its own culture, educational system, settings and practice so the effects may vary. Hence, this study provides insights about how to use CM appropriately and effectively in teaching medical-surgical nursing in Chinese student nurses and avoid its shortcomings. The students' in-depth sharing helps to develop principles for using CM in classroom teaching. Moreover, educators are encouraged to use innovative and interactive teaching approaches to enhance students' learning and cater for 21st-century students' needs. The function of animation in PowerPoint does not need any additional cost so it will not cause any financial burden. Hence, I intend to share it with my colleagues in my department, the colleagues in other departments as well as other educators around the world. I believe that every discipline has its own troublesome knowledge which is a hurdle for student learning and one of the core missions in higher education is encouraging and facilitating learning (Marbach-Ad, Egan & Thompson, 2015). Since most of the results are positive, it is worth widely promoting them through disseminating the results in local and international conferences and journals.

On the other hand, CM is not just an effective teaching tool; it is also a good learning tool. Introducing CM to students can provide an alternative method to facilitate their learning. Since the results of this study revealed that students use CM in different conditions, it implies that regardless of any classifications of students' learning styles, they can use CM depending on their needs in different situations. Lastly, numerous learning theories have been developed over the last few decades but the substantive theory developed in this study links up learning and teaching. It sheds light on the effects of CM between learning and teaching.

Jimerson (2001) conducted a meta-analysis and discovered a negative relationship between course repetition and students' academic performance, which meant the re-takers did not perform better than the new takers. Such findings were also congruent with subsequent studies conducted in different places all over the world in the same century (Nasser & Nauffal, 2012), even in nursing education (Turner, 2005). Some studies also found that there were no differences between the re-takers and new takers (Morrison and No, 2007; Fenton, 2002). However, this was not the case in this study. Although CM seems ineffective for re-takers, the finding of this study revealed that the experience gained from the clinical practicum could facilitate re-takers' understanding of knowledge and resulted in better academic performance. In contrast, the new takers did not have such clinical experience before taking this course, and simulation teaching in the laboratory and classroom teaching were only provided. Such finding calls for further discussion on the design of the programme curriculum as well as the course itself. Should the first clinical practicum be arranged before the first medical-surgical nursing course? Should we provide more simulation training sessions? What is the best suited nursing curriculum design for the student nurses? Dornan, Littlewood, Margolis, Scherpbier, Spencer and Ypinazar (2006) suggested that if early clinical placement can be arranged in the first and/or second years of the curriculum it would enhance students' cognitive benefits and strengthen their learning of subsequent knowledge from prior lively experience. Given that I am a member of the programme management committee, I can share my findings and further discuss them with my colleagues.

7.4 Original contributions of the research

This study contributes to the literature on nursing education and attempts to explain the interrelationships between CM, knowledge, environment and students'

learning. Given that there are scant studies with regard to the impacts of CM on students' learning and many of them focused solely on one particular area using quantitative methods, such as critical thinking, studies which used qualitative or mixed methods are only able to describe students' positive and negative learning experience with CM but are unable to explain the causal relationship between CM and their learning. Moreover, there is limited research examining if CM is suitable for students with different sensory styles as well as to develop a substantive theory about this research topic. Both the quantitative and qualitative results in this study are able to fill these gaps and strengthen the stability of substantive theory. However, the long-term effects of CM on students' learning could not be examined in this study.

7.5 Personal reflections

I learnt the term 'grounded theory' 5 years ago but I did not have any idea about it. When both my supervisors suggested me to employ it in my thesis, I was shocked. Although I have spent plenty of time exploring it and been frustrated several times during my discovery of knowledge, I am thankful that my supervisors have given me such opportunity to learn grounded theory in great detail.

I have been a nurse educator for 9 years so the quality of learning and teaching is the main concern and research interest in my career. The quality of teaching is the most critical external factor that would affect the learning quality so teaching and learning are indivisible. Thus, I have a strong sense of mission to nurture my students to be competent nurses. Given that nursing is a professional career which involves humans' life and death, it is crucial to let students understand the logic of medical-surgical nursing and promote meaningful learning instead of rote learning. As a result, I keep on searching for tools to facilitate their learning. The findings of this study

provide me an in-depth understanding of the relationships between knowledge, human learning and the environment as well as the core elements of effective teaching methods.

I concur that everyone has his/her own learning style but in reality, particularly when dealing with large classes, it is difficult to employ different teaching tools to fit students with different learning styles. Therefore, I am glad to learn that a structured diagram with animation which can illustrate the relationship between concepts is suitable for students with different sensory dominant modalities. It is particularly useful in teaching large classes. In the nursing profession, we always emphasize evidence-based practice. I think that it is the same in the educational arena so the results generated by integration of quantitative and qualitative data in this study provide scientific support for my teaching practice. In addition, although it was my first attempt to use GT, it aroused my interest and I found that it was very meaningful to explore and explain the causal relationships about human behaviour which is very helpful in the nursing profession and education as we always interact with students, patients and their families. I learnt nursing and learning theories in nursing and educational programmes so I understand how theory enlightens one's practice. Therefore, I hope one day to develop a formal theory to illuminate others.

