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Reflection, Insight, and Critical Thinking in Nutrition Diagnostics Graduates

Kristen Jane Williams
Lindenwood University

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by

Kristen Jane Williams

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Rhonda Bishop — 10-11-2018

Dr. Rhonda Bishop, Dissertation Chair — Date

Sherry DeVore — 10-11-2018

Dr. Sherry DeVore, Committee Member — Date

Kathleen Branstetter-Hall PhD, RN — 10-11-2018

Dr. Jo Branstetter-Hall, Committee Member — Date

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work at Lindenwood University and that I have not submitted it for any other college or university course or degree.

Kristen Jane Williams

Signature:  Date: 10-11-2018

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Abstract

Dietitian nutritionists are challenged with processing information and making clinical decisions as part of the nutrition diagnostic process, hence it is important to understand how dietitian nutritionists think and make clinical judgments (Goodman et al., 2018; Trostler & Meyers, 2008). Two major processes underlie decision-making: experiential (intuitive) and rational (conscious) thinking (Croskerry et al., 2017). The reflection process is a metacognitive skill thought to influence thinking (Croskerry, 2017). This mixed methods study was designed to investigate the difference in thinking styles, self-reflection, and insight between graduates of a Dietetic Internship and a combined Master of Science/Dietetic Internship, as well as the relationship between thinking styles, self-reflection, and insight. The Rational-Experiential Inventory (REI-40) was used to examine thinking styles and the Self-Reflection and Insight Scale (SRIS) was used to examine self-reflection and insight. Participant perceptions regarding individual thinking styles and abilities to diagnose nutrition problems were investigated using two focus groups of participants with similar didactic and clinical practice experiences. There were no statistically significant differences in the mean REI-40 or SRIS scores between the groups. Because the study was underpowered, the relationship between the SRIS and REI-40 scores was unanswered (Polit, 2010). Three core themes emerged from the focus groups interviews: confidence, competence, and coaching. Information from this study adds to current knowledge on critical thinking and decision-making by dietitian nutritionists. The study is potentially important for developing dietetics and nutrition program curricula, as well as continuing education and clinical support tools for practitioners.

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Chapter One: Introduction

In 1998, the Academy of Nutrition and Dietetics began exploration of the effectiveness of medical nutrition therapy in the practice of dietetics and nutrition (Splett & Myers, 2001). A major finding was the lack of common definitions of nutrition care and a specific nutrition care process (Splett & Myers, 2001). The association recognized other allied health professions had a well-defined process or model of care (American Nurses Association, 2017; American Occupational Therapy Association, 2014; American Physical Therapy Association [APTA], 2014; Splett & Myers, 2001). Nursing and physical therapy processes include diagnosis as a key element of their processes (American Nurses Association, 2017; APTA, 2014). In 2003, the Academy of Nutrition and Dietetics adopted the Nutrition Care Process and Model that evolved to include a diagnostic step (Hakel-Smith & Lewis, 2004; Kight, 1985; Lacey & Pritchett, 2003). The Nutrition Care Process and Model is a four-step process designed to provide a consistent framework to diagnose nutrition problems and provide nutrition care (Swan et al., 2017).

According to Hakel-Smith and Lewis (2004), the nutrition care process was defined for the purpose of solving nutrition problems by using the same scientific approach and methods as medicine and other health professions. Both nursing and medicine describe the process for problem solving as a decision-making process to diagnose and treat (American Nurses Association, 2017; Croskerry, Cosby, Graber, & Singh, 2017). The initial groundwork in 2003 by the Academy of Nutrition and Dietetics established a framework for specific functions within the process that included critical thinking, decision-making, and problem solving (Lacey & Pritchett, 2003). Hakel-Smith and Lewis (2004) further elaborated on six clinical judgments or critical thinking

processes reflected in the nutrition care process that describe problem identification and problem solving. Determination of the diagnosis results from critical thinking or diagnostic reasoning of the practitioner and is critical to the process (Hakel-Smith & Lewis, 2004).

The diagnostic step is particularly critical in clinical nutrition, as the standardized diagnostic language refers to a nutrition diagnosis (Hakel-Smith & Lewis, 2004; Vivanti, O'Sullivan, Porter, & Hogg, 2017). According to Hakel-Smith and Lewis (2004) and others (Sandrick, 2002; Vivanti, et al., 2017), nutrition diagnosis is distinct from medical and nursing diagnosis, and allows identification of nutritional problems that registered dietitian nutritionists are uniquely qualified to address. The Nutrition Care Process Terminology is a standardized language that supports the four steps of the Academy of Nutrition and Dietetics Nutrition Care Process and Model and is key to the diagnostic step defining nutrition problems (Swan et al., 2017).

Kight defined nutritional diagnosing as "the evidence-based ruling in and ruling out of nutritional health-related problems RDs (Registered Dietitians) are uniquely qualified to identify and process" (as cited in Sandrick, 2002, p. 429). Kight further stated that RDs process the diagnosis/es at a higher-valued cognitive level than was previously possible via nutritional diagnosis (Sandrick, 2002). In her Nine-Step Nutrition Care Process, Kight indicated the process used to diagnose nutritional problems encouraged advanced level thinking or cognition (Sandrick, 2002). According to Kight, the nutritional professional's ability to upgrade linking of information by reasoning and decision-making can be viewed as meta-cognition (Sandrick, 2002). Kight described meta-cognition as knowledge about how to use information or data, how to think

logically and critically, and to think in a quality way to generate new knowledge (Sandrick, 2002).

Despite the progressive thinking of Kight, the dietetics and nutrition discipline has largely been unable to define and describe skills necessary to critically reason and diagnose nutrition-related problems (Charney & Peterson, 2013; Trostler & Myers, 2008). Only recently have critical thinking tasks been described and associated with each step in the process (Goodman et al., 2018; Swan et al., 2017). In the most recent Academy of Nutrition and Dietetics expert consensus update review of the Nutrition Care Process and Model, critical thinking skills acquired within career development stages were linked to the Dreyfus model of skill acquisition (Swan et al., 2017). However, attempts to link practice level designations of competent, proficient, and expert, with presumed critical thinking skills and abilities at each practice level of nutrient diagnoses have been unsuccessful (Shiner, Tanner, & Collins, 2015). Shiner et al. (2015) concluded practice level did not affect application of the nutrition care process to diagnose nutrition problems.

Clinical reasoning in practice-based disciplines can be summarized as the critical thinking and decision-making of a health care provider in clinical practice (Turpin & Higgs, 2017; Victor-Chmil, 2013). Clinical reasoning skills required by other healthcare practitioners including physicians, nurses, occupational therapists, and physical therapists would logically be the same or very similar to those needed by dietitian nutritionists (Croskerry et al., 2017; Furze, Gale, Black, Cochran, & Jensen, 2015a; Nikopoulou-Smyrni & Nikopoulos, 2007). The need for critical thinking is acknowledged in dietetics and nutrition literature but has not gone beyond recognition of

the need to link critical thinking with a clinical reasoning process (Charney & Peterson, 2013; Hakel-Smith & Lewis, 2004; Swan et al., 2017) until the recent publication by Goodman et al. (2018).

Goodman et al. (2018) used the California Critical Thinking Disposition Inventory (CCTDI) and the Health Sciences Reasoning Test with Numeracy (HSRT-N) to investigate critical thinking skills in experienced registered dietitian nutritionists (RDNs) specializing in integrative and functional nutrition. The Goodman and colleagues' study (2018) was the first to report critical thinking skills in the dietetics and nutrition discipline. In addition to using validated critical thinking tools, the CCTDI and the HSRT-N, Goodman et al. (2018) also incorporated a qualitative component, where RDNs completed a case study. Because the Nutrition Care Process and Model provides a framework that requires critical thinking and judgment, application to a case was particularly relevant to gaining insight into thinking and reasoning skills (Lacey & Pritchett, 2003: Trostler & Meyers, 2008). Prior to the work of Goodman et al. (2018), information about how practitioners in dietetics and nutrition clinically reason, think about, and make decisions has been largely unexplored (Trostler & Myers, 2008).

Clinical judgment is crucial to physician performance in medicine and is essential in the diagnosing process (Croskerry, Petrie, Reilly, & Tait, 2014). While diagnostic reasoning has been identified as the most vital of physician skills, diagnostic error is common (Norman et al., 2017). As a result of the recognition and prevalence of diagnostic error, much focus has been placed on clinical decision-making and how doctors think as they make decisions (Croskerry et al., 2014). Education, experience, and knowledge impact clinical decision-making and represent key factors among the many

variables that influence the complex process of clinical decision-making and diagnosing (Norman et al., 2017). There is disagreement about how cognitive errors, education, knowledge, and experience contribute to diagnostic errors, and about how the errors can be prevented (Croskerry et al., 2017; Monteiro, 2013; Norman et al., 2014).

The dual process model of thinking is the dominant theory used as a model of clinical reasoning in medicine (Croskerry et al., 2017; Norman et al., 2014). The foundational feature is that thinking involves two systems (Norman et al., 2017). The faster system, Type 1, is intuitive, heuristic, automatic, and unconscious, while the slower system, Type 2, is reflective, controlled, conscious, and effortful (Evans & Stanovich, 2013; Norman et al., 2017). Medicine continues to investigate the relationships between the two thinking processes and errors in clinical reasoning (Norman et al., 2017). How practitioners in dietetics and nutrition clinically reason, think about, and make diagnostic decisions has not been investigated (Goodman et al., 2018; Swan et al., 2017). The exploration of relationships in thinking styles and diagnostic reasoning is a timely and relevant issue in dietetics and nutrition practice (Goodman et al., 2018; Swan et al., 2017; Trostler & Meyers, 2008).

Background of the Study

Clinical diagnostic reasoning is important in healthcare, as diagnostic decisions impact patient outcomes (Lambe, O'Reilly, Kelly, & Curristan, 2016). Despite adequate knowledge and good clinical skills, diagnostic error is not unusual in medical practice (Lambe et al., 2016). Although the rate of diagnostic error is unknown, it is estimated to be in the range of 10% to 20% (Graber, 2013). Experts estimate as much as 75% of diagnostic failures can be attributed to clinician diagnostic thinking failures (Graber,

Franklin, & Gordon, 2005). Diagnostic errors reflect the complex interplay of system-related and cognitive factors, typically with multiple root causes (Graber et al., 2005; Hughes & Nimmo, 2017). Cognitive factors are found in the majority of cases (Graber, 2013).

The leading theory to explain how clinicians engage in clinical decision-making is the dual process theory (Croskerry, 2017). Two major processes underlie human decision-making as defined by the dual process theory: experiential (intuitive) and rational (conscious) thinking (Croskerry, 2009). The theory is further defined by the concept that reasoning may proceed by a fast, unconscious, retrieval process (Type 1) or a more analytical, slow, deliberate, and conscious logical process (Type 2) (Croskerry et al., 2017). Increased reliance on Type 2 processing is assumed to improve diagnostic reasoning (Croskerry et al., 2017). Complex tasks such as clinical diagnoses may involve both Type 1 and Type 2 thinking (Norman et al., 2014). The predominant thinking process used to make clinical decisions is unknown (Lambe et al., 2016).

Clinical decision-making styles have been studied in a number of populations, including nurse practitioner students (Gorton & Hayes, 2014), New Zealand cardiologists (Sladek, Bond, Huynh, Chew, & Phillips, 2008), Canadian emergency physicians (Calder et al., 2012), Canadian paramedics and paramedic students (Jensen et al., 2016), and student pharmacists (Cox & McLaughlin, 2014; McLaughlin, Cox, Williams, & Shepherd, 2014; Williams, McLaughlin, Cox, & Shepherd, 2016). To date, decision-making styles have not been studied in dietitians or dietetic student populations (Goodman et al., 2018). As with other health professions, it is important to understand how dietitians make decisions so adverse events related to clinical judgment and

diagnosing can be reduced or prevented (Trostler & Myers, 2008).

Because of the high prevalence of cognitive errors, much attention has focused on factors that influence, as well as minimize, these errors (Graber et al., 2005). Interventions to reduce cognitive errors include decision support tools, reflective practices, and training in metacognitive skills to recognize flaws in intuitive thinking (Croskerry, 2017; Croskerry, Singhal, & Mamede, 2013b). Improved metacognition, or thinking about one's thinking, represents a strategy to promote reflection in practice (Croskerry, 2017). Good metacognitive skills enable the recognition of suboptimal performance followed by the ability for realistic self-criticism (Croskerry, 2017). The ability to reliably self-monitor may enhance the ability to acquire knowledge or recognition of specific cognitive errors (Croskerry, 2017), otherwise known as self-regulation (Zimmerman, 2008).

Self-reflection, insight, critical thinking, and reasoning are important constructs in medicine, nursing, and allied health professions (Cooper, Da Silva, & Powell, 2017; Cooper & Frain, 2017; Turpin & Higgs, 2017). It is presumed the required skills of reflection and insight, considered important in critical thinking, and making good and accurate clinical decisions by physicians and nurses are also essential for RDNs (Cooper et al., 2017; Gates & Amaya, 2015; Goodman et al., 2018; Turpin & Higgs, 2017). While self-reflection, insight, critical thinking, and reasoning have been investigated in medicine, nursing, and other allied health disciplines, how metacognition, critical thinking, and reasoning are related has not been well studied in any discipline (Cooper et al., 2017; Gates & Amaya, 2015; Turpin & Higgs, 2017). It is especially relevant to begin to understand how dietitian nutritionists think and make clinical decisions and

diagnose nutrition problems to prevent suboptimal decisions that compromise patient outcomes (Goodman et al., 2018; Trostler & Meyers, 2008).

Theoretical Framework

The models of skill acquisition, dual process, and self-regulation served as a theoretical basis for the study and were used as the overreaching premise of how graduates of an advanced practice approach to nutrition diagnostics program are able to make nutrition diagnoses (Croskerry et al., 2017; Dreyfus & Dreyfus, 1980; Epstein, Pacini, Denes-Raj, & Heier, 1996; Evans & Stanovich, 2013; Zimmerman, 2008). In the Dreyfus model of skill acquisition, acquisition and development of a skill passes through five levels of proficiency: novice, advanced beginner, competence, proficiency, and expertise (Dreyfus & Dreyfus, 1980). Dual process theory is the dominant model of clinical reasoning in the healthcare field and categorizes thinking processes as intuitive or rational (Croskerry et al., 2017). Croskerry (2009, 2013) proposed a model that uses dual process theory to develop a universal approach to understanding clinical decision-making. According to Zimmerman's (2008) model of self-regulation, a student or practitioner can proactively adjust and modify affective, cognitive and behavioral processes to the achievement of desired performance.

In the Dreyfus model of skill acquisition, stages of clinical competence illustrate the level of experience and knowledge typically associated with an experienced expert who has been described as using more intuitive decision-making, while beginning practitioners rely more on the analytical process to make explicit consideration of diagnostic alternatives (Benner, 2004; Dreyfus & Dreyfus, 1980). When the dual process model is applied to clinical reasoning, a continuum of thinking styles is represented by an

experiential or intuitive process and a rational or reasoning process (Croskerry et al., 2017). The ability to use thinking processes in varying patient contexts is important to make accurate diagnoses (Croskerry et al., 2017). The experiential process is typically associated with more experience and knowledge, while the rational process is thought to be used in more complex situations and by less experienced and knowledgeable practitioners (Croskerry et al., 2017).

