DEVELOPING AND VALIDATING INSTRUMENTS FOR MEASURING CRITICAL THINKING AND CLINICAL DECISION-MAKING CONSTRUCTS FOR NURSES IN MALAYSIA

NUR HIDAYAH BINTI ZAINAL @ MUHAMAD

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by

NUR HIDAYAH BINTI ZAINAL @ MUHAMAD

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LIST OF SYMBOLS

≥	Greater than or equal to
=	equality
>	greater-than
<	less-than
X	multiplication
___	division / fraction
−	subtraction
α	Alpha

LIST OF ABBREVIATIONS

AI	Accurate Information
ANOVA	Analysis of Variance
AO	Achieve the Objectives
APA	American Psychological Association
AVE	Average Variance Extracted
CC	Critical Characteristic
CCTDI	Californian Critical Thinking Disposition Inventory
CCTST	California Critical Thinking Skills Test
CDM	Clinical Decision-making
CDMNS	Clinical Decision-making Nursing Scale
CDMS	Clinical Decision-making Survey
CE	Comprehensive Evaluation
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
Chi square/df	Chi Square/Degrees of Freedom
CK	Critical Knowledge
CPR	Cardio Pulmonary Resuscitation
CT	Critical Thinking
CTA	Critical Thinking Assessment
CTAS	Critical Thinking Ability Scale
CTCDMS	Critical Thinking and Clinical Decision-making Scale

CTDS	Critical Thinking Disposition Scale
CTSM	Critical Thinking Scale McMaster
CVR	Content Validity Ratio
DA	Decision Abilities
DAC	Decision Accuracy
EFA	Exploratory Factor Analysis
GFI	Goodness of Fit Index
HSRT	Health Sciences Reasoning Test
I-CVI	Item Level Content Validity Index
KMO	Kaiser-Meyer-Olkin
NCECT	National Council for Excellence in Critical Thinking
NCTC	Nurse's Critical Thinking Characteristic
N-CT-4 Practice	Nursing Critical Thinking in Clinical Practice Questionnaire
NISM	Nurse's Interpersonal Skills and Self-management
NK	Nurse's Knowledge
NS	Nurse's Skills
PES	Practice Environment Scale
PFA	Principal Factor Analysis
PO	Possible Options
RMSEA	Root Mean Square Error of Approximation
S-CVI	Scale Level Content Validity Index
SEM	Structural Equation Modelling
TLI	Tucker-Lewis Index
UA	Universal Agreement

WGCTA	Watson-Glaser Critical Thinking Appraisal

MEMBINA DAN MENGESAHKAN INSTRUMEN PENGUKURAN KONSTRUK PEMIKIRAN KRITIS DAN MEMBUAT KEPUTUSAN KLINIKAL UNTUK JURURAWAT DI MALAYSIA

ABSTRAK

Kemahiran pemikiran kritikal (CT) dan membuat keputusan klinikal (CDM) adalah merupakan kemahiran penting yang diperlukan oleh jururawat untuk memberi perkhidmatan berkualiti. Sehubungan dengan ini, matlamat kajian adalah untuk (i) Membina skala pengukuran yang dikenali sebagai *Critical Thinking and Clinical Decision-Making Scale* (CT & CDMS); (ii) Menentukan kajian pengesahan ke atas CT & CDMS. Pada mulanya, ia dibina berdasarkan dua model iaitu *4-Circle Critical Thinking Model* dan *Conflict-Theory Model of Decision-making*. Seterusnya, khidmat pakar profesional kejururawatan digunakan bagi mendapatkan kesahan kandungan dan khidmat pakar bahasa pula digunakan bagi menerangkan kesahan muka. Kemudian, instrumen telah diedarkan kepada 16 jururawat berpengalaman untuk mendapatkan komen dan pandangan. Setelah itu, soal-selidik telah diedarkan kepada 200 responden bagi menjalankan prosedur *Exploratory Factor Analysis (EFA)* melalui IBM-SPSS versi 24.0. Berdasarkan keputusan EFA, instrumen disusun semula sewajarnya dan kajian lapangan diteruskan dengan 200 responden yang berlainan. Seterusnya, data dianalisa menggunakan prosedur Confirmatory Factor Analysis (CFA) melalui IBM-SPSS-AMOS versi 23.0. Keseluruhannya, pertimbangan dari pakar menunjukkan terdapat 36 item dari dua konstruk yang mempunyai nilai *Content-Valdity-Ratio* 1.00. Setelah sesi penambahbaikan dilakukan, terdapat 38 item yang dikekalkan dengan tahap purata *Item-Content-*