Chapter 8. Conclusions

Medical-surgical nursing is a troublesome field of knowledge in nursing education and always results in low pass rates because students need to acquire higher-order thinking skills to connect with prior knowledge, analytical skills to identify patients' problem and eventually formulate a holistic nursing care plan with a 5-step nursing process. Nurse educators all over the world use different methods to overcome such troublesome knowledge in order to facilitate students' learning. Among the contemporary learning and teaching methods, CM seems to be the most cost-effective one. In higher education, educators are encouraged to promote deep learning and teach with evidence-based practice and theoretical support. In this study, CM was the standalone intervention and it has been incorporated into the existing collaborative learning environment which is exactly built upon the idea of co-construction of knowledge underpinned by the social constructivist theory. This idea tried to facilitate individuals' construction of knowledge through illustrating the relationships of concepts with CM and further consolidate their understanding through co-construction of knowledge with peers under a collaborative learning environment. The impacts of CM on students' learning was evaluated by comparing the pass rate and overall grade in CM and non-CM groups as well as conducting focus group interviews. Using a mixed methods research approach allows one to obtain a comprehensive picture of a phenomenon from both objective and subjective perspectives, thus finally developing a more solid substantive theory.

In this study, the validation of VARK questionnaire version 7.8 was achieved with the researched Chinese population and the results showed that the reliability estimates ranged from 0.69-0.84, which is acceptable. With the help of VARK

classification, the majority of the students were multimodal learners (41%) among the 177 students in the CM group. This finding was the same as in other studies conducted in various healthcare professions, such as nursing (Alkhasawneh et al., 2008; Alkhasawneh, 2013), medicine (Nuzhat et al., 2013; Sinha et al., 2013; Slater et al., 2007; Urval et al., 2014), dentistry (Murphy et al., 2004), physiotherapy (Breckler et al., 2009; Lujian & DiCarlo, 2006) and health science (Meehan-Andrews, 2009). It may indicate that many university students are capable of managing different situations or different kinds of knowledge with different sensory modalities in order to obtain the best outcome or it may relate to the nature of the discipline as the same phenomenon is only found in health-related or science subjects. This may not be the case in other disciplines. Among the different sensory modality groups, aural learners' overall grade is the highest in both spring and summer groups which is different from in Nuzhat et al. (2013) and Alkhasawneh et al. (2008) as the multimodal learners performed the best in their studies. For the lowest, the results vary between semesters. Kinaesthetic learners, visual learners and read/write learners performed the worst in spring, summer and the combined group respectively. Given that the sample size in subgroups was quite small, particularly the read/write group, there were only 11 students despite the spring and summer groups being combined.

Quantitative results revealed several positive impacts of CM in terms of students' academic performance. First, the pass rate was significantly improved from 77.6% to 100%. Second, the overall grade in CM and non-CM groups exhibited a statistically significant improvement with a large effect. Third, the first takers' overall grade was significantly higher than re-takers with a small effect. Fourth, the first takers' overall grade in CM groups was significantly higher than for the non-CM group with a very large effect. Fifth, the re-takers' overall grade in CM group was significantly

higher than for the non-CM group with a large effect. However, no statistically significant difference was observed in the overall grade among visual, aural, read/write, kinaesthetic, and multimodal groups. Given that limited similar study has been conducted before, a comparison between studies is difficult to perform. I can only use Kostovich et al.'s (2007) study in which the researchers used Kolb's learning style inventory to classify the students into four groups, that is active, abstract, reflective and concrete and they attempted to compare the CM grades between groups. The results showed no statistically significant difference. For the time being, based on the above results, it may be concluded that using animated CM with collaborative learning seems able to facilitate students' bridging of old and new knowledge, enhance their understanding of the context and attain better academic performance, and this approach is likely suitable for all learners despite any classification of sensory modality.

Findings from the focus group discussions exhibited the good and down sides of using CM, uncovered how CM affects their thinking and how group work affects their learning. The image of CM mimics the learners' way of thinking inside the brain and it links the concepts in a systematic and well-organized manner for a short period, which enhances the comprehension of relationships between concepts and promotes memorization in long-term memory. Additionally, a CM was drawn to answer scenario-based questions with groupmates during tutorial sessions, and further enhanced and consolidated the understanding of knowledge. Although collaborative learning could trigger learners' learning mechanism through interaction with each other, educators may not be able to guarantee that the expected interactions will actually occur within the group (Dillenbourg, 1999) because the effort or engagement by the learner depends on his/her own control. Nevertheless, an educator at least can create a collaborative

learning environment and act as a facilitator in the group discussions to increase the probability of interaction and meaningful learning occurs.

Although the presence of meaningful learning was not investigated in this study, vast amounts of literature have supported the potential of CM in facilitating meaningful learning (Okebukola & Jegede, 1988; Okebukola, 1990; Novak, Gowin & Johansen, 1983; Ault, 1985; Lehman, Carter & Kahle, 1985). Furthermore, most of the examination questions in researched course were scenario-based questions and all the questions were pitched at quality framework (QF) level 5 standard. The programme management committee takes on this role to review and endorse exam papers. To attain higher scores in examinations, students are required to understand the relationships between the aetiology, signs and symptoms, pharmacological and non-pharmacological treatment as well as the nursing interventions of common problems derived from each disease well. Then, they need to acquire critical thinking skills to identify the nursing problems and corresponding nursing interventions based on the information provided in the scenarios. Using rote learning may also enable answering the questions but definitely cannot result in high scores because the answers should directly address the problems indicated in the questions. Irrelevant answers score zero marks. Hence, the profound improvement of academic results in CM groups may indicate that meaningful learning was present in their learning process.