The ability to engage the appropriate thinking process by reflection is thought to be important in making more conscious and reasoned decisions (Croskerry et al., 2014). Self-regulation is a critical capacity required to make appropriate judgments (Grant, Franklin, & Langford, 2002; Roberts & Stark, 2008). Self-reflection and insight are two metacognitive components of self-regulation that can assist in promoting problem-solving and professional awareness (Clark & Zimmerman, 2014; Roberts & Stark, 2008). The self-regulation process consists of strategic thinking and action before, during, and after a clinical task (Artino, Cleary, Dong, Hemmer, & Durning, 2014; Grant et al., 2002; Zimmerman, 2008). The ability to self-regulate behavior by increased reflection and insight may influence the thinking processes used to make clinical decisions by both novice and expert practitioners and is supported by the three models of skill acquisition, dual process, and self-regulation (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008).

Statement of the Problem

Critical thinking and reasoning are important skills in dietetics and nutrition practice (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004; Trostler & Myers, 2008). The RDNs utilize a nutrition care process to

identify nutrition-related health concerns where critical thinking skills are essential to ensure accuracy in nutrition assessment and diagnosing (Charney & Peterson, 2013). However, little is known about the progression of critical thinking skills among this population nor has the exact nature of critical thinking and reasoning been defined in this area (Charney & Peterson, 2013; Goodman et al., 2018; Trostler & Myers, 2008).

In describing the nutrition care process, Hakel-Smith and Lewis (2004) indicated the need to further elaborate on the clinical judgment and critical thinking skills as components of the process. In contrast, a 2014 review of the uses, benefits, and historical evolution of the diagnostic framework used in dietetic practice, there is no mention of critical thinking or reasoning as an integral component in the process (Hammond, Myers, & Trostler, 2014). Only recently has the first study been conducted investigating critical thinking in a small group of RDNs (Goodman et al., 2018). In addition, despite emphasis on critical thinking in dietetics education, peer-reviewed literature in the United States is lacking studies addressing the assessment of dietetic students' critical thinking abilities (Ross, Loeffler, Schipper, Vandermeer, & Allan, 2013; Trostler & Myers, 2008). In assessing clinical dietetic student performance in training centers in Scotland, Pender and de Looy (2004) highlighted assessment components within dietary assessment and diet history taking skills. Dietary assessment and history taking skills included evaluation of the ability to draw together and interpret major components of the dietary assessment and make a reasoned clinical judgment (Pender and de Looy, 2004).

In outlining ethical responsibilities of dietitian nutritionists to maintain personal practice competence, the need for self-assessment based on self-reflection is emphasized (Gates & Amaya, 2015). Self-regulation, reflection, and insight are also concepts largely

undeveloped in dietetic practice and education (Gates & Amaya, 2015). Self-evaluation was emphasized as important to improve clinical practice in the most recent Academy of Nutrition and Dietetics Standards of Practice in Nutrition Care designed to evaluate the quality of practice in dietitian nutritionists (Andersen et al., 2018). When investigating clinical skills needed for a competent dietetic student, Pender and de Looy (2004) described reflection as an element in the dietary assessment category as an important skill that can assist to develop strategies to make improvements in the assessment of diet (Pender & de Looy, 2004). Similar studies investigating or evaluating reflection in the United States have not been found (Andersen et al., 2018).

Ongoing advances in technology and the healthcare workplace require dietitian nutritionists to possess critical thinking skills to identify and solve complex patient problems (Andersen et al., 2018; Brody et al., 2014; Charney & Peterson, 2013; Pender & de Looy, 2004). As a result, there is an urgency for the development of these skills in dietetic education and the need to describe the skills of practicing professionals (Charney & Peterson, 2013; Goodman et al., 2018; Trostler & Myers, 2008). The relationships among self-reflection, insight, and critical thinking are required to ultimately understand the quality of thinking and clinical decisions in dietitian nutritionist practitioners (Croskerry, 2017; Gates & Amaya, 2015; Trostler & Meyers).

Purpose of the Study

The purpose of this study was to evaluate reflection, insight, and thinking styles in graduates of a 10-month Nutrition Diagnostics Dietetic Internship (DI) and of a 22-month combined Nutrition Diagnostics Master of Science/Dietetic Internship (MND/DI) program. Understanding the skills of reflection, insight, the preferences toward, and

perceived ability to use experiential and rational thinking styles can provide insight into the quality of thinking and clinical reasoning in graduates who have used an advanced practice approach to nutrition diagnosing in their post-baccalaureate training required to become Registered Dietitian Nutritionists.

Research questions and hypotheses. The following research questions and hypotheses guided the study:

1. What difference, if any, exists between the Self-Reflection and Insight Scale (SRIS) reflection scores of graduates of a 10-month Dietetic Internship (DI) and graduates of a 22-month Master of Science/Dietetic Internship (MND/DI) program?

. $H1_0$: There is no significant difference in the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H1_a$: There is a significant difference in the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

2. What difference, if any, exists between the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H2_0$: There is no significant difference in the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H2_a$: There is a significant difference in the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

3. What difference, if any, exists between the Rational-Experiential Inventory-40 (REI-40) of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H3_{0:}$ There is no significant difference in the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H3_a$: There is a significant difference in the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

4. Are SRIS reflection and insight scores correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H4_0$: The SRIS reflection and insight scores are not correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H4_a$: The SRIS reflection and insight scores are positively correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

5. How do students who are nearing completion of an MND/DI program perceive the process of making a nutritional diagnosis?

Significance of the Study

How healthcare practitioners think, reason, and make decisions or diagnoses are important skills critical in clinical practice (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Croskerry et al., 2017; Hakel-Smith & Lewis, 2004; Victor-Chmil, 2013). While critical thinking and reasoning are important skills for nutrition practitioners, very little is known about how dietitian nutritionists think and make decisions in clinical practice (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004). In 2004, Hakel-Smith and Lewis indicated the need to further elaborate on clinical judgment and critical thinking skills in the nutrition care process used to diagnose nutrition problems. However, more than 10 years later, little is known about the

progression of critical thinking and reasoning skills among practitioners in the clinical nutrition discipline, nor has the nature of how decisions are made been described in this area (Charney & Peterson, 2013; Goodman et al., 2018; Vivanti et al., 2017).

It is thought metacognitive skills in which practitioners are able to think about, monitor, and reflect on their thinking may be instrumental in the diagnostic process (Croskerry et al., 2017; Dhaliwal & Detsky, 2013; Simpkin, Vyas, & Armstrong, 2017). Huang, Newman, and Schwartzstein (2014) described the higher cognitive skills of synthesis, self-reflection, and perspective taking, along with orientation to be deliberate, as important attributes in the thinking process important for diagnosing by physicians. Development of a metacognitive framework, where one can reflect and gain insight to one's thinking, is thought to be a self-regulatory component in the critical thinking and reasoning processes that lead to diagnostic decisions (Croskerry et al., 2017; Huang, Lindell, Jaffe, & Sullivan, 2016). Gates and Amaya (2015) emphasized the need for dietitian nutritionists to have the skills of self-assessment and reflection for practice competence, yet unlike literature and practice in medicine and nursing, self-regulation, reflection, and insight are concepts largely unrecognized in dietetic practice and education (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Cooper et al., 2017; Gates & Amaya, 2015; Turpin & Higgs, 2017).

The current and future healthcare environment presents challenges that will require dietitian nutritionists to possess critical thinking and reasoning skills to identify and solve complex patient problems, as well as demonstrate competence in practice to meet increased regulatory requirements for the provision of safe, quality care (Andersen et al., 2018; Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender

& de Looy, 2004). As a result, there is an urgency for the development of these skills in dietetic education and the need to describe the skills of practicing professionals (Andersen et al., 2018; Charney & Peterson, 2013; Goodman et al., 2018). The relationship among self-reflection, insight, and critical thinking is ultimately required to understand the quality of thinking and clinical decisions (Croskerry, 2017). The study begins to address the large void in the dietetics and nutrition literature and practice regarding how practitioners think and reason in making decisions (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018).

Definition of Key Terms

For the purposes of this study, the following terms were defined:

Analytical reasoning. The deliberate, thoughtful, considered, conscious process of analytical reasoning **(**Croskerry et al., 2017).

Clinical judgment. Clinical judgment is "the sum total of one's knowledge, cognitive processes, and experience applied to clinical decisions" (Croskerry et al., p. 329). In clinical judgment, how the expert applies critical thinking in clinical practice to make decisions, involving cognitive, metacognitive, and tacit knowledge is explained (Croskerry et al., 2017; Turpin & Higgs, 2017; Victor-Chmil, 2013).

Clinical reasoning. Clinical reasoning is "a context-dependent way of thinking and decision-making in professional practice to guide practice actions. It utilizes core dimensions of practice knowledge, reasoning and metacognition and draws upon these capacities in others" (Turpin & Higgs, 2017, p. 374).

Cognitive bias. Systematic error in thinking that often occurs through the use of heuristics (Croskerry et al., 2017).

Critical thinking. Critical thinking is defined as "that mode of thinking—about any subject, content, or problem—in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it" (Foundation for Critical Thinking, n.d., para. 2). The Foundation for Critical Thinking goes on to further state, "Critical thinking is self-directed, self-disciplined, self-monitored, and self-corrective thinking" (Foundation for Critical Thinking, n.d., para. 2).

Diagnosis. A medical definition of diagnosis is "an explanation of a pathological condition with determination of the underlying cause(es) and pathophysiology" (Croskerry et al., 2017, p. 3).

Diagnostic process. The diagnostic process is "…a complex, patient centered, collaborative activity that involves information gathering and clinical reasoning with the goal of determining a patient's health problem" (Balogh, Miller, & Ball, 2015, p. 32).

Dual processing theory, dual process model. The dual process model "describes how cognition occurs through 2 different types of cognitive processing: a rapid intuitive pathway (system 1) and a second more deliberate analytical pathway (system 2) that is slow and requires more conscious effort" (Croskerry et al., 2017, p. 334).

Heuristics. A shortcut in information processing rules that allow an abbreviated form of decision-making to reach a reasonable conclusion (Croskerry et al., 2017, p. 336).

Insight. A metacognitive activity where an individual gains the clarity of understanding of one's thoughts, feelings and behavior and is an essential part of the learning and self-regulation cycle (Grant et al., 2002). Insight is related to the state of

internal awareness (Grant et al., 2002).

Intuitive reasoning. Fast, automatic reasoning that occurs with little or no deliberate thought (Croskerry et al., 2017).

Metacognition. Metacognition is "one's ability to think about one's thinking and emotions and, to some extent, predict what others are thinking and feeling" (Eichbaum, 2014, p. 74).

Nutritional diagnosing. As defined by Kight, nutritional diagnosing is "The evidence-based ruling in and ruling out of nutritional health-related problems that RDs [registered dietitians] are uniquely qualified to identify and process" (Sandrick, 2002, p. 429).

Rationality. Fact or evidence-based reasoning (Croskerry et al., 2017).

Reflection. A metacognitive process where there is an intention to develop a greater awareness and understanding of self, others and the particular situation by "connecting with feelings that occurs before, during, and after situations… so that future encounters with the situation including ways of being, relating, and doing are informed from previous encounters" (Wald, 2015, p. 697).

Self-regulated learning. A process comprised of metacognitive, motivational, and behavioral strategies students use to acquire academic skills (Zimmerman, 2008).

System 1. A decision-making mode that is fast, reflective and mostly unconscious; also known as intuition (Croskerry et al., 2017).

System 2. A deliberate, thoughtful, and slow mode of thinking; also known as analytical (Croskerry et al., 2017).

Type 1 processing. Type 1 processing is "A type of cognition described in the dual process model for thought processes that are fast and automatic and virtually without conscious thought. Type 1 processes are also described as intuition" (Croskerry et al., 2017, p. 346).

Type 2 processing. Type 2 processing is: "Also referred to as analytic reasoning; a type of cognition that is slow, deliberate, and conscious. Type 2 processing is used to make complex decisions" (Croskerry et al., 2017, p. 347).

Limitations and Assumptions

The aim of this mixed methods explanatory research study was to draw on the strength of both quantitative and qualitative data to address a gap in the dietetics and nutrition literature regarding the thinking and reasoning of dietitian nutrition practitioners. Despite the intention to use the strengths of the mixed methods approach, there were some noted limitations identified in the study that potentially influenced the research findings and the ability to answer the research questions. It is noted there are potential threats to the validity of any study's conclusions (Polit & Beck, 2016). However, limitations allow for the ability to conduct a viable study (Aguinis & Edwards, 2014). Acknowledgement of potential study limitations offers an ability to understand how results and conclusions are affected (Aguinis & Edwards, 2014).

The following limitations were identified in this study:

Causal inferences. Despite the quantitative emphasis of the study, the study design could not support causal inferences (Polit & Beck, 2016). Although efforts were made, exploration of a relationship between group scores on the SRIS and the Rational

Experiential REI-40 surveys was not possible (Polit & Beck, 2016). Further discussion of this limitation is found in Chapter Five.

Instrument. While both the SRIS and the REI-40 surveys have been found to be consistent and reliable, there are not established scores or norms for either of the surveys (Phillips, Fletcher, Marks, & Hine, 2016; Roberts & Stark, 2008). There is potential for internal validity threat, where testing may have sensitized participants between surveys (Polit & Beck, 2016). Construct validity may have been threatened by the potential for reactivity to the study situation, in which participants wanted to be perceived as competent and/or please the researcher and answer the surveys accordingly, producing bias (Polit & Beck, 2016). There was also the risk of bias with unanswered questions in the surveys (Polit & Beck, 2016).

In the qualitative instrument aspect of the study, there were small challenges in transcribing audiotapes of the focus group sessions (Creswell, 2014). The ability to discriminate among voices on the tapes, along with difficulties by the group facilitator in taking notes during the sessions may also have been potential limitations (Creswell, 2014). The lack of total anonymity in the focus groups may have biased participant responses (Polit & Beck, 2016). Construct validity may have been threatened by the potential for reactivity to the study situation where participants introduced bias by answering questions in a manner where they perceived they are competent by the researchers (Polit & Beck, 2016). Identification and management of outliers in the data may also be a limitation (Aguinis & Edwards, 2014). Identifying potential outliers is challenging if the outliers produce bias and can be corrected or removed from the data (Aguinis & Edwards, 2014).

Precision. There was no potential for statistical conclusion validity due to the lack of control or consideration of confounding variables (Polit & Beck, 2016). There was no investigation of variables that could influence outcome results, including demographics, age, years of work experience, area of practice, and gender.

Prior research studies. Gaps in nutrition and dietetics literature have limited the ability to lay a foundation for the study (Charney & Peterson, 2013; Goodman et al., 2018; Hakel-Smith & Lewis, 2004; Swan et al., 2017). Reliance on research in medicine, nursing, and other allied health professions was required to understand the research problems in dietetics and nutrition (Furze, Black, Hoffman, Barr, Cochran, & Jensen, 2015b; Jensen et al., 2016; Sladek et al., 2008).