Validity-Index (I-CVI), Scale-Content-Validity-Index/Universal-Agreement (S-CVI/UA) dan purata perkadaran kepakaran bagi skor kaitan, kejelasan dan kesederhanaan untuk konstruk CT ialah 1.00. Manakala, tahap purata I-CVI bagi skala keraguan ialah 0.99, S-CVI/UA adalah 0.95 dan purata perkadaran kepakaran adalah 0.99. Sementara itu, tahap purata I-CVI bagi skor kaitan, kejelasan, kesederhanaan dan keraguan untuk konstruk CDM ialah 0.99, S-CVI/UA ialah 0.95 dan purata perkadaran kepakaran adalah 0.99. Namun, setelah perubahan dilakukan, tahap purata I-CVI meningkat kepada 1.00. Keputusan EFA menunjukkan berlaku pengurangan item dari 38 kepada 21 item. Selain itu, keputusan CFA menunjukkan data sesuai dengan model yang dicipta melalui *Chi-square/degree-of-freedom* (2.111), *Comparative-Fit-Index* (0.965), *Tucker-Lewis-Index* (0.951) dan *Root-Mean-Square-Error-of-Approximation* (0.075) untuk komponen CT manakala, Chi square/df (1.992), CFI (0.980), TLI (0.972) dan RMSEA (0.071) untuk komponen CDM. Pada keseluruhannya, CT & CDMS menghasilkan konsistensi dalaman yang baik dengan nilai *Cronbach's alpha* 0.865 dan 0.891 untuk faktor 1 dan faktor 2 bagi CT manakala 0.945 dan 0.841 untuk faktor 1 and faktor 2 bagi CDM. Nilai *Average-Variance-Extracted (AVE)* pula masing-masing 0.834 bagi CT dan 0.907 bagi CDM menunjukkan bahawa kesahan konvergen dipenuhi. Keempat-empat faktor yang telah dihasilkan melalui EFA yang mengandungi 21 item diberi nama sebagai *'Critical Characteristic', 'Critical Knowledge', 'Decision Abilities'* dan *'Decision Accuracy'*. Kesimpulannya, CT & CDMS telah diperakui sebagai alat pengukur yang boleh dipercayai dan telah disahkan untuk mengukur tahap pemikiran kritikal dan membuat keputusan klinikal dalam kalangan jururawat.

DEVELOPING AND VALIDATING INSTRUMENTS FOR MEASURING CRITICAL THINKING AND CLINICAL DECISION-MAKING CONSTRUCTS FOR NURSES IN MALAYSIA

ABSTRACT

Critical Thinking (CT) and Clinical Decision-making (CDM) are two important skills for nurses to provide a quality nursing care. Hence, the aims of this research were to: (i) develop a questionnaire on Critical Thinking and Clinical Decision-Making Scale (CT & CDMS); (ii) determine the validation study of CT & CDMS. The initial version of CT & CDMS was developed based on two models: *4-Circle Critical Thinking Model* and *Conflict-Theory Model of Decision-making*. During the pre-testing stage, the nursing expert professionals were involved to obtain the content validity and the language experts were involved in consensus for face validity. Next, the instrument was distributed to 16 nurses, in order to gather their comments, and check the consistency in their responses. Subsequently, the researcher distributed the questionnaire to gather data from 200 respondents. Using data from pilot study, the researcher performed the Exploratory Factor Analysis (EFA) through IBM-SPSS 24.0 in order to assess the usefulness of every item. Based on the results from EFA, the researcher rearranged the questionnaire accordingly and performed field study survey where another 200 respondents were sampled. Using the data from field study, the researcher performed the Confirmatory Factor Analysis (CFA) procedure through IBM-SPSS-AMOS 23.0 in order to validate the instrument for construct validity, convergent validity, discriminant validity and composite reliability. Overall, judgement from the expert showed that 36 items from two constructs with CVR value

of 1.00. However, after refinement, the instrument had 38 items retained with the mean I-CVI level for the relevance, clarity and simplicity scale for CT construct was 1.00, the S-CVI/UA was 1.00 and mean expert proportion was 1.00. However, the mean I-CVI level for the ambiguity scale for CT construct was 0.99, the S-CVI/UA was 0.95 and mean expert proportion was 0.99. Meanwhile, the mean I-CVI level for the relevance, clarity, simplicity and ambiguity scale for CDM construct was 0.99, the S-CVI/UA was 0.95 and mean expert proportion was 0.99. In addition, the face validity showed good comprehensibility and feasibility. The EFA procedure has reduced the items from 38 to 21. Meanwhile, the CFA procedure has confirmed the construct validity through the fitness indexes namely Chi square/df (2.111), CFI (0.965), TLI (0.951) and RMSEA (0.075) for the CT construct while Chi square/df (1.992), CFI (0.980), TLI (0.972) and RMSEA (0.071) for the CDM construct. Overall CT & CDM produced very good internal consistency with Cronbach's alpha value of 0.865 and 0.891 for factor 1 and factor 2 for CT and 0.945 and 0.841 for factor 1 and factor 2 for CDM construct respectively. The convergent validity for the construct was achieved through Average Variance Extracted (AVE) value of 0.834 for CT and 0.907 for CDM. Four factors extracted by EFA consist of 21 items were named as Critical Characteristic, Critical Knowledge, Decision Abilities and Decision Accuracy. Thus, the CT & CDMS was concluded to be a reliable and validated instrument in measuring the level of critical thinking and clinical decision-making of nurses in clinical settings.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Critical thinking (CT) and clinical decision-making (CDM) are two important skills for nurses to provide health care in this new era. Nurses must be able to analyse a large array of information by using CT skill in order to deliver effective day-to-day patient care (Fountain, 2011; Huber, 2013; Papathanasiou, Kleisiaris, Fradelos, Kakou & Kourkouta, 2014; Mahmoud & Mohamed, 2017; Jacob, Duffield & Jacob, 2017) and solve complex problems that occur in the clinical practice by using CDM skill to ensure patient safety and promote the positive outcomes (Karimi-Noghondar & Haghdoost, 2012; Smyth & McCabe, 2017; Standing, 2017; Noohi, Nibbelink & Brewer, 2018). Today, in an era of health care reform, the role of nurses is more important than ever. Nurses are exposed to the ever-changing complicated conditions in the health care services and to be able to cope with these conditions effectively, nurses should be a competent decision maker (Muntean, 2012). There is strong evidence linking the nursing service and improved patient outcomes (Dykes & Collins, 2013). As a patient's status changes, the nurse must recognise, interpret, and integrate new information and make decision about the course of action to take (Noohi, Karimi-Noghondar, Haghdoost, 2012). Therefore, meeting the patient's outcomes requires a complex decision-making process, which goes hand-in-hand with critical thinking implementation. The development of CT and CDM skills prepare nurses in achieving competencies during nursing practice (Fukada, 2018; Melnyk, Gallagher-Ford, Long & Fineout-Overholt, 2014; Lunney, 2013; Dolansky & Moore,