Nevertheless, a few disadvantages were also identified by students; these disadvantages included its extensiveness, time-consuming and confusing nature, and lack of detailed information. The narrative results of this study are in accordance with previous literature (Harrison & Gibbon, 2013; Hinck et al., 2006; Kostovick et al., 2007). Thus, the preference of students to use traditional care plans is also found in the findings of Hinck et al. (2006). This phenomenon may be attributed to the presence of

a preconceived notion as textbooks and nursing care plans use traditional table formats. Whether or not students use CM when preparing for examinations, their common behaviour is to use their perceived effective strategy to consolidate and memorize the context in order to attain the best outcome, that is good examination results. The students' behaviour reflected that the optimal effect of CM mainly takes place upon initial contact with new knowledge. Once the learners overcome the hurdle of understanding the troublesome knowledge, they re-organize the learnt knowledge with their habitual learning method for better memorisation. In addition, the introduction of CM provided a new insight of learning and way of thinking to students so that some of them used it in different ways when preparing for examinations and further extended its application to their daily life or other courses.

Both the quantitative and qualitative results showed that CM has a significant effect in learning medical-surgical nursing courses, particularly when synthesizing knowledge and when student nurses are first-time enrolees in a course. This phenomenon may echo Haugwitz, Nesbit and Sandmann (2010) and Patterson, Dansereasu & Wiegmann (1993), who elucidated that CM is only effective for those learners with low cognitive ability as the map characteristics may develop conflicts with the strategies that high-ability learners usually employ or such high-ability learners have already reached their cognitive functional ceiling. In this study, although the students' cognitive ability was not measured, the explanation is that the first takers need extra time and cognitive load to comprehend new knowledge when compared with re-takers. In this sense, their cognitive ability to handle new knowledge is lower than for re-takers. This may explain why most of the re-takers found CM useless.

Moreover, the significant improvement of students' learning may imply that students' critical thinking skill has also been improved. People use critical thinking in

their daily life, such as comparing and making decision on purchasing furniture. However, to improve one's critical thinking skill in order to make him/her able to make a correct decision is higher than that in nursing profession as the decision is in relation to patient's life or death. Nurses have to ensure that their decisions are made appropriately and for patients' the best interest. As such, nursing educators attempted a diversity of teaching methods to promote students' critical thinking skill. In this study, students are required to answer the scenario-based questions in examination. The students' academic performance in CM group indicated that all of the students are able to apply, analyse and evaluate the patient's condition in the examination, whereas, application, analysis and evaluation are the required components in critical thinking. Of course some did better than others.

Nonetheless, a few limitations also existed in this study. The teaching content, teachers and questions in the written examinations of non-CM and CM groups were not exactly the same. Thus, only one previous non-CM group was used to compare the pass rate. In addition, numerous extrinsic and intrinsic factors can affect one's academic performance, such as motivation, self-efficacy, stress, study time, and family- and teacher-related factors (Shawwa, Abulaban, Abulaban, Merdad, Sara Baghlaf, Algethami, Abu-shanab & Balkhoyor, 2015). Furthermore, due to the extreme imbalance of sample size between the first takers and re-takers in the non-CM group, gender as well as the re-takers in both non-CM and CM groups, a few of the comparisons may not be able to uncover the true reality.

Different sensory modality students seem to benefit from using CM when they come into contact with new knowledge at the initial stage. Results showed that CM helped students understand the relationships between concepts in medical-surgical nursing and synthesize their learning in a short period. Although students may or may

not use CM for their examination, to use CM effectively for bridging the chunks of knowledge, it is suggested that it be used with the following strategies. Use CM at the end of lectures to summarize the taught knowledge, provide an opportunity for students to draw CM collaboratively to answer scenario-based questions and provide debriefing with CM after group exercises. To prove the potential of this tool, researchers should explore it further with large samples in other medical-surgical courses. Using a cross-sectional survey to evaluate the whole class' perception on using CM is recommended. Thus, a longitudinal study of the long-term effects of CM is also suggested. Further investigations would help to develop a formal theory in the future.