Sample demographics. The nature of the quantitative aspect of this study required the use of purposive, convenience sampling (Fraenkel, Wallen, & Hyun, 2014). Small sample numbers and the lack of probability sampling did not ensure a representative population distribution and prevented the ability to generalize results to other populations, an issue of external validity (Polit & Beck, 2016). Given the particular emphasis in nutrition diagnostics by participants, the sample was not representative of the larger population of dietitians. Purposive sampling was a consciously biased selection, so there was no external, objective method to assess for selected participants' representation of the typical dietitian (Polit & Beck, 2016).

The small sample size presented potential for insufficient statistical power to show a difference between the two groups being investigated, with the possible consequence of a Type II error, an issue of statistical conclusion validity (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016). In addition, detecting a correlation

between the group scores on the SRIS and the REI-40 surveys was constricted by the small sample size (Polit & Beck, 2016). The sample size for both the DI and MND/DI groups was insufficient to prevent risk of a Type II error (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016).

Because the qualitative sampling strategy was based on data availability or convenience sampling, study results may have produced biased results as the sample may not represent the typical MND/DI cohort (Polit, 2010; Polit & Beck, 2016). It is uncertain how homogeneous the sample was and whether participants in the focus group reflect experiences and perceptions of the larger population of graduates of the MND/DI cohorts (Polit & Beck, 2016). Focus groups are also subject to bias because of a potential for participant domination and susceptibility for opinions and perspectives popular and acceptable within the group to unfold (Boswell & Cannon, 2017; Polit & Beck, 2016).

Sample size in qualitative investigations is typically smaller in size than in quantitative methods (Creswell, 2014; Polit & Beck, 2016). Determining an adequate sample size is driven by saturation, as acquiring more data does not necessarily lead to more information (Polit & Beck, 2016). Polit and Beck (2016) also indicated, in small groups of four or less participants, there is a risk for inadequate dialogue within the group secondary to the apprehension and discomfort of some individuals to contribute and share thoughts and views. There is potential that the sample size was not large enough to address the study purpose and research questions (Polit & Beck, 2016; Stalmeijer, McNaughton, & Van Mook, 2014). The inexperience of the researcher, research questions and study purpose, the convenience sampling, and methodological choice of the focus group may have limited the results (Polit & Beck, 2016).

Self-reported data. Bias from self-reported data in this study may have been a potential limitation due to the inability to independently verify what participants said in surveys or focus groups (Brutus, Aguinis, & Wassmer, 2013). The potential sources of bias may have come from selective memory, telescoping, attribution, and exaggeration by the study participants (Brutus et al., 2013).

The following assumptions were accepted:

1. Respondents to the online surveys were actual graduates of the programs.
2. Responses of participants were offered honestly and without bias.
3. Participants had the requisite knowledge base to understand the survey questions and the focus group questions.
4. Participants understood the instrument terminology in both the surveys and the focus group questions.
5. Respondents could accurately recall information necessary to provide accurate responses.

Summary

Clinical diagnostic reasoning is important in healthcare as diagnostic decisions impact patient outcomes (Lambe et al., 2016). Despite adequate knowledge and good clinical skills, diagnostic error is not unusual in medical practice (Lambe et al., 2016). Because of high prevalence of cognitive errors, much attention has focused on the factors that influence, as well as minimize, these errors in medical practice (Graber et al., 2005). Interventions to reduce cognitive errors include reflective practices and training in metacognitive skills to improve thinking (Croskerry, 2017; Croskerry et al., 2013b).

Critical thinking and reasoning are important skills in dietetics and nutrition practice and are essential to ensure accuracy in nutrition diagnosing (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004; Trostler & Myers, 2008). In contrast to medicine and nursing, little is known about thinking and reasoning skills related to diagnostic reasoning and accuracy in the dietetics and nutrition discipline (Brody et al., 2014; Charney & Peterson, 2013; Croskerry et al., 2017; Goodman et al., 2018). The three models of self-regulation, dual process, and skill acquisition show the ability to self-regulate behavior by increased reflection and insight may influence the thinking processes used to make clinical decisions by both novice and expert dietetic practitioners (Benner, 2004; Croskerry et al., 2017; Zimmerman, 2008).

The challenges in decision-making in all healthcare disciplines with the resultant errors in thinking that result in diagnosing patient problems was outlined. The relevance to the dietetics and nutrition discipline was addressed, along with the gaps in understanding how practitioners think and make decisions. The theoretical framework was established. The statement of the problem, the study purpose, and the research questions and hypotheses were defined. Key terms were defined, and limitations and assumptions were stated.

In the next chapter, elaboration on the conceptual framework and integration of the models of skill acquisition, dual process, and self-regulation are provided. The concepts of critical thinking, clinical reasoning, and clinical judgment as related to diagnosing are discussed. Theories of reasoning and decision-making are investigated, along with an in-depth discussion of the characteristics and principles of the dual process approach and Croskerry's adapted model for diagnostic reasoning. The metacognitive

skills of self-reflection and insight are discussed in the context of self-regulation as a process of strategic thinking and action before, during, and after a clinical task and the relationship to professional awareness and problem-solving.

Chapter Two: Review of Literature

Critical thinking and reasoning have been described as important skills in dietetics and nutrition practice, yet little is known about the progression of critical thinking skills among this population, nor has the exact nature of critical thinking and reasoning been defined in this area (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004). Understanding the skills of reflection, insight, and the preferences toward and perceived ability to use experiential and rational thinking styles, can provide insight into the quality of thinking and clinical reasoning (Croskerry, 2017; Croskerry et al., 2017). The purpose of this study was to evaluate reflection, insight, and thinking styles and the relationships between the concepts in graduates of a 10-month DI and of a 22-month combined Nutrition Diagnostics MND/DI program.

In this chapter, a theoretical framework to provide insight into how clinical decisions are made is established. More specifically, it is proposed the theories of skill acquisition, dual process, and self-regulation can be used as the overarching premise of how graduates of an advanced practice approach to nutrition diagnostics program are able to make nutrition diagnoses (Croskerry et al., 2017; Dreyfus & Dreyfus, 1980; Zimmerman, 2008). The Dreyfus model of skill acquisition, Croskerry's dual process model of diagnostic reasoning, and Zimmerman's model of self-regulation are investigated to show the ability to self-regulate behavior by increased reflection and insight may influence the thinking processes used to make clinical decisions by both novice and expert practitioners (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008).

Critical thinking, clinical reasoning, and clinical judgment in diagnosing are explored to understand the foundational principles that characterize how decisions are made by healthcare practitioners (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Turpin & Higgs, 2017). Frameworks for thinking and decision-making further elaborate how decisions are made (Dwyer, Hogan, & Stewart, 2014; Lighthall & Vazquez-Guillamet, 2015). Dual process systems have been adapted for medicine and are investigated as the dominant model for decision-making (Croskerry et al., 2017). The dual process system links characteristics that describe one system where thought is unconscious, intuitive, or experiential and another where thinking is deliberate, conscious, and rational (Croskerry et al., 2017; Kahneman, 2013). How the preference for experiential or rational thinking influences decision-making are investigated.

Theoretical Framework

The Dreyfus model of skill acquisition, Croskerry's dual process model of diagnostic reasoning, and Zimmerman's model of self-regulation provided the framework to investigate self-reflection, insight, and clinical decisions of nutrition diagnostics program graduates in this study (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Epstein et al., 1996; Evans & Stanovich, 2013; Zimmerman, 2008). According to the Dreyfus model of skill acquisition, skill development occurs by passing through five stages: novice, advanced beginner, competence, proficiency, and expertise (Dreyfus & Dreyfus, 1980). Croskerry's (2009) dual process theory of clinical reasoning categorizes thinking processes as intuitive or analytical, providing insight into diagnosing and decision-making. Zimmerman's self-regulation model is a process that consists of strategic thinking and action before, during, and after a clinical task (Artino

et al., 2014; Grant et al., 2002; Zimmerman, 2008). The Dreyfus model of skill acquisition, Croskerry's dual process model of diagnostic reasoning, and Zimmerman's model of self-regulation work together to help understand how clinical decisions in nutrition diagnostics program graduates are influenced by the thinking styles and metacognitive self-regulatory characteristics of self-reflection and insight (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008). The three models are discussed in detail in the following sections.

Dreyfus model of skill acquisition. The Dreyfus model of skill acquisition created by Stuart and Hubert Dreyfus is a staged developmental theory to explain the acquisition of skill and the development of expertise (Dreyfus & Dreyfus, 1980). In the Dreyfus model, skills are acquired gradually and progressively move from a reliance on rules and the analytical process to intuitive reasoning based on tacit understanding that is readily available to the expert practitioner, resulting in action and decisions without engagement of formal cognitive processes (Benner, 2004). Clear rule following occurs at basic skill levels, while experience-based knowledge characterizes advanced skills (Dreyfus & Dreyfus, 1980). The primary tenet of the Dreyfus model is when skills increase there is less dependence on abstract principles and a greater reliance on concrete experience (Dreyfus & Dreyfus, 1980). Dreyfus and Dreyfus (1980) argued that higher levels of performance are dependent upon concrete experiences. Further, pattern recognition, intuition, and reflection are critical in professional skill development (Benner, 2004; Croskerry et al., 2017).

Skills acquisition in the Dreyfus model is an ongoing process which ranges from novice to expert (Benner, 2004; Dreyfus, 2004). As the individual progresses through

each of the five stages (novice, advanced beginner, competent, proficient, and expert) the individual exhibits qualitatively distinct features representative of that stage (Benner, 2004; Dreyfus, 2004). Skill acquisition in each new area typically proceeds through each successive level (Benner, 2004; Dreyfus & Dreyfus, 1980).

In the novice stage, the individual is governed by rules; behaviors are inflexible, and situations are free of context (Benner, 2004; Dreyfus, 2004). Dreyfus and Dreyfus (1980) described the novice stage as one where there are context-free features that can be recognized without experience. Improvement occurs by feedback that leads to conformity to the rule (Dreyfus & Dreyfus, 1980). The advanced beginner begins to understand context and can operate on general guidelines, while still focusing on the rules (Benner, 2004; Dreyfus, 2004). Despite the ability to apply context-specific rules, performance remains only marginally acceptable in the advanced beginner stage. (Benner, 2004).

With more experience, competence develops and practice is conscious and deliberate, yet lacking in speed and flexibility (Benner, 2004; Dreyfus, 2004). Experiences in real situations result in recognition of meaningful patterns or situational patterns, referred to as aspects (Dreyfus & Dreyfus, 1980). Situations are no longer context-free but require recognition of aspects and knowledge of guidelines necessary to choose a plan, goals, and strategies for application of rules and procedures to particular situations (Dreyfus & Dreyfus, 1980).

Proficiency is characterized by intuition in decision-making and an experience-based ability to recognize what is relevant and what is not relevant in situations, yet the proficient individual is still reliant on rules and maxims (Benner, 2004; Dreyfus, 2004).

Situational discrimination is embodied, and certain aspects stand out as being important, (Dreyfus, 2004). There is recognition of a large number of options, followed by conscious deliberation to determine the appropriate action (Dreyfus, 2004; Dreyfus & Dreyfus, 1980).

The expert performer no longer relies on analytic principles, rules, or maxims but has an ability to zero in on problems and solutions without considering large numbers of alternatives (Benner, 2004; Dreyfus, 2004). Deep situational experience acquired over extended time in a specific skill domain characterizes the expert (Benner, 2004). Moving quickly, reliance on pattern recognition, attunement to distortions in patterns, and the ability to slow down when the situation does not fit the expected pattern describes the expert stage (Benner, 2004; Brush, Sherbino, & Norman, 2017; Dreyfus & Dreyfus, 1980). Expert performance is automatic, unconscious, intuitive, and informed by experience or implicit knowledge (Benner, 2004; Dreyfus & Dreyfus, 1980).

Translation of the Dreyfus model. Despite the original application to skills in fighter pilots, chess playing, and driving cars, the model has been adopted and translated in a number of healthcare disciplines to acquisition and application of clinical skills, as well as a model to understand critical thinking, clinical reasoning, and clinical decision-making (Bartels, 2013; Benner, 2004; Carraccio, Benson, Nixon, & Derstine, 2008; Charney & Peterson, 2013; Furze et al., 2015a). The Dreyfus model was initially adapted by Benner (2004) to explain the development of nursing skills. Benner's (2004) application of the Dreyfus model was predictive and descriptive of the distinct stages of skill acquisition in nursing practice, allowing experiential learning to be addressed in a complex, dynamic field of practice. In the Dreyfus model framework, there is an ability

to predict that additional experience leads to increased in attunement and understanding of more contextual patient situations, moving from rule-driven thinking to an intuitive, experience-based approach that is context-dependent (Benner, 2004).

Physicians have also translated the Dreyfus model to explain skills in clinical medicine (Carraccio et al., 2008). Stages in the model were placed along a continuum of learning and assessment, emphasizing the gradual transition from stage to stage and illustrating the application of the model to assessment of physician development (Carraccio et al., 2008). By applying the Dreyfus model to patient care, a framework emerges to understand and define the acquisition of medical competencies (Carraccio et al., 2008; Carraccio & Englander, 2013).

Bartels (2013) investigated clinical decision-making with experienced pharmacists in ambulatory care. Experienced pharmacists with more direct patient care made more clinical decisions and relied more on pattern recognition when making common decisions, while considering the unique context-specific patient situation (Bartels, 2013). A higher amount of context-related understanding and knowledge is presumed to be advantageous in application to each unique clinical situation and decision (Benner, 2004). Bartels (2013) found there was an unconscious inclusion of both domain and context-related knowledge when making clinical decisions. Pharmacists were able to acquire a final, situated, or whole understanding necessary for a clinical decision of drug therapy, exhibiting characteristics of the expert stage described in the Dreyfus model (Bartels, 2013; Dreyfus & Dreyfus, 1980).

The Dreyfus model of skill acquisition has also been used in physical therapy education as a framework to describe the development of clinical reasoning skills across

the educational continuum (Furze et al., 2015a). Consistent with Benner's work (2004), Furze et al. (2015a) used the Dreyfus model to describe benchmarks in the acquisition of skills, along with the developmental progression of the skills. A three-year process resulted in development of a clinical reasoning grading rubric (Furze et al., 2015a). The rubric incorporated skill acquisition based on the Dreyfus model, along with explicit, expert consensus-based descriptions of key characteristics and traits in the stages of beginner to proficient (Furze et al., 2015a).

In adoption of the Nutrition Care Process and Model in dietetics and nutrition in 2003, knowledge and skill acquisition were not delineated as components of the process for the new decision-making framework for the discipline (Lacey & Pritchett, 2003). Critical thinking skills were described as essential to the process (Lacey & Pritchett, 2003). Seven years later, the Academy of Nutrition and Dietetics adapted the Career Development Guide using the Dreyfus Model (Charney & Peterson, 2013). As described by Charney and Peterson (2013), dietetics education and supervised practice experience provide the foundation of dietetics practice and are represented in the novice and beginner stages. Entry-level knowledge and skill follow in the competent stage (Charney & Peterson, 2013). Demonstration of performance of knowledge and skills in a particular focus area that supersedes supervised practice is considered proficient, while in expert practice, the RDN has an intuitive grasp of situations along with the highest level of knowledge and skill acquisition in either a general or focused practice area (Academy of Nutrition and Dietetics, 2016). More research is needed to validate the model in dietetics and nutrition (Charney & Peterson, 2013).