2013; Reem, Kitsantas, & Maddox, 2014; Potter, Perry, Stockert & Hall, 2016). Furthermore, the requirement to implement these duo skills will facilitate nurses to survive across healthcare complexity and patient acuity nowadays (Tyne, 2018; Schuelke & Barnason, 2017; LaMartina & Ward-Smith, 2014; Seright, 2011). In addition, the role of nurses had recently expanded widely and these types of skills are important not just for clinical care, but for making important policy decisions instead. As professionals, nurses contribute nursing expertise in every setting and at every level of care delivery and policy development (Matthews, 2017). Recent evidence of this is the appointment of Rear Admiral Sylvia Trent-Adams, Ph.D., RN as the Acting Surgeon General in the United States Department of Health and Human Services (U.S. Department of Health & Human Services, 2017). In this regard, the nursing profession can improve the service by developing CT and CDM skills to increase diagnostic accuracy and may contribute to more positive results in services (Lunney, 2010; Shoulders, Follett & Eason, 2014; Carvalho, Oliveira-Kumakura & Morais, 2017; Zuriguel-Pérez et al., 2015).

1.2 Problem Statements

According to the World Health Organisation Patient Safety mission statement, the organisation seeks to provide patients with a safe and healthy environment through facilitate sustainable improvement in patient safety and managing risks to prevent harm (World Health Organisation, 2017). However, each year, there are thousands of medical errors reported everywhere. According to John Hopkins patient safety experts, more than 250000 deaths per year in the United States are caused by medical errors. This finding replaced respiratory disease as the third leading cause of death (Daniel &

Makary, 2016; McMains, 2016). In Malaysia, this problem has placed a big concern to the health ministry. Through the Patient Safety Council of Malaysia Official Portal, there have been so many incidents reported including wrong surgery, unintended retained foreign body, transfusion error, medication error and patient falls (Table 1.1) which have led to the integration of the 13 Patient Safety Goals by the nurses in their provision of nursing care (Malaysian Patient Safety Goals: Nurses Roles and Responsibilities, 2015). In the meantime, many errors have resulted from flaws in thinking that affect decision-making (Hughes, 2008). Therefore, the high performance's expectation of nurses to overcome and reduce the incidents involving registered nurses is dependent upon the nurse's CT and CDM abilities. This ideation is also supported in a journal on Enhancing Patient Safety, which has stated the nurse's ability to use their full skills and role to identify, interrupt and correct medical errors will contribute to prevent patient harm (Gaffney et al., 2016).

Table 1.1 Statistics on Patient Safety Incident

STATISTICS ON PATIENT SAFETY INCIDENT	CASES	
	Near Miss	Actual
Wrong Surgery Performed	-	5
Unintended Retained Foreign Body	-	32
Transfusion Error	977	64
Medication Error	248 307	3526
Adult Patient Fall	-	3329
Paediatrics Patient Fall	-	550

Source: Patient Safety Unit, Ministry of Health Malaysia 2016

Apart from medical error, the nurses also deal with the human lives that require high concentration and CDM skills in delivering care at any level of duty especially when the patient's situation deteriorates on the sudden onset and needs emergency attention. In Liverpool, a woman with Down's syndrome died from cardiac failure after nurses and doctors both failed to record and respond to her deteriorating symptoms (Jacob, 2017). Meanwhile, the Sinar Online dated on February 12, 2014 mentioned a sad story of a young mother who lost her twin babies simultaneously as a result of the nurse's failure to identify the deteriorating symptoms and respond appropriately at the time of event. This situation could be related to the nurses perceived to have poor ability in CT and CDM that lead them often fail to detect impending patient deterioration and act on clinical information (Waldie, Tee, & Day, 2016; Considine & Currey, 2015; Levett-Jones et al, 2010). Therefore, the urgency to overcome medical errors and healthcare challenges with greater need for care based on patient situation especially upon deterioration becomes the factor that contributes to the requirement of CT and CDM skills. In response to these problems, our study proposes to develop and validate an instrument called the Critical Thinking and Clinical Decision-making Scale (CT & CDMS) in order to evaluate the level of CT and CDM abilities of nurses in the clinical settings.