The results found in this study help to develop a substantive theory which explains how the knowledge construction occurs and is stored in the learner's memory by the contribution from teacher and learner. A few phenomena can be explained by three theories. They are dual coding theory, cognitive theory of multimedia learning and social cognitive theory of self-regulation and seven core categories are identified to form the theory. They are troublesome knowledge, effective learning and teaching strategy, memory, active learning, perceived effective strategy and success. During the constant comparison, I found that students' learning experience with CM and MM was very similar and particularly they will affect the students' way of thinking in regard to which other advanced organizers do not have such effect. Since many researchers have asked whether they are the same, in this study, their common characteristics together with participants' feedback were retrieved and conceptualized in the theory. This is a page sized diagram which can show concepts with keywords or phrases or short sentences and lines linked up with the concepts. In the literature, researchers either use pencil and paper or electronic programs to draw the CM in their studies. On the contrary, in this study, teachers used CM with PowerPoint animation in lectures and students

were required to draw CM with pencil and paper in a collaborative learning environment. Therefore, CM, multimedia teaching together with a collaborative learning environment can form a potent catalyst for facilitating knowledge construction. Bandura's social cognitive theory emphasizes that learning occurs when individuals interact with people and their environment. Under the same principle, students' learning in higher education contexts is mainly facilitated by students themselves, teachers and peers, as well as the learning environment. To conclude, collaborative CM is likely an effective learning and teaching method in teaching medical-surgical nursing particularly to the learners who are totally new to the knowledge. It can assist learners to understand complex knowledge by connecting chunks of concepts, promote better memorisation, widen their ways of thinking and eventually improve their academic performance. Although CM is likely to be more effective for learners of new knowledge, it is still worth to introduce CM to all students because learners will use it in different situations in order to fit their needs. Other than CM, something able to divide the content into several chunks and able to illustrate the relationships with lines used together with collaborative learning may also be able to facilitate the construction of knowledge.

Furthermore, re-takers' learning experience indicated that clinical experience certainly could help in understanding the theoretical knowledge which raises the necessity of curriculum and course reviews. Lastly, the substantive theory of this study provided insights into the learning approach of Chinese learners and it strengthened the existence of the third approach to learning apart from surface and deep approaches.

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Appendix A

Sample of Scenarios-Based Question in Tutorial Sessions

Ms. Chan, 50-years old, complained of abdominal pain x 3/52 and admitted to surgical ward and. Then she underwent oseophgogastroduodenoscopy with biopsy and diagnosed as gastritis.

Admission note:

Past medical history

E admit x epigastric pain x 3/52

1) Persistent colicky pain, generalized
2) Increasing pain toady, particularly over epigastrium
3) No radiation to back
4) On & off epigastric pain, worse after food intake
5) Nausea^{+} , no vomiting, BO normal with no PR bleeding
6) Acid reflux with mild retrosternal pain, no heartburn
7) No fever / chills, no urinary S/S

Seen GI at QEH, given Nexium 20 mg BD, slight pain relief for 1/52 only

Physical examination

Temp.: 36.5°C (Tympanic)

Pulse: 86/min (Regular pattern)

BP: 124/80 mmHg Mean BP: 94 Position: Sitting

RR: 18/min SpO_2: 96% Oxygen Therapy: No Sputum: No

Body measurement

Weight: 53.5 kg Height: 163cm Body mass index: 20.14

Level of Consciousness

Alert

Glasgow Coma Scale:

Eye: 4 (Eye opening spontaneously)

Verbal: 5 (Oriented)

Motor: 6 (Obeys commands)

Total: 15/15

Social History

Marital Status: Married

Employment Status: Employee

Occupation: Clerk

Habit

Smoking: Non-smoker Drinking: Non-drinker Substance: Non-user

Lab. Investigation

Hb: 12.4 WCC: 3.3 Plt: 191

INR: 1.02

LRFT: normal except

ALP: 111 (static) Amylase: 93

CXR: no free gas under diaphragm, chest clear

AXR: bowels not dilated, no obvious stones

Doctor's order

- NPO
- IVF 2D1S Q8H I.V.I
- BP/P Q4H
- ECG (12-lead)
- I.V. Pantoloc 40 mg Q24H
- I.V. Tramadol 50 mg Q8H p.r.n.
- I.V. Maxolon 10 mg Q8H p.r.n.

Appendix B

VARK Questionnaire (Version 7.8)

Student Number:_____

The VARK Questionnaire (Version 7.8)

How Do I Learn Best?

Choose the answer which best explains your preference and circle the letter(s) next to it.
Please circle more than one if a single answer does not match your perception.
Leave blank any question that does not apply.

1. You are helping someone who wants to go to your airport, the center of town or railway station. You would:
    a. go with her.
    b. tell her the directions.
    c. write down the directions.
    d. draw, or show her a map, or give her a map.
2. A website has a video showing how to make a special graph. There is a person speaking, some lists and words describing what to do and some diagrams. You would learn most from:
    a. seeing the diagrams.
    b. listening.
    c. reading the words.
    d. watching the actions.
3. You are planning a vacation for a group. You want some feedback from them about the plan. You would:
    a. describe some of the highlights they will experience.
    b. use a map to show them the places.
    c. give them a copy of the printed itinerary.
    d. phone, text or email them.
4. You are going to cook something as a special treat. You would:
    a. cook something you know without the need for instructions.
    b. ask friends for suggestions.
    c. look on the Internet or in some cookbooks for ideas from the pictures.
    d. use a good recipe.
5. A group of tourists want to learn about the parks or wildlife reserves in your area. You would:
    a. talk about, or arrange a talk for them about parks or wildlife reserves.
    b. show them maps and internet pictures.
    c. take them to a park or wildlife reserve and walk with them.
    d. give them a book or pamphlets about the parks or wildlife reserves.
6. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?
    a. Trying or testing it.
    b. Reading the details or checking its features online.
    c. It is a modern design and looks good.
    d. The salesperson telling me about its features.
7. Remember a time when you learned how to do something new. Avoid choosing a physical skill, eg. riding a bike. You learned best by:
    a. watching a demonstration.
    b. listening to somebody explaining it and asking questions.
    c. diagrams, maps, and charts - visual clues.
    d. written instructions – e.g. a manual or book.