In an attempt to extend the Dreyfus model to critical thinking skills described as

necessary in nutrition assessment and the Nutrition Care Process and Model (Lacey & Pritchett, 2003), Charney and Peterson (2013) outlined the progression of critical thinking skills in dietetics practice. A recent update of the Nutrition Care Process and Model highlighted the variety of critical thinking skills important in the process and included the critical thinking skills described by Charney and Peterson (2013) in each of the four process steps (Swan et al., 2017). As discussed previously, critical thinking skills are required for health care practitioners to diagnose patient problems and provide safe care (Lambe et al., 2016), yet the inherent requirement for critical thinking skills in nutrition diagnosing, the knowledge and skills needed are unknown (Charney & Peterson, 2013; Goodman et al., 2018). The progression of critical thinking in RDNs outlined by Charney and Peterson (2013) at each level of practice using the Dreyfus model requires additional research and validation (Swan et al., 2017).

Drawing from the Dreyfus model, specifically the foundational principle of gradual, progressive transition from a reliance on analytical thought processes to intuitive reasoning, literature in cognitive psychology has indicated experts engage in two different types of thought processes (Kahneman, 2013; Sherman, Gawronksi, & Trope, 2014). As discussed, automaticity that develops with knowledge and experience characterizes the expert who predominately thinks and acts intuitively when making decisions (Benner, 2004; Dreyfus & Dreyfus, 1980). Decisions are made in a nonanalytic mode with little cognitive effort (Kahneman, 2013). Deliberate recruitment of cognitive resources occurs when the expert is confronted with situations with more complexity or that are outside the typical patterns recognized intuitively (Croskerry et al., 2017; Kahneman, 2013).

Individuals who are less experienced rely more on deliberate and conscious thinking to understand and make decisions (Benner, 2004; Dreyfus & Dreyfus, 1980). There has been significant attention in the healthcare literature in recent years on what is termed the dual-processing model of dual-process thinking (Croskerry et al., 2017). Researchers are interested in understanding when the conscious or analytical mode of thinking is used as opposed to the unconscious or intuitive mode and when and how practitioners transition from one mode to the other in practice (Croskerry et al., 2107).

Croskerry's universal model of diagnostic reasoning. Many approaches have been used to understand clinical reasoning and the diagnostic process, and the approaches largely fall into the two categories of intuitive or analytical reasoning (Croskerry et al., 2017; Evans & Stanovich, 2013). After many years of research in medical decision-making that followed decision-making approaches primarily in psychology (Kahneman, 2013; Sherman et al., 2014), Croskerry (2009) proposed a model of diagnostic reasoning based on both the intuitive and analytical processes and the dual-process theory. The two foundational approaches to thinking and reasoning, intuitive and analytical, have been recognized over the past several decades and are generally known as the dual process theory (Kahneman, 2013). Much of the work in dual process theory was done in the mid-1990s in cognitive psychology (Epstein, 1994; Sherman et al., 2014). According to this approach, two cognitive systems are used to think and reason and are now considered to be universal to all humans (Croskerry et al., 2017; Kahneman, 2013).

Intuitive system. The intuitive cognitive system is also known as tacit, experiential, and context-dependent (Croskerry et al., 2017; Evans & Stanovich, 2013). The intuitive system is a reflexive, automatic system that occurs in automated mode,

produces a response generated without effort, and operates below the threshold of perceptible consciousness (Croskerry et al., 2017; Evans & Stanovich, 2013). The intuitive system is rapid, uses readily available information, and operates on the principle of recognition of patterns or similarities encountered in similar situations (Croskerry et al., 2014). The intuitive system is characterized by an increased vulnerability to bias, a reduced or variable reliability, and an increased incidence of error when compared to the analytical system (Croskerry, 2009; Croskerry et al., 2017).

Analytical system. The analytical system is described as deliberate and rational (Croskerry et al., 2017; Evans & Stanovich, 2013). Rational and deliberate judgement is based on additional information collected actively by the individual in his or her environment and the conscious application of rules that have been acquired through learning (Croskerry et al., 2017; Evans & Stanovich, 2013). Kahneman (2013) described the system as rule-governed, slow, and cognitively demanding. The analytical system is characterized as reliable and less vulnerable to bias when compared to the intuitive system (Croskerry, 2009; Croskerry et al., 2017).

Dual process model for diagnostic reasoning. Kahneman (2013) argued that most common daily decisions are made using the intuitive path, yet it is generally agreed that the analytical system has input in many decisions. While the expert gives priority to the intuitive process, the analytical process can consciously overrule the intuitive process in situations where a conflict is detected (Croskerry et al., 2017; Croskerry et al., 2013; Kahneman, 2013). Intuitive and analytical processes within the scope of clinical reasoning are not mutually exclusive and it is likely that both systems of processing are involved in diagnostic decisions (Croskerry et al., 2017; Croskerry et al,

2013). The best diagnostic reasoning may result from a balance of both intuitive and analytic reasoning (Croskerry, 2009).

Clinical diagnostic decisions are made in either the intuitive or analytic mode of thinking (Croskerry et al, 2013). The decisions that predominate in dual process thinking are fast, made in the intuitive mode, and are thought to result in more mistakes than decisions made in the analytic mode (Croskerry et al, 2013). Cognitive heuristics are common in the intuitive mode and are thought to be an evolutionary predisposition that mostly work well but are less reliable than analytic processing and can be a common source of error or cognitive bias (Croskerry et al., 2017). Cognitive bias in clinical decision-making is one of the primary causes of diagnostic error and may be of greater significance than lack of knowledge (Croskerry et al., 2017). Croskerry (2009, 2013) proposed a model that uses dual process theory to develop a universal approach to understanding clinical decision-making. The intention of the universal model and approach was to explain how clinical decisions are made and to reduce the rate of diagnostic error by clinicians (Croskerry, 2009).

An additional feature of the Croskerry model (Croskerry et al., 2013) is that skill acquisition resulting from repetitive analytic processing leads to and allows intuitive processing. The intuitive process is the primary default mode; excessive reliance on the intuitive process prevents reflection and use of the analytic mode (Croskerry et al., 2013). Effort at analytic reasoning can override unconscious negative biases, and the clinician can move back and forth between the two systems (Croskerry et al., 2013, 2017).

Zimmerman's theory of self-regulation. Regulation of cognitive processes, known as self-regulation, has been of significant interest to researchers in sociology and

psychology and has gained attention and interest in other sciences (Artino et al., 2014; Grant et al., 2002). Of particular interest for the current study is the relevance to medicine and allied health disciplines, where self-regulation is a critical capacity required to make appropriate judgments and decisions (Roberts & Stark, 2008). Not only is self-regulation essential to make appropriate judgments, but healthcare practitioners are also required to be able to identify what they know and do not know when caring for patients, as well as have the ability to diagnose their own learning needs (Berkhout et al., 2015; Roberts & Stark, 2008). The self-regulation process consists of strategic thinking and action before, during, and after a clinical task (Artino et al., 2014; Grant et al., 2002; Zimmerman, 2008).

There are a number of well-respected models of self-regulation presented in the literature (Berkhout et al., 2015). Zimmerman's social cognitive model of self-regulation is one of the most comprehensive models and is frequently used in medicine to describe the cognitive processes of students and practitioners (Berkhout et al., 2015; Clark & Zimmerman, 2014). Zimmerman (2000) described the cyclical phases of self-regulation to include a forethought phase, a performance phase, and a self-reflection phase. Individuals make goals and plans, monitor their actions to ensure goal achievement, and reflect on their actions to revise or determine new goals (Zimmerman, Schunk, & DiBenedetto, 2017).

While a universal definition of self-regulated learning does not yet exist, Zimmerman (2015) described the process as one where individuals acquire skills using metacognitive, motivational, and behavioral strategies. Self-regulation is a self-directed process where mental abilities are transformed to knowledge and task-related skills in a

specific area or discipline (Zimmerman, 2015). Accordingly, a learner or clinician can proactively adjust and modify affective, cognitive, and behavioral processes to lead his or her learning to the achievement of desired performance (Zimmerman, 2008). Self-regulated learners and clinicians actively and autonomously guide their own learning and update their knowledge whenever necessary (Berkhout et al., 2015; Zimmerman, 2000). Key in the definition of self-regulation is personal initiative, perseverance, and adaptive skill in pursuit of learning (Zimmerman, 2015). Self-regulation is not an attribute that either exists or does not, but instead is a variable process that can be adjusted and modified (Zimmerman, 2015).

Cyclical phases of self-regulation. The quality and quantity of self-regulatory processes distinguish effective from ineffective knowledge and skill acquisition and ultimately the ability to make quality decisions (Zimmerman, 2000). The interrelationship between phases of the self-regulation cycle illustrates the influence of the dynamic personal, behavioral, and environmental factors on learning and performance (Zimmerman, 2000). The self-regulatory phases have been identified from a variety of empirical sources (Zimmerman, 2000). Zimmerman (2013) divided cyclical phases of the self-regulatory process into the connected, but independent sub-processes of forethought, performance, and self-reflection.

Forethought. The forethought phase is the initial phase that occurs before efforts to learn and consists of task analysis and self-motivation beliefs (Zimmerman, 2013). Processes in the forethought phase are required for adequate planning necessary to perform the task (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Key components of the task are identified, and strategies and goals are formed based on previous

knowledge or experience (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). According to Panadero and Alonso-Tapia (2014), establishing criteria or standards for performance assessment is critical in the task analysis sub-process. Elaborating an action plan by strategically planning is essential for success (Zimmerman, 2013). Experts who spend more time planning have greater success than novices (Zimmerman, 2015). High levels of self-motivation beliefs and values are required to maintain the initiative and persistence needed to ultimately perform the task (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013).

The four personal variables needed to maintain motivation for the task are self-efficacy, outcome expectations, task interest and value, and goal orientation (Zimmerman, 2013). Expectations of self-efficacy relate to personal beliefs about the ability to perform the task, while outcome expectations are the beliefs about how successful the actual outcome will be (Panadero & Alonso-Tapia, 2014). Task interest and value relate to the importance placed on the task and motivation to perform the task (Panadero & Alonso-Tapia, 2014). Goal orientation refers to the merits of the task and the value perceived by the learner (Zimmerman, et al., 2017).

Performance. Self-control and self-observation constitute the performance phase (Zimmerman, 2013). Six possible metacognitive strategies from the forethought phase proposed to maintain self-control, concentration, and interest during performance are imagery, self-instruction, attention focusing, environmental structuring, help seeking, and task strategies (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Forms of self-observation can assist efforts at self-control and include the metacognitive approach of self-monitoring or self-supervision, where what is done is compared to pre-established

criteria (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). The standards or criteria allow self-assessment during the process (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Self-recording is the second type of self-observation and creates a formal record of the processes during the performance, revealing steps or parts of the process that may have previously been undetected (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013).

Self-reflection. The two major components of the self-reflection phase processes are self-judgment and self-reaction (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). The self-judgment process is where evaluation of performance occurs and includes the two sub-processes of self-evaluation and causal attribution (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). In self-evaluation, the task is evaluated based on criteria, while causal attribution is the explanation given by the learners or clinicians about themselves in regard to how well they performed the task (Panadero & Alonso-Tapia, 2014). Self-reaction links to self-judgments by self-satisfaction and adaptive inference (Zimmerman, 2013). Self-satisfaction reactions are perceptions the learner has regarding how satisfied or unsatisfied he or she is when judging performance (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Adaptive or defensive responses relate to efforts or adjustments made by the learner to protect self-image (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013).

The cyclical nature of self-regulation is illustrated by the impact that self-reflection from previous efforts has on future forethought processes (Zimmerman, 2013). The use of forethought, performance, and self-reflection processes are related to greater task achievement and self-efficacy (Zimmerman, 2013). In addition, self-regulatory skills of experts and novices are quite different (Bagheri & Ghanizadeh, 2016;

Zimmerman, 2013). Experts are better at setting goals, establishing strategies, self-monitoring, and have higher levels of self-motivation, leading to greater self-satisfaction with task progress, furthering efforts to improve (Zimmerman, 2013).

Four levels in the cognitive path to self-regulation. While the main focus of Zimmerman's cyclical phase model is on the interaction between the metacognitive and motivational processes, it does not address how the processes are acquired (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Zimmerman outlined four levels of regulation that explained how skills are acquired (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). The four levels of regulation are observation, emulation, self-control, and self-regulation (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). Observation and emulation are considered social, while self-control and self-regulation are focused on self (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013).

In the observation level, the learner observes a social model to acquire the correct skill, which leads to the ability to qualitatively discriminate performance levels (Panadero & Alonso-Tapia, 2014; Zimmerman, 2013). At the emulation level, the learner duplicates the skill or task where performance and motivation can be improved by feedback and guidance provided by the social model (Zimmerman, 2013). Self-control occurs when there is mastery of the skill in a context not supported by the social model (Zimmerman, 2013). Achievement of the self-control level requires deliberate, structured practice with focus on the learning process versus focus on outcomes (Zimmerman, 2013). According to Zimmerman (2013) execution at the self-control level is automatic. The final level in the cognitive path to self-regulation is achieved when the learner can adapt to changing situations and conditions, as well as adjust strategies based on needed

outcomes (Zimmerman, 2013). Development of skill acquisition in this multilevel sequence of self-regulation begins with extensive guidance and progresses with feedback and reinforcement to the level of self-regulation characterized by motivation, self-efficacy, competence, confidence, and the ability to focus on outcomes with minimal attention to the process (Zimmerman, 2013).

The Dreyfus model of skill acquisition, Croskerry's dual process model of diagnostic reasoning, and Zimmerman's model of self-regulation show that the ability to self-regulate behavior by increased reflection and insight may influence thinking processes used to make clinical decisions by both novice and expert practitioners (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008). The ability to use intuitive and rational thinking processes in varying patient contexts is important to making accurate diagnoses (Croskerry et al., 2017). Engagement of the appropriate thinking process by reflection is thought to be important in making more conscious and reasoned decisions (Croskerry et al., 2014). Self-regulation is a critical capacity required to make appropriate judgments (Grant et al., 2002; Zimmerman, 2008). The three metacognitive components of self-regulation, self-reflection, and insight can assist in promoting professional awareness, clinical decision-making, and diagnosing patient problems (Croskerry, 2017).