1.3 Objectives of the Study

1.3.1 General Objective

To develop and validate instrument for assessing the Critical Thinking and Clinical Decision-making Scales (CT & CDMS)

1.3.2 Specific Objectives

The specific objectives in this study are presented in the following two stages:

Stage 1:

(i) To develop the Critical Thinking and Clinical Decision-making Scales through item generation process

(ii) To identify the content validity through content experts comment

(iii) To identify the face validity through the language experts comment

Stage 2:

(i) To determine the construct validity of CT & CDMS

(ii) To determine the reliability of CT & CDMS

1.4 Research Questions

The research questions of this study are as follows:

i. Does the content validity of CT & CDMS achieved?

ii. Does the face validity of CT & CDMS subjectively appears to measure the variable or construct that it is supposed to measure?

iii. Does the construct validity of CT & CDMS measure the concept that it is intended to measure?

iv. Does the CT&CDMS consistently reproduce similar results at different times and occasions?

1.5 Operational Definitions

1.5.1 Instrument Development

Instrument development is defined as a systematic process of creating and testing questionnaire, survey or rating scale items and response options (EHE Research Methodology Centre, 2017). In this study, the instrument development is focused on designing the questionnaires in order to assess CT and CDM abilities among nurses in clinical settings using the 4-Circle Critical Thinking Model and Conflict-Theory Model of Decision-making.

1.5.2 Validation Study

Validation studies aim to establish the suitability of the indicators for the concept of the phenomenon, through expert review on the issue, indicating its relevance to the outcome. Clinical validation aims to confirm whether the components of outcomes, such as titles, definitions and magnitudes, developed and validated by experts, are supported by actual clinical data from a specific population, and to apply tests that demonstrate statistical associations and configure the level of empirical validity of the instrument (Oliveira et al., 2013). In this study, the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) was performed to evaluate the construct validity of CT & CDMS.

1.5.3 Critical Thinking Skills

The critical thinking refers to the ability of nurses to identify problems and raise questions, collect evidence to support answers, evaluate alternative solutions and communicate effectively with others to implement solutions for the best results (Elder

& Paul, 2010). In this study, critical thinking is focused on Nurse's Critical Thinking Characteristic (NCTC), Nurse's Knowledge (NK), Nurse's Interpersonal Skills and Self-management (NISM) and Nurse's Skills (NS). The first CT domain, namely NCTC, is a pattern of intellectual traits in a nurse such as logical, proactive, realistic, relevant and analytical that serve as a component of activation for thinking abilities. Second CT domain, NK, is a nurse's understanding and action to be taken prior to decision-making in clinical practice. The third domain, NISM is the abilities of a nurse to enable therapeutic communication to gain information and abilities to manage stress. Finally, the fourth domain, NS, is the abilities and expertise in handling nursing procedures and technologies (Alfaro-Lefevre, 2016). The critical thinking skill is measured based on the five-item Likert type scale.

1.5.4 Clinical Decision-making Skills

Clinical decision-making skills refer to a contextual, continuous, and evolving process, where data are gathered, interpreted, and evaluated in order to select an evidence-based choice of action (Tiffen, Corbridge, & Slimmer, 2014). In this study, the CDM skills are focused on Possible Options (PO), Achieve the Objectives (AO), Comprehensive Evaluation (CE) and Accurate Information (AI). The first domain, PO, is the nurses' know-how to gather information from possible options in order to find the best option to choose. Second domain, AO, is the abilities to achieve goals regardless of personal or institutional. The third domain, CE, is the nurse's efforts in performing the evaluation process to ensure the best result. Finally, the fourth domain, AI, is the methods of nurses obtaining accurate information before making a clinical

decision (Janis & Mann, 1977). The clinical decision-making skill is measured based on the five-item Likert type scale.

CHAPTER 2

LITERATURE REVIEW

2.1 Instrument Development

2.1.1 Definition of Critical Thinking and Clinical Decision-making Skills

Generally, many definitions pertaining to CT and CDM skills have been described by previous researchers with different theories. The review of some CT skill definitions shows the conceptual diversity as a result of disciplinary framework from where they obtain (Paul & Elder, 2014; Zuriguel-Pérez et al., 2017). The National Council for Excellence in Critical Thinking (NCECT) has described CT as the intellectual process of conceptualising, applying, analysing, synthesising and evaluating data gathered by observation, experience, reflection, reasoning or communication to guide the action (Paul & Elder, 2019). This council also mentioned that a set of information and belief-generating and processing skills and the habit based on the intellectual commitment of using those skills to guide behaviour are the components that contribute to CT. Meanwhile, The American Psychological Association (APA) through the Delphi Report has defined CT as the intellectual process that is purposeful and self-reasoning and results in interpretation, analysis, evaluation and inference (Peter, Facione, Gittens, Carol Ann, 2015). This report also mentioned the components of CT including cognitive abilities and attitudinal disposition. In the other hands, nursing authors put forward a range of definitions regarding critical thinking. Two researchers from Turkey defined the CT as the intellectual process of searching, obtaining, evaluating, analysing, synthesising and conceptualising information as a guide to develop the nurses thinking with self-awareness and ability to use this information by adding creativity and taking

risks in order to ensure positive impact on the patient outcomes (Yildirim & Ozkahraman, 2011). In the meantime, another researcher defined CT as a complex procedure that shows an ability to think upon reasoning to minimize errors and enhance positive patient outcomes (Alfaro-Lefevre, 2016). In other hands, decision-making is a method for choosing options in order to achieve goals and problem resolution (Adair, 2019). Besides, according to Johansen and O'brien (2016) stated that decision-making is described as a dynamic conceptual process that may affect the patient's outcomes. Hence, nurses should be equipped with this skill in order to develop the process further in the professional arena.