8. You have a problem with your heart. You would prefer that the doctor:
    a. gave you a something to read to explain what was wrong.
    b. used a plastic model to show what was wrong.
    c. described what was wrong.
    d. showed you a diagram of what was wrong.
9. You want to learn a new program, skill or game on a computer. You would:
    a. read the written instructions that came with the program.
    b. talk with people who know about the program.
    c. use the controls or keyboard.
    d. follow the diagrams in the book that came with it.
10. I like websites that have:
    a. things I can click on, shift or try.
    b. interesting design and visual features.
    c. interesting written descriptions, lists and explanations.
    d. audio channels where I can hear music, radio programs or interviews.
11. Other than price, what would most influence your decision to buy a new non-fiction book?
    a. The way it looks is appealing.
    b. Quickly reading parts of it.
    c. A friend talks about it and recommends it.
    d. It has real-life stories, experiences and examples.
12. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:
    a. a chance to ask questions and talk about the camera and its features.
    b. clear written instructions with lists and bullet points about what to do.
    c. diagrams showing the camera and what each part does.
    d. many examples of good and poor photos and how to improve them.
13. Do you prefer a teacher or a presenter who uses:
    a. demonstrations, models or practical sessions.
    b. question and answer, talk, group discussion, or guest speakers.
    c. handouts, books, or readings.
    d. diagrams, charts or graphs.
14. You have finished a competition or test and would like some feedback. You would like to have feedback:
    a. using examples from what you have done.
    b. using a written description of your results.
    c. from somebody who talks it through with you.
    d. using graphs showing what you had achieved.
15. You are going to choose food at a restaurant or cafe. You would:
    a. choose something that you have had there before.
    b. listen to the waiter or ask friends to recommend choices.
    c. choose from the descriptions in the menu.
    d. look at what others are eating or look at pictures of each dish.
16. You have to make an important speech at a conference or special occasion. You would:
    a. make diagrams or get graphs to help explain things.
    b. write a few key words and practice saying your speech over and over.
    c. write out your speech and learn from reading it over several times.
    d. gather many examples and stories to make the talk real and practical.

Appendix C

Participant Information Sheet

Participant Information Sheet

Title: The Effects of Concept Mapping in Student Nurses' Learning of Medical-Surgical Nursing

I am a Senior Lecturer of the School of Nursing in Tung Wah College. I am going to conduct a research project regarding the effects of concept mapping in regard to student nurses. You are being invited to participate in this research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask me if you would like more information or if there is anything that you do not understand. I would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

Thank you for reading this.

1. What is the purpose of the study?

This study is to explore the effect of concept mapping on student nurses' learning of medica-surgical nursing.

2. Why have I been chosen to take part?

You are being invited to take part in this research because you are enrolled in NUR3011 Care of People with Non-Communicable Diseases (I) that will utilize concept mapping as a learning tool.

3. Do I have to take part?

Your participation is voluntary and you are free to withdraw at any time without explanation and without incurring a disadvantage.

4. What will happen if I take part?

If you decide to take part in this study, you will attend a video-recorded group interview at the end of the semester. The group interview will be composed of five to eight students and will last 30-45 minutes.

5. Expenses and/or payments

After the interview, HKD100 cash will be given to you to acknowledge your contribution of time and as reimbursement for travelling expenses.

6. Are there any risks in taking part?

There are no significant risks involved in taking part in this study. I am not the instructor for this course, and any information you share with me during the interview will be held strictly confidential. It could be that you are not comfortable talking about your learning experience.

7. Are there any benefits in taking part?

You may find the project interesting and enjoy talking about your learning experiences in this course (i.e., how concept mapping helped/hindered your learning of medical-surgical nursing). Ultimately, the findings of this study may provide useful information to the nurse educators regarding the use of concept mapping as a learning tool.

8. What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let me know by contacting Ms. Julia Wong on 3468-6842 and I shall try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Secretary, Committee on the Research Governance Officer at ethics@liv.ac.uk.

9. Will my participation be kept confidential?

All participants will be assured of anonymity and confidentiality. Only the researcher has the authority to access the data. Your names or characteristics will not be disclosed in any report. All data will be stored in a double locked cabinet or encrypted and destroyed 5 years after completion of the data analysis.