Critical Thinking, Clinical Reasoning, and Clinical Judgment in Diagnosing

It is generally agreed that the manner in which healthcare practitioners think, reason, and make decisions or diagnose may be their most important and critical skill (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Croskerry et al., 2017; Hakel-Smith & Lewis, 2004; Victor-Chmil, 2013). Gruppen (2017) indicated the complex skill of

clinical reasoning may be the most characterizing attribute for physicians. Norman (2005) reiterated clinical reasoning is key to physician competence and emphasized the difficulty in defining clinical reasoning and the commonly used synonyms of problem-solving, decision-making, and judgment. How to measure competence in clinical reasoning and the associated cognitive and critical thinking skills are equally challenging (Norman, 2005). Facione and Facione (2008) went as far as to say healthcare practitioners have a moral imperative to improve and monitor their clinical reasoning and judgment skills, as patient lives depend on competent clinical problem solving.

Critical thinking, clinical reasoning, clinical decision-making, diagnostic reasoning, and clinical judgment are concepts often used interchangeably (Alfaro-LeFevre, 2017; Croskerry et al., 2014; Furze et al., 2015b; Victor-Chmil, 2013). Clinical decision-making is a broad term characterizing decisions made by healthcare practitioners (Alfaro-LeFevre, 2017; Turpin & Higgs, 2017). The clinical decision-making process occurs in complex, evolving situations that require skills and knowledge unique to each discipline and when identifying the diagnosis is pivotal to patient safety and outcomes (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Turpin & Higgs, 2017). The argument can be made that critical thinking, clinical reasoning, and judgment are all components of decision-making and diagnosing (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Furze et al., 2015b; Turpin & Higgs, 2017).

While it is understood how essential clinical decision-making, clinical reasoning, critical thinking, and judgment are for diagnosing in the 21st century, there is significant concern about how well physicians and other healthcare professionals are able to make good, reasoned decisions (Christensen et al., 2017; Croskerry et al., 2017; Lee, Abdullah,

Subramanian, Bachmann, & Leong, 2017; Sharples et al., 2017; Turpin & Higgs, 2017). The lack of skills required in the areas of critical thinking, clinical reasoning, and judgment are addressed in healthcare education literature (Andreou, Papastavrou, & Merkouris, 2014; Furze et al., 2015b; Sharples et al., 2017). Part of the problem is the lack of definitions of concepts and criteria required to be skilled in critical thinking, reasoning, and judgment (Christensen et al., 2017; Dwyer et al., 2014; Furze et al., 2015a; Norman, 2005).

Due to the lack of common nomenclature for clinical reasoning and problem-solving terms, Musgrove, Morris, Estrada, and Kraemer (2016) investigated terminology used in the literature to describe the clinical reasoning process in clinical problem-solving exercises. Clinical problem-solving exercises are used in medical education to illustrate the thinking process of expert clinicians (Musgrove et al., 2016). Musgrove et al. (2016) found the most common terms ranked by educators and clinicians included dual-process thinking, hypothesis generation, problem representation, metacognition, illness scripts and problem categorization. Dual-process thinking was the top prioritized clinical reasoning term used by both educators and clinicians and is the most recognized model to represent thinking processes in medicine (Croskerry et al., 2017; Musgrove et al., 2016; Norman et al., 2017).

The other top ranked concepts may provide insight into application in explicating clinical problem solving in education (Musgrove et al., 2016). Musgrove et al. (2016) conclusions are consistent with others in that education in clinical reasoning can benefit from common nomenclature (Dwyer et al., 2014; Furze et al., 2015a). The conclusions support the findings of Norman (2005), who described the discrepancies, confusion, and

difficulties in synthesizing the clinical reasoning literature because of the lack of commonality in even basic clinical reasoning concepts.

Critical thinking. The ability to think critically is an ability essential to all healthcare practitioners (Facione & Facione, 2008; Huang et al., 2014; Sharples et al., 2017). Critical thinking has been linked to problem solving abilities, improved diagnostic skills, and a reduction in clinical errors (Huang et al., 2014; Sharples, 2017). According to Facione and Facione (2008), critical thinking is a term that describes the cognitive processes required for clinical reasoning. It is a judgment process that represents the cognitive capabilities required to solve problems (Facione & Facione, 2008). Paul and Elder (2013) emphasized the importance of recognition that not all thinking is the same and often not of high quality. As previously discussed, critical thinking is a concept without a common definition and is argued by some experts to be context dependent (Facione & Facione, 2008; Paul & Elder, 2013; Turpin & Higgs, 2017). Concepts used to represent critical thinking include clinical reasoning; clinical decision-making; diagnostic reasoning; clinical judgment; critical appraisal; reflective thinking; rational reflection; and rational, reflective thinking (Alfaro-LeFevre, 2017; Croskerry et al., 2014; Ennis, 2015; Furz et al., 2015b; Huang et al., 2014; Turpin & Higgs, 2017; Victor-Chmil, 2013).

According to the Foundation for Critical Thinking, critical thinking is defined as: that mode of thinking—about any subject, content, or problem—in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it. Critical thinking is self-directed, self-disciplined, self-monitored, and self-corrective (Foundation for Critical Thinking, n.d.). A consensus definition of critical

thinking derived from the American Philosophical Association's Delphi Report in 1990 stated, “critical thinking is self-regulatory judgment resulting in interpretation, evaluation, analysis, and explanation of considerations upon that judgment” (Facione, 1990, p. 3). Both definitions emphasize the concepts of self-analysis, regulation, and evaluation or assessment (Facione, 1990; Foundation for Critical Thinking, n.d.).

For the purpose of the Millennium Conference Critical Thinking in Health Profession Education, Huang et al. (2014) adapted a definition by Scriven and Paul for the clinical context of health care. The definition of critical thinking used in the conference was “application of higher cognitive skills (e.g., conceptualization, analysis, evaluation) to information (gathered from medical history, records, physical exam, or diagnostic evaluation) in a way that leads to action that is precise, consistent, logical, and appropriate” (Huang et al., 2014, p. 95). The higher cognitive skills of synthesis, self-reflection, and perspective talking, along with orientation to be deliberate about thinking are additional attributes described as being important in the thinking process important for diagnosing (Huang et al., 2014). The concepts of analysis, evaluation, and self-reflection are consistent with the definitions proposed by the Foundation for Critical Thinking and the American Philosophical Association (Facione, 1990; Foundation for Critical Thinking, n.d.; Huang et al., 2014).

Metacognition. An additional definition of critical thinking is thinking about thinking, also termed metacognition (Paul & Elder, 2013). In describing his metacognitive approach to medical education, Eichbaum (2014) defined metacognition as “one’s ability to think about one’s thinking and emotions and, to some extent, predict what others are thinking and feeling” (p. 74). Recognizing the complex, uncertain world

and the overwhelming and growing volume of medical knowledge, Eichbaum (2014) designed an innovative curriculum for first-year medical students to develop as agile and flexible thinkers who have the ability to be mindful and have the capacity for cognitive and emotional monitoring and regulation (Eichbaum, 2014). Croskerry et al. (2017) corroborated the importance of metacognition in the context of decision-making and even posed the idea that metacognitive skills are among the most important skills in making the best diagnostic decisions. The cognitive strategies of self-monitoring and self-regulation may be a framework for practitioners to gain insight into how they are thinking and making clinical decisions (Croskerry et al., 2017).

Flavell (1979) viewed critical thinking as a form or construct of metacognition, while others see metacognition as subsumed under critical thinking (Willingham, 2007). As previously stated, the American Philosophical Association Delphi Report linked critical thinking and self-regulation (Facione, 1990). Connections can also be drawn between metacognition, critical thinking, and self-regulation (Huang et al., 2016; Sharples et al., 2017; Zimmerman, 2008). Metacognition, or the ability to think about one's own thinking, supports critical thinking in that those who can monitor and evaluate their own thought processes are more likely to demonstrate high-quality thinking (Paul & Elder, 2013). In addition, the ability to critically evaluate arguments and reasoning is necessary for self-regulated learning (Zimmerman, 2008). As a component of self-regulation and managing thinking processes, metacognition can take the form of initially making a plan prior to undertaking a problem, followed by addressing thinking during the problem process or looking back to reflect on thinking after the problem has been addressed (Cutrer, Sullivan, & Fleming, 2013).

Huang et al. (2016) described the cognitive and metacognitive habits medical and nursing faculty deem important in critical thinking education as constituting three major categories of processes; higher-order thinking and metacognition, reflection and mindfulness, and zooming in and out. The higher-order thinking skills include assessment, analysis, synthesis, and evaluation (Huang et al., 2016). Metacognition was described as developing a framework where thinking can be recognized and evaluated (Huang et al., 2016). Further, metacognition distinguishes the thinking involved in the dual process model (Croskerry et al., 2017; Huang et al., 2016). Reflection and mindfulness practices were also described as metacognitive in nature where the exploration of experiences, self-awareness, self-monitoring, and insight provide the required foundation for critical thinking (Huang et al., 2016). The cognitive concepts identified are consistent with previous definitions of critical thinking, as well as connecting to the concepts of reflection, mindfulness, insight, and thinking styles (Croskerry et al., 2017; Facione, 1990; Facione & Facione, 2008; Foundation for Critical Thinking, n.d.; Huang et al., 2014, 2016).

Reflection. As Croskerry et al. (2017) stated, reflection is recognized as key in health care practice and appreciated as the ability to critically and deliberately think through a clinical problem so insight is gained and changes in practice can occur (Asselin & Fain, 2013; Chen, Lai, Chang, Hsu, & Pai, 2016; Pai, 2015; Tsingos, Bosnic-Anticevich, Lonie, & Smith, 2015). Critical thinking using self-reflection where experiences, behaviors, and decisions are reviewed, results in moving from unconscious (intuitive) to conscious (rational) thinking (Pai, 2015; Tsingos et al., 2015). Reflective thinking increases the ability to see patient situations from different vantage points to

gain other perspectives and insights (Tsingos et al., 2015). The ability to reflect allows the practitioner to challenge biases, beliefs, and assumptions in thinking and to identify potential cognitive errors (Balogh et al., 2015; Croskerry, 2017; Mamede & Schmidt, 2005). The goals of reflection are insight, wisdom, and informed flexibility (Epstein, 2008). Improvements in reflective insight lead to improved clinical problem solving (Pai, 2015).

Reflective practice originated with Dewey's theory of inquiry where he described reflection as looking back at what has been done to gain meaning for future experiences (Dewey, 1938). Dewey's viewed thinking as an active process and equal to doing, and that reflection could only take place in practice (Dewey, 1938). More recently, the concept of reflection-in-action included the idea that reflective practice is something individuals do (Schön, 1987). Reflection is a means to create new knowledge about practice through encounters and experiences in practice, while more specifically, reflection-in-action is thinking about actions at the time of occurrence (Sandars, 2009; Schön, 1987).

Importantly, in situations that are unique, unstable, or uncertain, practitioners can engage in reflection that can allow the generation and testing of different hypotheses for a diagnosis (Ng, Kinsella, Friesen, & Hodges, 2015; Rolfe, 2014; Schön, 1987). The ability to reflect results in examination of practices, questioning assumptions, identifying biases, reframing situations, and building new knowledge as a way forward in addressing the uncertainty and complexities of patient problems (Cutrer et al., 2013; Ng et al., 2015). Reflection-in-action draws on knowledge engaged in the practice, turns thinking back on the action, and allows the intuitive advanced practitioner to think about what is occurring

while in practice, as well as the process of how it is happening (Schön, 1987). Reflection-in-action shifts thinking from intuitive or unconscious to rational, analytical, and conscious (Cutrer et al., 2013; Pai, 2015).

Mann (2016) stated reflection is necessary for self-regulation. As an integral component of self-assessment, reflection benefits the practitioner with the ability to integrate new and existing knowledge and experience, and enhance diagnostic accuracy (Mann, 2016). Reflection leads to self-awareness and a level of self-understanding, whereby the practitioner can gain knowledge about thinking and behavior that are not available and obvious (Epstein, 2008). The self-understanding or insight can allow the practitioner to adjust to the existing and changing conditions and correct for thinking in the future (Cutrer et al., 2013; Epstein, 2008).

Epstein and Hundert (2002) included reflection as a component of the definition for professional competence of physicians, medical residents, interns, and students. Habits of mind are essential for professional competence and include self-awareness, presence, curiosity, recognition of cognitive biases, and observation of one's own thinking (Epstein & Hundert, 2002). Self-reflection can minimize the likelihood of overestimating one's professional skills and manifesting attitudes and behaviors that compromise patient care (Knapp, Gottlieb, & Handelsman, 2017). According to Epstein and Hundert (2002) and others (Cutrer et al., 2013; Ng et al., 2015), reflection is a quality of a good physician and enables examination of clinical reasoning. The ability to self-reflect is a component of self-monitoring and self-regulation that can help the practitioner ask questions and look for additional and new information that can lead to recognition and adjustment of cognitive biases (Epstein & Hundert, 2002). The continuous self-

monitoring of reflection-in-action is essential to maintain competence and prevent errors in decision-making (Epstein, 2008).

Because reflection is an intention to understand how and why something occurred and to learn from the experience, it is central to self-regulation where goals and self-knowledge are re-evaluated within the context of newly acquired knowledge (Sandars, 2009; Zimmerman, 2008). Schön's work (1987) included not only reflection-in-action, but the concept of reflection-on-action. Reflection-on-action is the process of thinking about the work that has occurred after the fact (Sandars, 2009; Schön, 1987). Reflection-on-action has the ability to influence reflection-in-action by increasing the available knowledge for future situations (Sandars, 2009; Schön, 1987). Both reflection-in-action and reflection-on-action practices have the ability to transform practice that is routine or informed by habit, without thought or analysis, by drawing on the critical intellectual skills of knowledge, experience, and conscious analysis (Pai, 2015; Sandars, 2009).

Interestingly, when investigating professional practice characteristics, including reflection, of primary care physicians, Mamede and Schmidt (2005) found reflection decreased with years of experience. Experienced physicians do not routinely engage in reflection when patient problems are routine and familiar (Mamede & Schmidt, 2005). Physicians benefit from the skills of pattern recognition, automatic thinking, and processing based on many similar patient experiences (Croskerry et al., 2017). With many years of practice and an increased reliance on the automated thinking approach, there is a consequential reduction in reflection and analytical reasoning (Croskerry et al., 2017; Mamede & Schmidt, 2005). Failures in diagnosing are related to cognitive biases

and the inability to investigate alternative evidence and solutions that might be offered by reflection (Croskerry et al., 2017; van den Berge & Mamede, 2013).

Mamede and colleagues (Mamede, Schmidt, & Penaforte, 2008; Mamede et al., 2010) have provided experimental evidence that diagnostic accuracy in complex clinical problems may improve if physicians use reflection to engage in analytical, reflective reasoning. In the first study, potential impacts of reflection on the accuracy of clinical diagnosis in clinical cases with varying degrees of complexity were investigated (Mamede et al., 2008). It was found that reflection had a positive effect when diagnosing complex practice cases but did not impact the accuracy of diagnosis in simple cases (Mamede et al., 2008). In the second study, Mamede et al. (2010) examined how cognitive processes differ between experts and novices when solving complex and routine patient problems. The researchers found that for experts, reflection, or conscious deliberation, was better and strongest in complex cases, and the mode of thinking did not matter in simple, routine cases (Mamede et al., 2010). Reflection was not beneficial to the novices in complex cases (Mamede et al., 2010). Reflection may be a strategy used to engage in both non-analytical and analytical thinking to combat the reliance on non-analytical or unconscious thinking that may lead to errors (Croskerry et al., 2017; van den Berge & Mamede, 2013).