Even though studies concerning the CT and CDM skills in nursing have been conducted for years but the research is still ongoing in order to measure both skills that will enhance the nurse's competencies to promote patient safety (Blum, Borglund & Parcells, 2010). Hereby, many research tools and instruments have been developed to investigate the required CT and CDM skills, such as The Californian Critical Thinking Disposition Inventory (CCTDI), The Watson-Glaser Critical Thinking Appraisal (WGCTA), The Clinical Decision-making Nursing Scale (CDMNS) and an instrument to measure and describe clinical decision-making models in different nursing fields (Facione, Facione, & Winterhalter, 2011; Lauri & Salantera, 2002).

2.1.2 Instrument Development in Critical Thinking

Over the last three decades, the measurement of CT has been the focus among researchers. A search of major databases has been conducted to review measurement tools that have always been used in the studies, such as through CINAHL Plus,

EBSCOhost, MEDLINE through Ovid and PubMed, PsycINFO, Scopus, ProQuest and Google Scholar. The most commonly used standard tools which is developed from APA definition to measure CT. Firstly, the California Critical Thinking Disposition Inventory (CCTDI) used widely in many studies, emerging as the leading scale to assess the CT in terms of dispositional aspects. This tool was developed to measure the extent to which individuals possess the attitudes of a critical thinker among the adult population (Facione & Facione, 2010). It is designed to measure the disposition using CT in engaging problems and decision-making. High scores on the CCTDI are positively associated with a strong desire to apply critical thinking skills in decision-making and problem-solving with leadership, ego durability and the ability to benefit from educational training and counselling. This tool was in English and many other authorized translations with domains that consist of maturity, systematicity, inquisitiveness, self-confidence, truth-seeking, open-mindedness and analyticity. The CCTDI has been used to obtain information regarding the job, academic advising, personnel training programs, learning outcomes assessment, accreditation self-studies and psychological research. However, this tool is too general and not suitable for clinical practice assessment.

Another instrument also developed by Facione and Facione is the California Critical Thinking Skills Test (CCTST) to assess CT among college students. This instrument is designed to allow test-takers to demonstrate the CT skills needed to succeed in settings where problem-solving and decision-making by formulating justifications are important. Besides, the CCTST has been proven to predict strength in CT in authentic problem situations successfully in professional licensure examinations. The items

range in varying difficulties and complexities, taking 45-50 minutes to answer. Meanwhile, the domains consist of analysis, inference, evaluation, deductive and inductive reasoning. However, this scale is not suitable to measure CT in clinical practice as it is developed for student learning purposes.

The Health Sciences Reasoning Test (HSRT) was an adaptation version of the CCTST (Facione & Facione, 2007; Facione & Facione, 2010). This instrument is designed for the health sciences professionals and students in order to assess their CT and clinical reasoning skills. The scores for this instrument have been found to predict successful professional licensure and high clinical performance ratings. The HSRT is the instrument of choice for educational research projects, hiring and staff development programmes in all health science settings. The items also range across varying difficulties and complexity. The domains are the same as CCTST, which consist of interpretation, analysis information, drawing an inference, and identifying claims and reasons and evaluation. However, this tool is time-consuming for nurses because it takes around 50 minutes to answer all questions.

The Watson-Glaser Critical Thinking Appraisal (WGCTA) is used to measure logical and creative components of critical thinking and assess critical thinking ability in individuals (Watson, 1980). The WGCTA is used in the job selection, talent management and academic evaluation. The latest short variation consists of 40 questions to be completed within 30 minutes compared to the old and long variation that consisted of 80 questions that had to be completed within 60 minutes. Meanwhile, the WGCTA domains consist of inference, recognition of assumptions, deduction,

interpretation and evaluation of arguments. However, this scale is not specific to measure CT in clinical practice especially for nurses.

The Critical Thinking Ability Scale (CTAS) was developed to measure CT among college students (Park, 1999). The reliability reported is 0.74. The domains consist of intellectual curiosity, healthy scepticism, intellectual integrity, prudence and objectivity that relate more to CT disposition rather than skills. Choi, Lindquist and Song (2014) used this scale to measure the effect of problem-based learning on CT and reported Cronbach's Alpha of 0.71. However, this scale is not suitable to measure CT in clinical practice as it is developed for student learning.

The Critical Thinking Disposition Scale (CTDS) is developed for nursing students (Park & Kim, 2009). The scale has reported Cronbach's Alpha 0.78. The domains of CTDS consist of intellectual integrity, creativity, challenge, open-mindedness, prudence, objectivity, truth-seeking and inquisitiveness. However, this scale is also not suitable to measure CT among registered nurses in clinical practice as it is developed for nursing students.