Appendix D

Participant Consent Form

PARTICIPANT CONSENT FORM

Title of Research Project: The Effects of Concept Mapping in Student Nurses' Learning of Medical-Surgical Nursing

Researcher(s): Ms. WONG Sze Wing, Julia

	Please initial box
1. I confirm that I have read and have understood the information sheet dated [DATE] for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected. In addition, should I not wish to answer any particular question or questions, I am free to decline.	☐
3. I understand that, under the Data Protection Act, I can at any time ask for access to the information I provide and I can also request the destruction of that information if I wish.	☐
4. I understand and agree that my participation will be video recorded and I am aware of and consent to your use of these recordings for research purposes	☐
5. I agree to take part in the above study.	☐

_____	_____	_____
Participant Name	Date	Signature
_____	_____	_____
Name of Person taking consent	Date	Signature

Researcher	Date	Signature

Principal Investigator:

Name:

Work Address:

Work Telephone:

Work Email:

Student Researcher:

Name: WONG Sze Wing, Julia

Work Address: Address: 16/F, Tung Wah College, 31 Wylie Road, Homantin, Hong Kong.

Work Telephone: 3468-6842

Work Email: juliawong@twc.edu.hk

Appendix E

Ethical Approval from the VPREC of the UoL

UNIVERSITY OF LIVERPOOL | ONLINE PROGRAMMES

Dear Julia Wong

I am pleased to inform you that the EdD. Virtual Programme Research Ethics Committee (VPREC) has approved your application for ethical approval for your study. Details and conditions of the approval can be found below.

Sub-Committee:	EdD. Virtual Programme Research Ethics Committee (VPREC)
Review type:	Expedited
PI:	
School:	Lifelong Learning
Title:	The effects of concept mapping in student nurses' learning of medical-surgical nursing
First Reviewer:	Dr. Lucilla Crosta
Second Reviewer:	Dr. Anthony Edwards
Other members of the Committee	Dr. Martin Gough; Dr. Morag Gray
Date of Approval:	24th May 2016

The application was APPROVED subject to the following conditions:

Conditions

1	Mandatory	M: All serious adverse events must be reported to the VPREC within 24 hours of their occurrence, via the EdD Thesis Primary Supervisor.

This approval applies for the duration of the research. If it is proposed to extend the duration of the study as specified in the application form, the Sub-Committee should be notified. If it is proposed to make an amendment to the research, you should notify the Sub-Committee by following the Notice of Amendment procedure outlined at http://www.liv.ac.uk/media/livacuk/researchethics/notice%20of%20amendment.doc.

Where your research includes elements that are not conducted in the UK, approval to proceed is further conditional upon a thorough risk assessment of the site and local permission to carry out the research, including, where such a body exists, local research ethics committee approval. No documentation of local permission is required (a) if the researcher will simply be asking organizations to distribute research invitations on the researcher's behalf, or (b) if the researcher is using only public means to identify/contact participants. When medical, educational, or business records are analysed or used to identify potential research participants, the site needs to explicitly approve access to data for research purposes (even if the researcher normally has access to that data to perform his or her job).

Please note that the approval to proceed depends also on research proposal approval.

Kind regards,

Lucilla Crosta

Chair, EdD. VPREC

Appendix F

Ethical Approval from the HASC of the Researched Institute

As the principal investigator, my signature testifies that I pledge to conform to the following:

As one engaged in investigation utilizing human subjects, I acknowledge the rights and welfare of the human subject involved.

I acknowledge my responsibility as an investigator to secure the informed consent of the subject by explaining the procedures, in so far as possible, and by describing the risks as weighed against the potential benefits of the investigation.

I assure the HASC that all procedures performed under the project will be conducted in accordance with prevailing standards of research ethics in the academic community. Any deviation from the project (e.g., change in principal investigator, research methodology, subject recruitment procedures, etc.) will be submitted to the HASC in the form of an amendment for its approval prior to implementation.

PRINCIPAL INVESTIGATOR:		
Wong Sze Wing, Julia		9 Dec 2015
(typed/printed name)	(signature)	(date)

(For Student PI only)

I/We hereby endorse this application with my approval and confirm that the investigator(s) are appropriately qualified in the research area involved to conduct the proposed research project, and am capable of undertaking this research study in a safe and ethical manner.

Name of Supervisor	Signature:	Date:
Head of Dept/School/Dept Reviewer* Name:	Signature:	Date

**Please delete as appropriate.*

****

APPROVAL BY COMMITTEE

RESEARCH ETHICS REVIEW (Low/negligible risk human research)

This form for the use of human subjects has been reviewed by the Committee on the Use of Human and Animal Subjects in Teaching and Research (HASC), Tung Wah College.

☑ Approved ☐ Not Approved ☐ Revised & Resubmit ☐ Re-submit for high risk research ethics application

Comments:

Prof Matthew Yau — (typed/printed name of Chairperson/HASC)

(signature)

14/1/2016 — (date)

Appendix G

Approval from the Registry of the Researched Institute

Form REG-I-08

TUNG WAH COLLEGE
Registry
Request for Access to Student Data

Section A: Requestor Information and Declaration

Staff Name: WONG SZE WING JULIA Email Address: juliawong@twc.edu.hk

Department/Office: School of Nursing Phone No.: 3468-6842

I hereby declare that:

(a) I shall comply with the requirements of the Personal Data (Privacy) Ordinance of Hong Kong and follow the Information and Personal Data Confidentiality and Security Guidelines for IT systems and Internet of the College.

(b) I shall kept the student data confidential and will NOT disclose the student data to other units within the College or any third party persons or organizations outside the College unless otherwise stated or with the student's prior consent.