Hess, Lipner, Thompson, Holmboe, and Graber (2015) also found evidence to support reflection as an approach to reduce diagnostic inaccuracy. In studying the effect of further reflection on diagnostic accuracy in senior medical residents, Hess et al. (2015) found a benefit in both simple and complex cases. Further reflection and reconsideration of the initial diagnosis were more relevant in situations where there was uncertainty

(Hess et al., 2015). Similar to Mamede et al. (2010), Hess et al. (2015) found a difference in diagnostic performance related to expertise of the residents. Further reflection enhanced diagnostic accuracy in both simple and complex cases in those considered high-ability residents, while low-ability residents did not benefit from reflection, suggesting effective reflection is dependent upon a fundamental level of knowledge and experience, or domain specific competence (Hess et al., 2015).

In discussing calibration, the ability to recognize an issue and make needed changes, Croskerry et al. (2017) discussed the importance of the metacognitive skill of self-reflection. A well-calibrated decision maker is able to reflect and recognize what thinking mode he or she is in and then move to the appropriate mode (Croskerry, 2009; Croskerry et al., 2017). The experienced practitioner, in the intuitive thinking mode, can re-calibrate, move to the rational thinking mode, and then consider additional relevant information and alternative actions (Croskerry, 2009; Croskerry et al., 2017; Thammasitboon & Cutrer, 2013). Specifically, reflection-in-action engages deliberate analytical reasoning to increase the practitioner's recognition of the use of heuristics and cognitive biases that may lead to faulty thinking and poor diagnostic decisions (Croskerry et al., 2017; Thammasitboon & Cutrer, 2013). Reflection can be a strategy to improve performance in clinical decision-making by increasing awareness and insight needed to re-calibrate thinking (Croskerry et al., 2017; Tsingos et al., 2015)

Because most diagnostic errors have been associated with flaws in clinical reasoning, the ability to reflect on, evaluate, and gain new knowledge about the diagnostic process can lead to an understanding or insight that might not otherwise be possible (Epstein, 2008; Pai, 2015; van den Berge & Mamede, 2013). As a component of

critical thinking and metacognition, reflection may be an essential clinical diagnostic skill that can improve overall thinking and clinical decision-making (Croskerry et al., 2017; Tsingos et al., 2015). The metacognitive framework of reflection, as a fundamental element of the cognitive strategies of self-monitoring and self-regulation, may help practitioners gain insight into how they are thinking and making clinical decisions (Asselin & Fain, 2013; Croskerry et al., 2017; Huang et al., 2016).

Insight. While reflection is an essential metacognitive skill in clinical healthcare practice, without understanding of what is observed in that reflection, there is no ability to change and inform future actions (Grant et al., 2002; Sandars, 2009). It is only through self-understanding or insight that the practitioner can adjust to the existing and changing conditions (Epstein, 2008). Insight is the product of reflection, the outcome of increased awareness, where the reflection of self-monitoring of thoughts and behaviors leads to a clarity of understanding (Grant et al., 2002; Sandars, 2009). According to Grant et al. (2002), the two metacognitive factors of reflection and insight are independent. One can reflect without gaining insight; however, as part of the self-regulation process, those who routinely monitor thinking and actions should have increased levels of both reflection and insight (Grant et al., 2002).

Brown, McAvoy, and Joffe (2014) discussed the role of insight in helping keep the practitioner on track and to get them back on track by increasing the clarity of understanding and identifying where one might perform poorly to compromise patient safety and quality of care. Insight into deficiencies is a common problem in poor performers (Zimmerman et al., 2017). Self-awareness and a clarity of understanding regarding performance leads to changes in practice (Brown et al., 2014). Effective

clinical reasoning depends on good reasoning skills, reflection, and the clarity of understanding or insight that can lead to changes in thinking and clinical performance (Brown et al., 2014; Croskerry et al., 2017; Thammasitboon & Cutrer, 2013).

The purpose of critical thinking is to grasp some truth, to figure something out, and to make accurate sense of something (Paul & Elder, 2013). The ability to figure out a problem requires objectivity and cannot be arbitrary or undisciplined (Paul & Elder, 2013). The higher order mental abilities, self-reflection and mindfulness, are required to critically think and are crucial for effective clinical judgment, decision-making, and diagnosing, yet are difficult to understand and measure because they are mental processes (Huang et al. 2014). However, the task of teaching and evaluating critical thinking is crucial in the health care environment to be able to clinically reason, ensure accurate patient diagnoses, and prevent further burdens on the system (Croskerry et al., 2017; Facione & Facione, 2008; Huang et al., 2014). Croskerry et al. (2017) noted the similarities between the skills required for critical thinking and those for diagnosing, as well as challenges in readily identifying the existence of the mental processes and skills needed for reliable and accurate decision-making.

Clinical judgment. Clinical judgement has been related to the concepts of critical thinking, clinical reasoning, diagnosing, and thought to be important and relevant to sound, evidence-based practice in health care (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Croskerry et al., 2017; Hakel-Smith & Lewis, 2004; Tanner, 2006; Victor-Chmil, 2013). According to Croskerry et al. (2017), clinical judgment is "the sum total of one's knowledge, cognitive processes, and experience applied to clinical decisions" (p. 329). Clinical judgment is the process where experts apply critical thinking in clinical practice

to make decisions involving cognitive, metacognitive, and tacit knowledge (Croskerry et al., 2017; Turpin & Higgs, 2017; Victor-Chmil, 2013).

Tacit knowledge is a concept used to describe professional knowledge possessed by experts acquired through experience that is not readily articulated (Turpin & Higgs, 2017). The knowledge is described as being at the unconscious level and is thought to develop over time through action and reflection with experience (Benner, 2004). Tacit knowledge is readily available to the expert practitioner, resulting in action and decisions without engagement of formal cognitive processes (Benner, 2004). The use of tacit knowledge can be paralleled to Type 1 or intuitive thinking in the dual process model (Croskerry et al., 2017). Croskerry et al. (2017) have stated clinical judgment has been criticized by those who advocate for decisions made by clinical evidence versus a judgment made from an unconscious, experience informed perspective.

Tanner's clinical judgment model (2006) includes four aspects essential to clinical judgment in nursing: noticing, interpreting, responding, and reflecting. Tanner (2006) recognized clinical judgment as a very complex process, identifying five assumptions of clinical judgment in nursing. The assumptions Tanner identified include the idea that judgments are influenced by the context of the situation and more by what the nurse brings to the situation than the objective information about the situation (Tanner, 2006). Nurses also use more than one reasoning approach that includes analytic and intuitive approaches, alone or in combination (Tanner, 2006). The final clinical assumption essential for development in clinical knowledge and reasoning made by nurses is reflection on practice (Tanner, 2006). Tanner's development of clinical judgment for nursing emphasized a focus on cognitive, metacognitive, psychomotor, and affective

domains, positing that clinical judgment requires skills in thinking-in-action and thinking-on-action of reflection, as represented in the clinical judgement model (Lasater, 2007; Tanner, 2006; Victor-Chmil, 2013).

Facione and Facione (2008) argued critical thinking is a clinical judgment process. The consensus definition from the American Philosophical Association Delphi Report stated, "Critical thinking is the process of purposeful, self-regulatory judgment" (as cited in Facione, 1990, p. 3). The critical thinking process is to determine what to believe and what to do in a particular situation, given the evidence (Facione & Facione, 2008). In an attempt to apply a discipline-free language for the health professions, Facione and Facione (2008) described the relationship between critical thinking and clinical judgment: "Critical thinking is the process we use to make a judgment about what to believe and what to do about the symptoms our patient is presenting for diagnosis and treatment" (p. 2). Consideration of evidence, context, methods, conceptualizations, and criteria is essential to making sound judgments (Facione & Facione, 2008). Alfaro-LeFevre (2017) also viewed critical thinking and clinical reasoning as processes, while noting clinical judgment is the outcome of those thinking processes; the resultant decision made. What is consistent and relevant in the thinking about clinical judgment is that the focus is not only on cognitive and metacognitive domains but also may include affective domains and variable reasoning approaches, including those that rely on tacit knowledge or Type 1, intuitive thinking, and reflection on the process (Croskerry et al., 2017; Facione & Facione, 2008; Tanner, 2006; Turpin & Higgs, 2017; Victor-Chmil, 2013).

Clinical reasoning. Clinical reasoning is a critical skill for all health professions, as it combines the cognitive and decision-making processes to ensure safety and provide

care for patients (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Furze et al., 2015b; Turpin & Higgs, 2017). As has been previously stated, clinical reasoning is used interchangeably with clinical judgment (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Croskerry et al., 2017). Problem solving and critical thinking are term that are synonymous with clinical reasoning but are also considered as elements of clinical reasoning (Alfaro-LeFevre, 2017; Kriewaldt & Turnidge, 2013). Other terms used to refer to clinical reasoning include diagnostic reasoning and therapeutic reasoning (Durnig, Artino, Schuwirth, & van der Vleuten, 2013; Monteiro, & Norman, 2013).

Clinical reasoning is the intuitive and analytical processes that clinical practitioners use to make judgments (Alfaro-LeFevre, 2017; Kriewaldt & Turnidge, 2013). Turpin and Higgs (2017) recognized the simplicity and complexity of clinical reasoning, offering the definition: "a context-dependent way of thinking and decision-making in professional practice to guide practice actions. It utilizes core dimensions of practice knowledge, reasoning and metacognition and draws upon these capacities in others." p. 374). The complex nature of clinical reasoning includes many dimensions: strong discipline-specific knowledge; cognitive or reflective inquiry; metacognition or reflective self-awareness; mutual decision-making; contextual interaction; task impact; reasoning ability; reflexive ability to promote positive growth in self and others; and critical, creative conversations to make clinical decisions (Turpin & Higgs, 2017).

The idea that clinical reasoning is not only about the clinician's conceptual processes but instead includes additional dimensions, is emerging as interest and understanding about how clinical decisions are made and what contributes to errors in decisions or diagnosing are growing (Cooper & Frain, 2017; Gruppen, 2017; Turpin

& Higgs, 2017). Cooper and Frain (2017) explicated core elements of clinical reasoning that contribute to reasoning strategies that synthesize information to make clinical decisions or diagnoses. Core elements include clinical skills, shared decision-making, critical thinking or metacognition, use and interpretation of diagnostic tests, evidence-based information, and understanding cognitive biases (Cooper & Frain, 2017). Key to the reasoning process is an understanding of how individuals think and how thinking might be flawed, particularly in light of the growing attention on diagnostic error (Balogh et al., 2015; Cooper & Frain, 2017; Croskerry et al., 2017).

The judgment-making capacity emerges from the clinical reasoning process (Kriewaldt & Turnidge, 2013). It is accepted that clinical reasoning is necessary for clinical judgment (Croskerry et al., 2017; Tanner, 2006; Victor-Chmil, 2013). Cognitive and metacognitive processes in clinical reasoning allow for analyzing knowledge related to the patient and clinical situation to make a reasoned clinical judgment (Victor-Chmil, 2013).

Croskerry (2009) emphasized the importance of clinical judgment in medicine and stated it is essential in making a diagnosis. Croskerry (2009) is an advocate of the dual-process approach to decision-making and the potential to describe the judgment process to assist physicians in improving their reasoning in clinical performance. The dual-process approach originated from social and psychological research on human judgment and has emerged as the predominant theory used in medicine to develop a better understanding of clinical judgment and diagnostic reasoning to ultimately improve clinical decisions, improve patient safety, and reduce errors, particularly in diagnosing (Croskerry, 2009; Croskerry et al., 2017). The overarching clinical reasoning is the

complex, multi-faceted process that generates diagnoses and weighs the risks and benefits of treatment to make patient management plans (Alfaro-LeFevre, 2017; Balogh et al., 2015; Cooper & Frain, 2017). How practitioners think, reason, and make decisions is their most valuable skill and inherent in clinical and diagnostic reasoning (Cooper & Frain, 2017; Croskerry et al., 2017; Durning et al., 2013; Gruppen, 2017; Simpkin & Armstrong, 2017).

Diagnosing. In medicine, there is a general agreement that diagnosis is one of the most important functions undertaken by physicians (Croskerry et al., 2017; Dhaliwal & Detsky, 2013; Simpkin & Armstrong, 2017). A medical definition of diagnosis is "an explanation of a pathological condition with determination of the underlying cause(s) and pathophysiology" (Croskerry et al., 2017, p. 3). Diagnosis can also mean the process by which the cause of the patient's complaint can be identified (LeBlond, Brown, Suneja, & Szot, 2015). A physician is required to diagnose, treat, and prognose (Dhaliwal, & Detsky, 2013). Of those three skills, the ability to diagnose is primary, as without the diagnosis, there is no ability to treat or accurately prognose (Dhaliwal, & Detsky, 2013). Diagnosing requires the integration of scientific knowledge and individual experience in clinical situations (Turpin & Higgs, 2017).

Diagnosing is also important in nursing and other allied health disciplines, including nutrition (American Nurses Association, 2017; APTA, 2014; Hakel-Smith & Lewis, 2004). Diagnosing in the nursing discipline addresses issues in behaviors and conditions pertinent to the health of the patient that can be changed by nursing interventions (Cholowksi & Chan, 1992). Physical therapists evaluate a patient and create a physical therapy-specific diagnosis which encompasses the patient's functional

limitations resulting from his or her physical impairment (APTA, 2014). Nutrition diagnosing identifies nutritional problems that RDNs are uniquely qualified to address (Hakel-Smith & Lewis, 2004; Sandrick, 2002; Vivanti et al., 2017). Nursing describes the process of diagnostic reasoning to arrive at a diagnosis (Cholowksi & Chan, 1992). Nutrition uses a nutrition care process to diagnose nutrition problems (Hakel-Smith & Lewis, 2004).

There is much discussion in the medical literature about the ability to cognitively handle complex patient problems and the relationship to diagnostic error (Brush et al., 2017; Croskerry et al., 2017; Dhaliwal, & Detsky, 2013; Simpkin & Armstrong, 2017). Metacognitive skills, where practitioners are able to think about, monitor, and reflect on their own thinking, may be instrumental in reducing cognitive errors that occur in the diagnostic process (Croskerry et al., 2017; Dhaliwal & Detsky, 2013; Simpkin & Armstrong, 2017). Awareness of cognitive errors in medicine has received much attention in the literature over the past 10 or more years with the understanding that decision-making involves an intuitive and an analytical process that has emerged from the dual process theory originating in the social and psychological sciences (Croskerry et al., 2014). Tanner's clinical judgment model (2006) also described intuitive and analytical processing in the diagnostic reasoning process; however, the terms used are nursing centered, deviating from the integrated dual process model from medicine (Croskerry, 2009). The nutrition discipline has no theories or models to describe thinking processes in decision-making or diagnosing beyond the nutrition care process (Hakel-Smith & Lewis, 2004; Sandrick, 2002; Vivanti et al., 2017).