Next, the Critical Thinking Assessment (CTA) is developed to evaluate the effects of a grand round education strategy on CT (Mann, 2012). This tool has reported an alpha of 0.69 and a standardised item alpha of 0.70. The domains consist of interpretation, analysis, evaluation, inference, explanation and self-regulation. However, this scale is not suitable to measure CT in clinical practice as it is developed for educational purposes.

The Critical Thinking Scale (CTSM) is developed by McMaster University to assess the effect of problem based-learning and concept mapping on CT skill. The reported Cronbach's Alpha was 0.94. The domains consist of inference, recognition of assumptions, deduction, interpretation and evaluation of the argument. However, this scale is not suitable to measure CT in clinical practice as it is developed for student learning purposes.

Lastly, the Nursing Critical Thinking in Clinical Practice (N-CT-4 Practice) is developed to assess CT skills of registered nurses in clinical place setting. According to Esperanza Zuriguel-Pérez et al. (2017), the N-CT-4 Practice domains consist of a combination of personal characteristics, intellectual and cognitive abilities, interpersonal abilities and self-management and technical abilities. However, this instrument consists of 109 items that are time-consuming. As a conclusion, the instrument available for critical thinking skill was not suitable for the study, hence, a model called 4-Circle Critical Thinking was selected due to its ability to minimize errors and increase the patient outcomes in clinical settings.

2.1.3 Instrument Development in Clinical Decision-making

There are several instruments that have been used in measuring CDM skills among nurses. The Clinical Decision-making Nursing Scale (CDMNS) is designed to measure the CDM skills among nursing students in the United States. The CDMNS domains consist of a search for alternatives or options, canvassing of objectives and values, evaluation and re-evaluation of consequences, and search for information and unbiased

assimilation of new information. The validity of CDMNS is established through the item is created from the literature on decision-making in nursing, preliminary testing of the tool to refine specific items and using the expert panel in order to help exclude items that are not related (Jenkins, 2001). However, this scale is not suitable to measure CDM in clinical practice among registered nurses as it is developed for student learning.

An instrument was developed to measure and describe CDM models in different nursing fields (Lauri & Salantera, 2002). This instrument was generated from different decision-making theories. It collectively assesses CDM at each of the four stages of the nursing process; data collection, problem identification, intervention and evaluation. However, this instrument consists of 56 items that are time-consuming for nurses.

The Clinical Decision-Making Survey (CDMS) is developed to assess the CDM among nurses (Ferrell et al., 2012). The CDMS consists of a 14-item survey with the purpose to obtain information from nurses relating to their decision-making processes when they are dealing with patients who are experiencing pain. However, the reliability of the instruments is not clear.

A tool was developed to measure CDM and clinical skills (Brudvig, Macauley & Segal, 2017). It consists of a 25-item survey with Cronbach's Alpha ≥ 0.964 across domains and the total scale. The survey has demonstrated excellent internal consistency and face validity. However, the psychometric properties have not been reported. As a conclusion, the instrument available for clinical decision-making skill was not suitable

for the study, hence, a model called Conflict-Theory Model of Decision-making was selected due to its ability to assess the decision-making especially under stress.

2.2 Instrument Validation

2.2.1 Instrument Validation in Critical Thinking

The field of education or occupation both state that research is required to inform action, to prove a theory and contribute to the development of knowledge. Therefore, the instruments used to evaluate research data must be valid and precise in order to avoid biased or flawed information collected, which may indirectly cause more harm than good. Validity is the extent to which an instrument measures what it is supposed to measure (Muijs, 2010). The researcher must determine which concept of validity is important. There are several types of validity namely construct-related evidence, criterion-related evidence and content-related evidence. The content validity, which describes the content-related evidence is the extent to which an instrument has an appropriate sample of items for the construct being measured (Polit & Beck, 2004). To examine content validity, the researcher should consult two or more experts by using Item Level Content Validity Index (I-CVI) and the Scale Level Content Validity Index (S-CVI), (Lynn, 1986; Polit, Beck and Owen, 2007). These experts should be chosen based on the selection criteria regarding the suitability level, expert knowledge of the subject and availability (Leape, Park, Kahan & Brook, 1992). Meanwhile, the criterion-related evidence is used to determine whether the count from a scale is a good predictor of an expected result. According to Creswell (2005), a correlation coefficient of a .60 or above will indicate a significant and positive relationship. In the meantime, the

construct-related evidence or construct validity can be established by determining whether the scores recorded by an instrument are meaningful, significant and useful by comparing the relationship of a question from the scale to the overall scale, testing a theory to determine if the outcome supports the theory, and by correlating the scores with other similar or dissimilar variables. The use of similar instruments is referred to as convergent validity and the use of dissimilar instruments is divergent validity. However, most of the instruments related to critical thinking especially for the nurses usually have only reported the reliability (Facione & Facione, 2010; Watson, 1980; Park, 1999; Park & Kim, 2009) whereas assessment for developed instruments must be both reliable and valid for the study results to be credible.