Signature of Requestor: Julia Date: 11 May 2016

Signature of Head/Director/ School Dean: Meyrick Chow Date: 11/5/16

Name: Meyrick Chow

Post: Acting Dean

Section B: Requested Student Data

☐ Student ID	☐ Gender	☐ Local/non-local	☐ TWC Email
☐ Student Name	☐ Enrolled Programme	☐ Postal Address	☐ Bank Account
☐ HKID/Passport	☐ Enrollment Status	☐ Phone No.	☐ Emergency Contact
☐ Date of Birth	☐ Academic Advisor	☐ Personal Email	
☒ Others: (please specify)	Academic results of NUR3011		

Criteria for the data (if any):

Section C: Purpose of Request
(please indicate the intended use of the requested student data)

The requested student data will be used in a research study titled as 'The effects of concept mapping in student nurses' learning of medical-surgical nursing'.

Form_REG-I-08A_dd20160301

1

Section D: Method of Access

☐ Access from Vista View in PowerCAMPUS Client (real-time multiple access)
PowerCAMPUS Account: _____

☒ Output to an Excel file (one-time access)
Email of Receiptient: juliawong@twc.edu.hk

☐ Others:
(please specify) _____

Remarks: _____

Section F: Approval by the Registrar (or Delegate)

☑ The request is APPROVED.

☐ The request is NOT APPROVED.

Remarks: No identification of the students will be provided.

Signature: _____ Date: 11 MAY 2016

Name:
Post:

Form_REG-I-08_20151202

Appendix H

Permission from Neil Donald Fleming on Using VARK Questionnaire (Version 7.8)

Julia WONG

From: Neil Donald Fleming <neil.fleming@vark-learn.com>
Sent: Thursday, December 10, 2015 15:34
To: Julia WONG
Subject: Using VARK for Research
Attachments: Researching Links Between VARK and Assessment.pdf; ATT00001.htm; VARK Research Principles.pdf; ATT00002.htm; VARK Scoring compared.pdf; ATT00003.htm

Dear Wong Sze Wing

Restrictions: You may not place VARK copyright materials online or on an electronic survey instrument, or any website, intranet or password protected site. This applies to using VARK for research, and all publications, free resources and for all resources made for sale, or for which fees are charged.

If you are a student or teacher in a high school, college or university you are welcome to use the VARK™ questionnaire for research by linking to our website You may also use paper copies. We ask that you provide this acknowledgement:

© Copyright Version 7.8 (2014) held by VARK Learn Limited, Christchurch, New Zealand.

Information about using VARK for research is in the attached files below.

Gathering your Data: We can assist. If you are using paper copies of the VARK questionnaires for your research we can promptly analyze your data into the VARK categories for a small fee using both the Research VARK algorithm and the Standard VARK algorithm for a small fee (approx. $US10).

If, using paper copies of VARK is not appropriate, and, as you are not permitted to place VARK copyright resources on any online or electronic site, we can gather your data for you. Our system does not need any installation on your IT system. You get to manage the site and to download your results. The VARK Subscription Service is demonstrated on our website and the cost for six months for a research project is approximately $US85.

VIDEO PRESENTATIONS
There are two inexpensive video presentations that help explain many of the finer points of VARK. The first is ***An Introduction to VARK*** and the second is ***VARK FOR TEACHERS*** who want to assess their own teaching methods and use VARK to modify their strategies. There is more detail on our website at this page:

http://vark-learn.com/products/webinars

Book Downloads: You may find the VARK books helpful. They are all available as immediate and inexpensive downloads. They are sent immediately after payment, so don't shut down your computer until the book arrives as a PDF on your browser.

Business users should visit our VARK business site at: http://business.vark-learn.com. VARK is not free for for-profit and not-for profit businesses and government agencies.

MENTORING: Backed by a wealth of experience and expertise, I will be offering mentoring for up to five teachers this coming semester.

1

Best wishes for your research.

Neil

Neil D Fleming

Appendix I

Samples of Verbatim Transcripts

Visual learners (new taker)

Interviewer	Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
Interviewee 1	Very impressive to me because CM is very clear. For instance, the keywords like “wound” in CM could drive me to write the interventions in relation to wound continuously. The tutor gave us a debriefing with a detailed explanation with CM. It made my mind set very clear.
Interviewee 2	The outcome depended on the degree of students’ participation. Some classmates were very active but some classmates never spoke a word…just waited for the answers.
Interviewee 1	CM divided the knowledge into small parts…something like point form. It was very easy to understand but it could not provide the rationales of interventions so that I needed to go back to the textbook. The keywords in CM really made me easy to remember. Particularly, when I look at it, I would “see…that is the point”, just because it was simple.
Interviewee 3	In the discussion, CM could show us the comprehensiveness in a short time, in order to be able to identify any area we missed. The discussion, the CM and I jotted down what the classmates and tutor said…all these made the knowledge easily go into my brain.
Interviewer	How did you prepare for the written exam?
Interviewee 3	I did not use CM. I used the same concept of CM. I divided the knowledge into categories with subheadings and then listed it in point form from top downwards.
Interviewee 4	At the beginning, I was not familiar with CM. However, after a certain period of time, I found that it was quite helpful because it helped me to categorise the knowledge into different groups. It also helped me in the exam because I could see the CM in my mind. I used it to draw a CM for the exam paper. It could guide me how to answer the questions. My mind set was very clear at that moment so I would not miss the points.