It is logical that all health practitioners have similar cognitive processes as well as biases and thinking styles, but empirical evidence does not exist to support that claim (Alfaro-LeFevre, 2017; Cooper, 2017; Cooper & Frain, 2017; Turpin & Higgs, 2017). In addition to the dual processing model with intuitive processing and analytical processing, the additional attributes of deliberate practice, metacognition, reflection, insight, and self-regulation, may have relevance to decision-making and diagnosing in healthcare (Brush et al., 2017; Croskerry et al., 2017; Eichbaum, 2014; Grant et al., 2002; Monteiro, & Norman, 2013; Norman et al., 2017).

Frameworks for Thinking and Approaches to Decision-making

Frameworks for thinking processes are necessary for decision-making and the successful application of critical thinking (Dwyer et al., 2014; Lighthall & Vazquez-Guillamet, 2015). The ability to understand, diagnose, and manage patient problems requires not only a strong knowledge base but is dependent upon reasoning or thinking skills to make decisions (Cooper & Frain, 2017; Turpin & Higgs, 2017). Despite significant research in sociology and cognitive psychology, human reasoning and decision-making are poorly understood and continues to be researched (Croskerry et al., 2017; Dwyer et al., 2014; Jensen et al., 2016; Norman et al., 2014; Pennycook, Fugelsang, & Koehler, 2015).

Decision-making errors, particularly in healthcare, have significant relevance to patient safety and outcomes (Balogh et al., 2015; Cooper & Frain, 2017; Croskerry et al., 2017; Turpin & Higgs, 2017). Considerable study has been devoted to investigation of diagnostic error in medicine, with emphasis placed on cognitive errors or errors in thinking and decision-making (Croskerry et al., 2017; Lambe et al., 2016; Lighthall &

Vazquez-Guillamet, 2015). Multiple models have been used to describe thinking processes and can be used to understand the cognitive errors described in clinical decision-making, with the dual process or dual-system theories receiving the most attention and study (Croskerry et al., 2014; Evans & Stanovich, 2013; Lighthall & Vazquez-Guillamet, 2015; Pennycook et al., 2015).

Logical reasoning approaches. In addition to dual process models, several reasoning approaches used to make clinical decisions warrant discussion, including hypothetico-deductive, deductive, inductive, abductive, rule-based, probabilistic, and causal reasoning (Croskerry, et al., 2017; Hughes & Nimmo, 2017; Lack & Rousseau, 2016). Hypothetico-deductive reasoning is a deliberate, slow strategy where diagnostic possibilities are generated and arguments are made to rule in or rule out the possibilities to arrive at the best solution (Croskerry et al., 2017; Hughes & Nimmo, 2017; Lighthall & Vazquez-Guillamet, 2015). Graber et al. (2005) stated the hypothetico-deductive process was found to be too general, not related to expertise or diagnostic accuracy, and not related to a process but to content knowledge.

Deductive reasoning begins with a general purpose or rule and leads to a specific conclusion based on the thinking that if the premise is true, then the conclusion will be true (Croskerry et al., 2017; Hughes & Nimmo, 2017; Lack & Rousseau, 2016). Croskerry et al. (2017) argued deductive reasoning is not adequate for clinical decision-making, as there is no generation of knowledge and no ability to address diagnostic questions. Inductive reasoning is more suited to describing a diagnosis by moving in the opposite direction of deductive reasoning, where evidence and patterns lead to the generation of a hypothesis or diagnosis (Croskerry et al., 2017; Hughes & Nimmo, 2017;

Lack & Rousseau, 2016). The disadvantage to inductive reasoning is there is no way to be certain about the proposed conclusion (Hughes & Nimmo, 2017; Croskerry et al., 2017). Testing and probability reasoning can bring more diagnostic certainty to an inductive conclusion (Croskerry et al., 2017). Probability relies on the practitioner's knowledge, experience, and interpretation of known tests to rate the likelihood of the diagnosis generated (Hughes & Nimmo, 2017).

Abductive reasoning works backwards from the effect to the cause, similar to inductive reasoning; however ,abduction works to provide a hypothesis based on the available facts (Croskerry et al., 2017; Hughes & Nimmo, 2017). The best plausible explanation and decision is made in situations where evidence and facts are incomplete, allowing action and treatment despite the uncertainty (Croskerry et al., 2017). Croskerry et al. (2017) indicated the combination of deductive, inductive, and abductive reasoning are more informative and can add strength to the diagnostic reasoning process but goes on to state the framework for diagnostic reasoning, even with the three models of reasoning and logic, is still incomplete.

Rule-based, or deterministic reasoning relies on established approaches or routines that are associated with routine or familiar problems (Croskerry et al., 2017; Hughes & Nimmo, 2017). Experts use this form of reasoning in their area of expertise but struggle when operating outside of that knowledge arena (Hughes & Nimmo, 2017). In causal reasoning, practitioners use their knowledge and expertise to support or refute hypotheses generated using other reasoning approaches (Hughes & Nimmo, 2017).

Clinical reasoning models. There are two main models that form the basis of dual process framework used by clinicians to make decisions where clinical data are

processed differently to determine a diagnosis (Croskerry et al., 2017). The two contrasting models are the analytic or rational model and the intuitive or nonanalytical model (Croskerry et al., 2017). Knowledge is foundational to clinical reasoning, but the ability to make a decision also requires clinical experience that is acquired over time (Hughes & Nimmo, 2017). Both experiential and scientifically rooted analytic methods are needed to make clinical decisions (Croskerry et al., 2017; Monteiro & Norman, 2013).

Analytical model. An analytical approach to diagnosing includes the generation of multiple diagnoses to test, refine, and determine a final diagnosis (Croskerry et al., 2017). The approach is considered to be slow, tedious, and too inefficient for most clinical decisions in the fast-paced, dynamic health care settings (Croskerry et al., 2017; Lighthall & Vazquez-Guillamet, 2015). The analytical approach is generally thought to be the primary approach used by students and inexperienced clinicians, while experts rely on the approach when problems are novel, unfamiliar or complex (Croskerry et al., 2107).

The deliberate, analytical approach is also used in patient cases where multiple problems exist, and each problem requires individual attention to gather and organize the relevant information needed to make a diagnosis (Croskerry et al., 2017; Lighthall & Vazquez-Guillamet, 2015). The approach is characterized by a conscious application of rules and logical judgment (Croskerry et al., 2017). A deliberate analytical approach is conducive to inexperienced practitioners as they are likely to make better decisions by systematically working through the process by comparing and contrasting characteristics

of the patient's problem (Lighthall & Vazquez-Guillamet, 2015; Tay, Ryan, & Ryan, 2016).

Intuitive model. The intuitive model is fast, energy efficient, and almost instantaneous (Croskerry, 2009). Experienced clinicians are largely able to unconsciously recognize patterns and call on illness scripts and past similar situations to quickly evaluate a patient situation and determine a diagnosis (Croskerry et al., 2017). Experts use what is referred to as experiential knowledge, where direct stored experience, or exemplars, are categorized and given meaning by the process of instantiation (Brush et al., 2017; Croskerry, 2009).

Reasoning in the intuitive model relies on inductive logic where evidence and patterns lead to the generation of a hypothesis or diagnosis (Hughes & Nimmo, 2017; Croskerry, 2009). Rapid pattern recognition is the predominate path to diagnosis (Mamede et al., 2008). Norman and Brooks (1997) described the clinical experiences accumulated over time as a kind of diagnostic sixth sense, where almost instantaneous judgement arises from limited information. Croskerry (2009) noted the employment of heuristics, or mental shortcuts, and reliance on instinctive first impressions to make fast decisions in conditions of uncertainty.

Two system or dual process theories of cognition. Dual process and dual system theories are rooted in human psychology and hold that two cognitive modes operate to process information and make decisions, while at the same time clarify the distinctions between the two modes (Croskerry et al., 2017; Epstein, 1994; Evans & Stanovich, 2013). Dual system theories broadly link a wide range of characteristics to

two systems of thought, where one is mindless or unconscious and the other is mindful or conscious (Croskerry et al., 2017; Epstein, 1994, 2014; Kahneman, 2013).

Epstein's cognitive-experiential theory. In 1973, Epstein (2014) introduced the concept of cognitive-experiential self-theory, now referred to as cognitive-experiential theory (CET). The CET was further defined and characterized in an article published by Epstein in 1994, where he described two parallel modes of processing information, rational and experiential systems, which interact and represent how people adapt to the world (Epstein, 1994). At the time he published his article, Epstein (1994) emphasized the need to understand how the two processes of thinking operate and influence each other. Epstein (1994) described the rational system as operating at the conscious level, while the experiential system operated as automatic and preconscious. The rational system was further characterized as intentional, analytic, logical, primarily verbal, and relatively affect free and the experiential system was described as holistic, associative, primarily nonverbal, and affective (Epstein, 1994).

Epstein (2014) described experiential or unconscious processing as the default mode, defined as automatic associative learning from experience that typically operates outside of awareness and is often moderated by feelings. Emotions or feelings in the experiential system can be important as a source of reinforcement and motivation and can influence conscious thought and reasoning (Epstein, 2014). Experiential processing is resistant to change, less differentiated, integrated and organized, and is characterized as overgeneralizing, oversimplifying, and stereotyping (Epstein, 2014). Experiential processing is an evolutionary adaptive process that is not well-suited for solving

complicated problems or for complex nuanced situations that require logical analysis and reasoning (Epstein et al., 1996).

According to Epstein (2014), rational processing is primarily inferential, responsible for conscious appraisals, and capable of breaking things down into component parts to solve problems. Rational processing is much more discriminating than experiential processing, which is conceptually organized and can be trained to develop strategies to minimize failures and optimizes successes (Epstein, 2014; Epstein et al., 1996). With awareness, the rational system can learn from experience, recognize how the experiential system operates, and acquire empirically-learned information to respond to new situations (Epstein, 2014).

According to Epstein, the most important presumption is that all humans cognitively process information from the two different systems, experiential and rational, where it is likely parallel and interacting (Epstein, 2014; Pacini & Epstein, 1999). Epstein (2014) described the rational-analytical processing as having the capability to understand and correct for the experiential-intuitive style, while the experiential system is unaware and independent of the rational system. Consequently, those who are prone to the experiential-intuitive system are capable of eliminating its influence when there is an awareness to behave more rationally (Epstein, 2014). The rational system is capable of overriding the unconscious or experiential mode of thinking; however, this system is also subject to bias by experiential thinking and can fail in attempts to be logical (Epstein, 2014). The degree of relative dominance of either system in particular situations is determined by a number of factors, including individual differences in preference for relying on one system more than the other, the situation and the association with typical

response patterns, the degree of feelings elicited, the amount and quality of relevant knowledge, and experience (Epstein, 2014; Epstein et al., 1996; Pacini & Epstein, 1999).

Kahneman and Tversky. Kahneman and Tversky investigated cognition to explain how humans process information and make judgments or decisions from that information (Kahneman, 2013). Kahneman and Tversky examined errors in statistical judgments by skilled statistic researchers, finding their intuitive judgments did not match the established statistical principles that are foundational to the discipline (Kahneman, 2013). Consistent discrepancies were found between statistical knowledge, experience, and statistical intuition (Kahneman, 2013). Kahneman (2013) described the adoption of a two-system view that categorized the two cognitive processes into intuition and reasoning. Kahneman further described in basic terms the two processes of cognition, intuition and reasoning, as two modes that operate simultaneously as System 1 and System 2 (Kahneman, 2013). System 1 is characterized as experiential, automatic, effortless, intuitive, unconscious, efficient and fast, while System 2 is a mode of awareness, is deliberate, conscious, inefficient and energy requiring, and slow (Croskerry, 2009; Kahneman, 2013).

Kahneman and Tversky's work has evolved over the years (Kahneman, 2013). A major finding that has been influential in the understanding of cognitive processes is the use and importance of shortcuts or heuristics to make decisions that are typically beyond the awareness of the individual (Kahneman, 2013). Kahneman (2013) proposed all errors in thinking and reasoning originate from the cognitive biases in System 1. The processing in System 1 relies heavily on heuristics that have the potential to lead to faulty conclusions and decisions (Kahneman, 2013). The activation of System 2 requires the

regulation of attention, while the System 1 regulation of consciousness is not present, and the mode is characterized by the application of heuristics to identify patterns and make associations (Croskerry, 2009; Kahneman, 2013).

Two system or dual process nomenclature. The two systems or modes of cognitive processing have multiple names in the literature (Evans & Stanovich, 2013), but the main terms describing the two systems are analytical and intuitive (Croskerry, 2009; Epstein, 1994). Stanovich (2013) discussed similarities of the numerous dual process theories noting the need to refer to the systems as processes to more accurately describe the existence of the set of systems in the brain that operate autonomously or consciously. Type 1 processing versus Type 2 processing terminology is preferred, allowing the ability to refer to processes that indicate multiple systems in the brain that operate to inform cognition (Evans, 2013; Stanovich, 2013). Evans (2013) further clarified there are two types of thinking versus two operating systems.

Characteristics of type 1 and type 2 processes. The analytical rational and experiential-intuitive cognitive process can be seen as similar to other dual-process theories (Evans, 2013). The overarching dual process and dual system processes of higher cognition characterize the cognitive systems of the rational and experiential processes and other similar theories and models in the literature where learning, decision-making, and reasoning are addressed (Evans, 2103, 2014; Evans & Stanovich, 2013). Features of the two processes described in many of these theories are largely consistent (Evans, 2013, 2014). Type 1, or experiential-intuitive processing, is characterized as unconscious, associative, parallel, belief based, and biased, while Type 2, or analytical-

rational processing, is described as conscious, rule-based, sequential, abstract, and normative (Evans, 2014).

There are a number of processes that meet criteria in Type 1 processing that include associative processes important for learning and retrieval of knowledge, language acquisition, working memory, and automatic responses due to rehearsal, repetition, and practice (Evans, 2013). The multiple systems in Type 2 processing include reasoning, working memory, cognitive ability, thinking dispositions, or cognitive styles that enable one to engage in rational decision-making (Stanovich, 2013). Type 1 processing is independent of working memory and cognitive ability, while Type 2 processing is influenced by individual differences in cognitive ability and reliant on working memory (Evans & Stanovich, 2013). Stanovich (2013) further emphasized individual differences in thinking styles and tendencies include distinctions in values, goals, self-regulation, and reflection.

Autonomy is the defining feature of Type 1 processing, consisting of both innate processing and experiential associations that have been learned to automaticity (Sherman et al., 2014). While there is no requirement for input from high-level control systems in Type 1 processing, and it works well in most circumstances, it is not designed for situations of unusual importance or difficulty (Sherman et al., 2014). When the need for additional analysis is called for, Type 2 processing can override the tendency for low effort, or to use heuristics (Sherman et al., 2014; Stanovich, 2013). Type 2 processing is associated with intentional work on tasks that require significant effort and focus and can intervene on the automatic, moment-to-moment thinking of Type 1 processing where

most human decision-making occurs (Kahneman, 2013; Stanovich, 2013). According to Croskerry (2009), both processes are required for clinical decision-making.