The California Critical Thinking Disposition Inventory (CCTDI) has reported overall median alpha coefficient of .90, demonstrating good reliability. However, a much lower Alpha Coefficient of 0.53 has been reported when performing the test reliability (Shin et al., 2006). Meanwhile, Stewart and Dempsey (2005) reported the reliability with an alpha coefficient between .67 and .77. This inconsistent result places some doubt on the reliability of this tool in the context of nursing practice. Besides, the factor analysis for CCTDI supported the existence of several common factors but is said to be not necessarily discrete with mean factor loading ranging from 0.387 to 0.528 across the scale. Furthermore, there is no fitness index available to show the construct validity of the scale.

The Kuder-Richardson (KR-20) of the California Critical Thinking Skills Test (CCTST) reported internal consistency of r = 0.70. Meanwhile, Spelic et al. (2001)

through their study has reported low alpha coefficients of 0.55, while another researcher reported the reliability of 0.62 (Beckie, Lowry & Barnett, 2001). Besides that, the factor loadings for items range from 0.30 to 0.77. Other than that, no other information available regarding validity that places some doubt towards this scale because the assessment instruments should have both reliability and validity.

The internal consistency statistic that is considered suitable for the Health Sciences Reasoning Test (HSRT) is Kuder-Richardson (KR-20). It is reported that the Kuder-Richardson (KR-20) is 0.81. Other than KR-20, no other information available regarding validity that places some doubt because the assessment instruments should have both reliability and validity for the study results to be credible.

The Watson-Glaser Critical Thinking Appraisal (WGCTA) reliability was reported to be .80. The confirmatory factor analysis showed that the model had a good fit. Chi-square statistic showed that the theoretical model and data-Driven model did not differ significantly (Chi-square = 4.07, p >0.05). Other fit indexes also showed a good fit (Normed Fit Index = .97; Goodness-of-Fit Index = .99; Root Mean Square Error of Approximation = .03 (Gadzella & Baloğlu, 2003). However, according to Walsh and Seldomridge (2006), the WGCTA measures the underlying constructs of classical logic and general reasoning skills rather than the application of critical thinking skills.

The CVI of the Nursing Critical Thinking in Clinical Practice (N-CT-4 Practice) was said to be 0.85. Cronbach's alpha coefficient was said to be 0.96. However, for the construct validity, the tool reported results below the minimum acceptability values

with Comparative Fit Index was .629 and Tucker-Lewis Index was .621. According to Awang (2012, 2015), Awang et al. (2018) the Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) values must be greater than 0.90 to indicate that the model fits the data well.

2.2.2 Instrument Validation in Clinical Decision-making

The reliability using the Cronbach alpha of the Clinical Decision-making Nursing Scale (CDMNS) is 0.79 at the beginning and removing the four lowest coefficient items yielded 0.83. Other than reliability, there is no other validation study conducted by the main researcher. However, the exploratory factor analysis (EFA) showed the Kaiser-Meyer-Olkin value of .73 and the confirmatory factor analysis (CFA) showed that RMSEA=.080, S-RMR=.089, GFI=.71, AGFI=.68 and CFI =.76, which were below the expected value in an adapted version of CDMNS (Edeer & Sarıkaya, 2015).

On the other hand, the factor reliability scores of the instrument developed by Lauri and Salantera ranged between 0.85-0.91. The EFA reported that the construct and content validity of the whole instrument in relation to its theoretical propositions has shown that the items describing analytically oriented decision-making had a statistically significant ($p < 0.01$) or very significant ($p < 0.001$) positive correlation with one another. However, there are no CFA and fitness index details available to show the construct validity of the instrument.

As a conclusion, proper assessment has not been taken to test the reliability and validity of the instruments used to measure either CT or CDM skills among nurses. Most of the

instruments reported in the literature rely only on the reliability results without information regarding psychometric properties specifically on construct validity and model fitness of the instruments. These will result in a great barrier in order to identify the CT and CDM skills as the available instruments may not be appropriate to be used. In addition, there are also some instruments that consists of so many items which are too time-consuming for the respondents. Therefore, the aims of the present study were to identify the model fitness of CT & CDMS, to assess the reliability and to determine the convergent validity of the scale.

2.3 Recent Studies in Critical Thinking Skills

2.3.1 Critical Thinking Studies Worldwide

Critical thinking (CT) is very crucial as it is embedded in a nurse's daily routine. In the meantime, the ability to think critically and solve problems in different clinical practice settings are required by all nurses (Toofany, 2008). A research was conducted to review the CT skills among registered nurses in medical-surgical settings in Pennsylvania. This research described that the overall scores of nurses with experience of 16 or more years were significantly higher than other experience categories (Turkel, 2016). This finding is similar to many research studies that suggest many newly registered or novice nurses lack the abilities or skills to think critically (Swinny, 2010; Kaddoura, 2013). Besides, the differences in problem recognition section trended toward significance, with the certified nurse's scoring higher than those without certification. This finding is also similar to some studies that illustrate which nurses who pursue their study to the next

level got higher scores than those who do not further their studies (Newton & Moore, 2013; Wangensteen, 2010).