Aural learners (new takers)

Interviewer	Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
Interviewee 1	In the tutorial session, I was responsible for identifying the problems from the provided questions and then my classmate who was sitting next to me drew accordingly because I was not very adept at using CM at the beginning. In the past, there were a lot of nursing interventions for respective diseases and some of them were very similar which made it very difficult for me to distinguish and memorise them. CM would show me the signs and symptoms of each disease and then which sign/symptom would bring up what kinds of problems and then each problem would lead to corresponding nursing interventions. It is more clear and easy to understand and memorise.
Interviewee 2	The discussions in tutorials helped me to clarify some misunderstanding…they would say something I had never thought of…their points made me think, “oh…I see!”. The conversations with classmates would then be stored in my memory.
Interviewer	How did you prepare for the written exam?
Interviewee 1	I listed all the nursing interventions for each disease, but I found that there were too many. I could not memorise all of them and easily mixed them up. Hence, I categorised them into several sub-groups, gave each group a subtitle and then laid them out in table form.
Interviewee 2	For me, CM is a draft…an overview. I would not use it for revision because it is in point form only…no detailed explanation. Instead, I would imagine what the patient would look like when s/he had the disease even though I have no clinical experience. Imagination would enhance my thinking of nursing interventions.
Interviewer	Are there any differences when compared with NCD 1 when preparing for the NCD 2 written exam?
Interviewee 2	I used rote learning in NCD 1. I memorised all the nursing interventions without categorisation. This time, I used the concept of CM to separate the nursing interventions into small groups similar to her (interviewee 1) and then wrote each intervention in detail during the revision. I found that my revision this time was more systematic and my performance in the exam was better than NCD 1 as I was able to write the answers very smoothly. This method seems better than the previous one.

Kinaesthetic learners (new takers)

Interviewer	Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
Interviewee 1	In the tutorial, there were more discussions with classmates than before. The discussion gave me a deeper understanding of the knowledge. For instance, we may have different approaches when dealing with the same patient (in the scenario). There is no absolute right or wrong. Different people have different approaches to tackle problems. I could learn from my classmates. CM drove me to think what is next and next. It provided me more options for thinking and it helped to input what I learnt into my memory in a more systematic way.
Interviewee 2	People think differently; hence discussion helps to compensate each other in order to provide a more comprehensive care plan. CM has its advantages but you need to be familiar with it first. It is good because it can show the linkages but it is quite time-consuming and quite extensive…I need a lot of space to draw it…sometimes with too many lines, flying to here and there, so I felt quite confused.
Interviewer	How did you prepare for the written exam?
Interviewee 1	My friend had shared detailed notes with me for revision but all were words…it made me frustrated. Instead, I converted the given notes into CM. I thought it was more helpful to me. I used software to draw the CM; hence, I did not have the problem just raised by interviewee 2.
Interviewee 2	I did not use CM for revision because I have not got used to it. I used my own categorisation method to divide the knowledge, wrote the interventions in point form, and then gave them numbers and prioritised them. My method is the same as the concept of CM…I think there is no difference between CM and mine.

Read/Write learners (re-takers)

Interviewer	Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
Interviewee	If I found my classmates missed any points, I would raise them and ask him/her to add them into the CM.
Interviewer	How did you prepare for the written exam?
Interviewee	I never used CM because I could not handle the lines…they made me confused. If there were two lines coming out from one concept, I could remember one line only. In revision, I like to list the content in point form which is able to show the interventions and their rationales. CM cannot contain too many words. It helped me to understand some of the concepts in some circumstances, but I need to go back to the textbook most of the time because it is too simple. I like to read books instead. I would memorise all the points from the textbook. In the exam, I asked for more extra paper and then I drafted the key points in table form, and then wrote in detail in the answer book according to the key points that I made on the extra paper.

Multimodal learners (new takers)

Interviewer	Can you describe what happened when you and your classmates were asked to form groups and answer the scenario-based questions with CM in the tutorial sessions? What was your feeling with regard to this method?
Interviewee 3	A discussion with classmates while drawing the CM could help to identify what I had missed in my thinking.
Interviewee 6	For me, I did not participate in drawing the CM in the first tutorial. I just watched what they were doing at the beginning. When I found they had missed something, I would tell them but my classmates pushed me to draw it in the second tutorial. I did not use CM for revision but it is good to use in class because it stimulated me to keep thinking around the key concepts during the discussion.
Interviewer	How did you prepare for the written exam?
Interviewee 1	I did not use a concept map for revision but I think its concept is the same as my learning practice. To me, it is a diagram, a tool that is able to fit what I learnt into the circles. We could add more around the key concept when needed but could not do that with essay form…no space to add additional information. It is good for discussing the key concepts but not very convenient for revision when compared with essay formed notes.
Interviewee 5	I like to use CM in class because classmates would add this and that in the CM during discussion. However, I did not use it when doing my revision because we were required to prioritise the nursing interventions when formulating a nursing care plan but this cannot be done in CM.