In Taiwan, a cross-sectional correlation study was conducted to measure CT skills with the nurse competencies (Chang et al., 2011). The finding showed that the CT ability of clinical nurses was at the middle level and had a significantly positive correlation with nursing competence. This study described that nurses with a master's degree scored significantly high in CT skills compared to the baccalaureate and diploma-prepared nurses. This finding is consistent with several research studies that mentioned higher CT skills in line with the education level of the nurses (Gloudemans, Schalk & Reynaert, 2013). Meanwhile, those with over 5 years of working years scored higher than those with below 5 years of working experience. Another research study also carried out in Taiwan explored the CT disposition among the nurse practitioners and related factors (Hsu, Chang, Chang & Chen, 2017). This study used a cross-sectional descriptive design and used a structured questionnaire to collect data from 210 nurse practitioners. The results showed that the nurses obtained the highest average score on systematicity and analyticity. The CT disposition also had a significant positive correlation with fundamental knowledge readiness, professional knowledge readiness and confidence in making clinical decisions. This study suggested the provision of formal or on-the-job continuing education training that may help nurses enhance their critical thinking.

Besides, a research study was conducted to describe the relationship between self-efficacy beliefs and CT skills among nurses in Netherlands (Gloudemans, Schalk &

Reynaert, 2013). This study also investigated whether CT skills among bachelor's degree nurses higher than diploma nurses. However, the results mentioned that nurses from bachelor's degree had higher CT abilities than the diploma.

Meanwhile, an experimental study was conducted on psychiatric nurses in Iran to review the effect of CT training on nurse's job satisfaction (Heydari, Sodmand & Meshkinyazd, 2016). The California Critical Thinking Disposition Inventory (CCTDI) was used to assess the nurse's CT. Findings showed there was a significant improvement in mean job satisfaction score in the intervention group after the intervention was implemented. This indicated the positive effect of CT education workshop on job satisfaction.

In Turkey, a descriptive research was performed to assess the CT dispositions of 85 nurses in critical care unit (Yurdanur, 2016). This research used California Critical Thinking Disposition Inventory (CCTDI). The results showed low-level of the disposition toward CT of critical care nurses. Besides, this research also found that nurses having a certificate for the intensive care unit had a significantly high total CT disposition score than those without intensive care certificate ($p<0.05$). Meanwhile, two researchers carried out a descriptive study to determine the CT level and problem-solving ability of nurse managers and nurses working at private hospitals in Turkey (Erkus and Bahcecik, 2015). This study used CCTDI to measure CT disposition level of 109 nurse managers and 1134 nurses. The findings demonstrated that the CT level of nurse managers and nurses was low and it was recommended to provide internal and

external training programmes to develop strategies in order to improve CT disposition in this group. Meanwhile, another research study was conducted to explore CT in nurse managers (Zori, Nosek & Musil, 2010). This study used CCTDI to measure CT of 12 nurse managers, whereas the Practice Environment Scale (PES) was used to measure 132 nurses' perceptions of the practice environment. The findings demonstrated significant ($p < 0.001$) differences between CCTDI scores of nurse managers for CT confidence, analyticity and open-mindedness and p value ($p < 0.01$) were found after compared with the staff nurses' score for systematicity. This study stated that the positive practice environments that are conducive to job satisfaction and the retention of the staff can be created by a manager with stronger CT dispositions.

Lastly, a convenience sample of 468 registered nurses was obtained from three local hospitals in Korea to review the relationship between the practice environment and the CT disposition of nurses (Lee & Pak, 2014). This research used the critical disposition instrument developed by Yoon (2004). The results of the study indicated that collegial nurse-physician relations in the nursing practice environment were related to nurses' CT disposition, and thus, it is important to improve the practice environment as well as using individual approaches including on-the-job training to improve nurses' CT disposition. Besides, there were also statistically significant differences in CT disposition according to age, education, length of career and marital status.

2.3.2 Critical Thinking Studies in Malaysia

In Malaysia, studies related to CT skills are mostly available in the perspective of educational rather than nursing practice. However, a cross-sectional study was

conducted to review the CT and CDM skills among registered nurses in critical care settings of a tertiary hospital on the East Coast (Ludin, 2018). This research described the critical care nurses perceived a high level of CT disposition with a total score of 71.5 and a mean of 48.55. In addition, the results also showed that gender, ethnicity, education level and working experience factors significantly impacted the CT skills for critical care nurses. Meanwhile, another cross-sectional study was conducted to assess the level of CT skills among Malaysian nurses and types of CDM used when caring for patients in Malaysia (Daphne Lee, 2018). Around 549 nurses participated in the study and the data were analysed using STATA version 14.0. The findings reported that the majority of nurses in Malaysia did not meet the required level of CT skills.

2.4 Recent Studies in Clinical Decision-making Skills

2.4.1 Clinical Decision-making Studies Worldwide

Through literature reviews, less attention has been given to the process of assessing nurse's CDM skill (Gillespie, 2010). However, a cross-sectional descriptive survey was conducted in Taiwan to investigate nurse practitioner's CDM skills and the factors that affect them (Chen, Hsu, Chang & Lin, 2016). The tool used to measure 197 nurse practitioners in this study was the Clinical Decision-Making Model Inventory. The findings showed that that nurses' age, experience, work unit, professional knowledge and CT disposition impacted on the decision-making scores. This study suggested considering a nurse practitioner's knowledge readiness and their specific requirements while planning on-duty education.