Evidence suggests individuals favor the use of one system or processing over another but are able to switch between both approaches (Croskerry et al., 2017; Evans & Stanovich, 2013). The two systems or processes are considered separate but interactive (Epstein et al., 1996; Pacini & Epstein, 1999) and can be utilized by clinicians in varying degrees depending on the context of the situation, as well as the knowledge, experience, and preference, or tendency, to favor one process over the other (Croskerry et al., 2017). Effective medical diagnosis, like many complex thinking activities, involve the two distinct thinking modes, the ability to use the appropriate mode given the situation, and to switch from one mode to the other (Croskerry, 2009). Croskerry (2009) indicated the two types of processing are complementary in many aspects. Repetitive processing and learning that occurs in Type 2 can adapt over time and lead to reflexive Type 1 processing (Croskerry, 2009). The use of Type 1 processing draws on past experiences, recognition of patterns, and use of heuristics (Croskerry, 2009).

While the effortful, systematic reasoning is considered foundational in Type 2 processing, the use of heuristics is characteristic of Type 1 processing (Epstein, 1994; Kahneman, 2013). Type 1 processing ignores objective probabilities and relies on the mental shortcuts in decision-making (Croskerry, 2009; Kahneman, 2013). In contrast, Type 2 processing is the logical, rational, linear system that only processes one thing at a time. The conscious, linear system is acquired through learning and becomes more competent with time and formal, domain specific training in critical thinking and logical reasoning (Croskerry, 2009; Evans, 2013; Stanovich, 2013).

Croskerry (2009) argued that Type 1 processing or intuitive thinking is likely mismatched to the modern environment and is vulnerable to error. The reliance on heuristics in Type 1 processing further increases the risk for diagnostic errors (Croskerry, 2009). It has been argued that mindful awareness of Type 1 and Type 2 processes may help improve decision-making processes (Croskerry, 2017). Croskerry (2017) and Stanovich (2013) posited rational thinking is the most important characteristic of the skilled, seasoned decision-maker.

***Unconscious thought theory*.** There has been considerable debate regarding what type of thinking is best suited for a particular task, with dual process theory the primary framework used to describe and understand the issue (Epstein, 1994; Evans & Stanovich, 2013; Kahneman, 2013). Rational thinking is commonly considered to be essential in making complex decisions where careful thought and consideration are needed (Croskerry et al., 2017; Stanovich, 2013). Another mode of thinking has been discussed in the literature where an unconscious mode of thinking may be used to make challenging decisions (Dijksterhuis & Strick, 2016). Unconscious thought theory refers to an unconscious mode of thinking that deviates from the dual process framework typically used to describe modes of thinking (Garrison & Handley, 2017). Unconscious decision-making occurs outside of conscious awareness, while the individual is knowingly doing another task (Garrison & Handley, 2017). The premise of unconscious thoughts is that complicated information can be processed in a slow, deliberate, analytical manner (Garrison & Handley, 2017). Judgments and decisions are made over longer periods of

time in the unconscious mode where integration, organization, and assessment of complex information can occur (Dijksterhuis & Strick, 2016; Garrison & Handley, 2017).

In the recent review of literature investigating unconscious thought processes, Dijksterhuis and Strick (2016) characterized the unconscious thought process as working best in complicated situations where information is significant in volume and quality. Dijksterhuis and Strick (2016) further indicated in complicated situations where unconscious thought is occuring, there also exists the use of some degree of conscious resources, often described as a distraction. Distraction is thought to be related to the affective component in the experiential or intuitive mode (Garrison & Handley, 2017). Active unconscious thought, along with reliance on distraction was shown to result in improved decisions (Garrison & Handley, 2017). Garrison and Handley (2017) proposed the idea that unconscious thought can be rational. Dijksterhuis and Strick (2016) recognized the need for additional research to more fully explicate and confirm the concept of unconscious thinking, yet advocated for consideration of a slow Type 3 mode of processing characterized by both periodic conscious and unconscious periods that organize and assess importance and relvance of information.

Croskerry's universal model of diagnostic reasoning. As previously discussed, Croskerry (2009, 2013) proposed a universal dual process model to understand clinical decision-making in medicine. Croskerry's integrated model of clinical or diagnostic reasoning is intended to provide a framework to understand the clinical reasoning that underlies components that constitute the diagnostic process (Croskerry, 2009; Croskerry et al., 2017). Some of the intuitive and analytical approaches used to make decisions have been discussed (Croskerry et al., 2017; Garrison & Handley, 2017; Hughes &

Nimmo, 2017; Kahneman, 2013). Croskerry's model includes the principal characteristics of Type 1 processes as low awareness, high automaticity, fast processing, associative, low effort, high capacity, low reliability, and error prone with risk for cognitive bias (Croskerry, 2009; Evans, 2013). Type 2 processing is described as high awareness and control, rule based, high effort, low capacity, high reliability with rare errors, and normative reasoning (Croskerry, 2009; Evans, 2013).

In addition to the characterized cognitive styles of Type 1 and Type 2 processes, Croskerry's linear model begins the process with the input of the patient's presenting symptoms to the decision maker (Croskerry, 2009). If the decision maker recognizes the disease, the fast, automatic Type 1 processes are enlisted to make a diagnosis (Croskerry, 2009). The reflexive, unconscious process is triggered to recognize patterns, which have occurred through prior Type 2 learning (Croskerry, 2009). Type 1 responses can extend beyond pattern recognition and may include other responses occurring at the same time (Croskerry, 2009; Croskerry et al., 2013). Croskerry's model includes incorporation of four categories of Type 1 processes that provide context for simultaneously generated parallel responses (Croskerry et al., 2017). The four subgroups of intuitive Type 1 processes described by Stanovich are hard-wired processes, emotional processes, over-learned processes, and implicitly acquired processes (Croskerry et al., 2013, 2017).

The first intuitive category is hard-wired processes or evolutionary adaptations that include instinctive heuristics that may induce biases of anchoring and adjustment, representativeness, availability, search satisficing, and overconfidence (Croskerry et al., 2103, 2017). The second category is emotional processes that can be acquired or learned, or the evolved adaptations of happiness, sadness, fear, surprise, anger, and disgust

(Croskerry et al., 2013, 2017). Over-learned processes constitute the third category where processes can become firmly embedded in thinking and behaviors (Croskerry et al., 2013, 2017). Explicit cultural and social habits, as well as those associated with specific knowledge domains, are included in this category (Croskerry et al., 2013, 2017). Implicitly acquired processes is the fourth subgroup of Type 1 processes and refers to learning that occurs without intent or conscious awareness (Croskerry et al., 2013, 2017). Implicit learning can play an important role in skills, perceptions, attitudes, and behavior and may result in unconscious acquisition of biases (Croskerry et al., 2013, 2017). Croskerry et al. (2013) indicated the automatic Type 1 processes are more vulnerable to bias and suboptimal decision-making.

If the patient presentation is not recognized by Type 1 processes, the slower, analytical Type 2 processes are engaged instead (Croskerry, 2009). Diagnosis is made via objective use of accepted rules of logic and reasoning (Croskerry, 2009). Type 2 processing typically consists of clearly defined steps, is not characterized by heuristics or an affective component, but instead, is more reliable and typically error and bias free (Croskerry et al., 2017).

Modifiers of the process. In practice, Type 1 and Type 2 processes may interact with each other to synthesize information to make a diagnosis (Croskerry, 2009; Croskerry et al., 2017). An initial presentation may have a characteristic recognizable pattern but has atypical features where the decision maker responds to Type 1 processes yet is able to monitor the Type 1 response (Croskerry, 2009; Croskerry et al., 2017). Interaction of Type 1 and Type 2 processes results in engagement of Type 2 processes to rationally override Type 1 to deliberately and consciously process the information

(Croskerry, 2009; Croskerry et al., 2017). If the result of Type 2 processing is negative, thinking might revert back to Type 1 processing (Croskerry, 2009; Croskerry et al., 2017). Croskerry et al. (2017) indicated balance between the two processing approaches is likely ideal for practitioners.

When the monitoring step is forced and allows the decision maker to reflect on what is happening in the clinical situation, there is an ability to override faulty thinking or use of heuristics, which may lead to a diagnostic error and poor patient outcome (Croskerry, 2009). Metacognition, or the ability to reflect and examine one's own thinking, can be critical in leading to a rational override and calibration of the thinking and reasoning process (Croskerry, 2009). Croskerry et al. (2017) further elaborated on the importance of metacognition in decision-making by stating metacognition may be among the most desirable skills in optimizing diagnosing. The ability to self-regulate, self-monitor, and reflect as components of metacognition is proposed as a framework for physicians to gain insight into the myriad of factors that influence decision-making (Croskerry et al., 2017).

In contrast, Type 1 processing may override the reasoning of Type 2 (Croskerry, 2009; Croskerry et al., 2017). The decision maker may choose to override the rational approach and follow intuition even knowing the best choice to make is one driven by evidence and has been validated (Croskerry, 2009; Croskerry et al., 2017). The departures from the rational approach are not uncommon in clinical decision-making and result from a variety of influences including ego, fatigue, cognitive biases, emotion, overconfidence, personality, and self-deception (Croskerry, 2009; Croskerry et al., 2017).

Croskerry's model is characterized by analytical skills in Type 2 processing that

are largely acquired through training, domain specific experience, and extensive knowledge (Croskerry et al., 2017). Effective reasoning in Type 2 processing is also characterized by good critical thinking skills and effective calibration that has occurred through years of consistent feedback from clinical decision-making (Croskerry et al., 2017). Rationality is the primary driver of Type 2 processing and is thought to be responsible for the ability to calibrate thinking required to make quality diagnostic decisions (Croskerry, 2017; Croskerry et al., 2017).

Rationality. Due to the incidence of medical decision errors and the resultant increase in death and healthcare costs, there has been an increased emphasis on improving clinical decision-making (Djulbegovic & Elqayam, 2017; Stark & Fins, 2014). Rationality, or making more rational decisions, has emerged as a relevant concept in medicine and healthcare (Croskerry, 2017; Djulbegovic & Elqayam, 2017). Croskerry (2017) stated rationality is the most important characteristic of the skilled decision-maker. The definition of rationality has been debated in medicine and cognitive sciences, with a general agreement that rational decisions should be logical, evidence based, and follow the principles of probability and science (Croskerry, 2017).

Stanovich (2013) has been influential in the debate describing an approach that defines factors which deter from rationality. Dysrationality was coined by Stanovich to describe factors that jeopardize rational thought (Croskerry et al., 2017). In outlining dysrationality, Stanovich (2013) discussed processing and content as the two areas where problems occur (Stanovich, 2013). Stanovich (2013) described the main issue in processing as when the brain operates as a cognitive miser. The cognitive miser has a strong predisposition to use the least possible effort to engage in problem solving and

decision-making (Kahneman, 2013). The tendency to reduce cognitive work increases the risk of biases and making decision with insufficient information (Kahneman, 2013). Content is the second area in Stanovich's model of dysrationality where problems occur and lies with intrinsic properties of brain function that are inherited or learned (Stanovich, 2013). Mindware has been termed to describe the software or intrinsic properties of how the brain processes and retrieves information (Croskerry, 2017). Processing requires deliberate thinking, or metacognition, during experiences and acquisition of knowledge (Croskerry, 2017). According to Stanovich (2013), problems with mindware appear when there are gaps or contamination of the intrinsic properties of brain function.

Gaps in mindware include issues with scientific thinking; adequacy or availability of knowledge; or the specific rules, strategies, or procedures necessary to perform the task and commonly occur due to lack of experience or knowledge (Stanovich, 2013). Of significance to the issue of cognitive errors in healthcare decision-making is the contamination of mindware, which is characterized by problems of bias as well as faulty or irrational reasoning and thinking (Croskerry, 2017). Failure in thinking due to issues in both mindware gaps and contamination can lead to inhibition of rational thought (Croskerry, 2017; Stanovich, 2013). Knowledge of the extent of awareness and access to cognitive processes can facilitate rationality and potentially alter decision-making (Croskerry, 2017; Nisbett, 2015).

Critical thinking. Critical thinking is essential to rational thinking and decision-making (Croskerry, 2017). Critical thinking is deliberate, intentional, self-monitoring, includes higher order mental abilities, self-reflection, and mindfulness or awareness (Foundation for Critical Thinking, n.d.; Huang et al., 2014; Stark & Fins, 2014).

Metacognition, or thinking about thinking, is often used interchangeably with critical thinking and can be extended to include specific attributes that are important in cognitive performance and rational thinking (Stark & Fins, 2014). The mindware gap of contamination is characterized by bias, along with faulty reasoning and thinking, or a lack of critical thinking (Croskerry, 2017).

Metacognition. As previously stated, improved thinking about thinking, or metacognition, is a strategy to promote reflection in practice (Croskerry, 2017). The metacognitive traits of reflection and insight are strategies that increase awareness and enable one to recognize and evaluate performance or thinking, followed by calibration (Croskerry, 2017; Stark & Fins, 2014). The ability to recognize cognitive biases and flaws in thinking can improve rational thinking and ultimately decision-making (Croskerry, 2017)

Reflection. The metacognitive trait of reflection may be a required trait for competent reasoning and rational decision-making (Croskerry, 2017). Reflection supports the attainment of effective mindware (Croskerry, 2017). As a component of self-regulation, the ability to reflect during and after a task can assist in both the recognition of faulty performance and thinking and can support strategies to improve rational decision-making (Croskerry, 2017; Zimmerman, 2008).

Thinking and diagnostic failure. Diagnosis is at the core of medicine and healthcare (Croskerry et al., 2017). Skills required of an effective diagnostician are essential to success in diagnosing and treating patients (Croskerry et al., 2017). Clinical reasoning and the underlying cognitive mechanisms are fundamental to the diagnostic process and lead to patient safety and improved patient outcomes (Croskerry et al., 2017).

Understanding of disease and the required approaches necessary to make an accurate diagnosis have improved, but are still inadequate (Croskerry et al., 2017). In 2000, the Institute of Medicine (IOM) report *To Err is Human: Building a Safer Health System*, increased awareness of the significance of diagnostic error in patient safety (Balogh et al., 2015). Considerable conversation and study in medicine and the health sciences literature regarding patient safety resulted from the IOM report with diagnostic error receiving less attention, despite relevance to the overall detriment to the patient (Thammasitboon, Thammasitboon, & Singhal, 2013). However, a significant number of individuals have since studied diagnostic errors, increasing the knowledge regarding incidence and causes (Croskerry et al., 2017; Graber et al., 2005; McDonald et al., 2013; Norman et al., 2017; van den Berge & Mamede, 2013).

The follow-up IOM report, *Improving Diagnosis in Health Care*, specifically recognized and highlighted diagnostic error as a critical form of error in health care (Balogh et al., 2015). The follow-up report reiterated there had been insufficient attention paid to investigation of diagnostic error over the 15 years since the release of the initial IOM report (Balogh et al., 2015). The new IOM report published in 2015, recognized that sparse data on diagnostic error, few reliable measures, and difficulty in identifying mistakes at the time of occurrence, present challenges in fully appreciating the significance of diagnostic failure (Balogh et al., 2015). Challenges exist in defining exactly what establishes a diagnostic error, or the related terms: delayed diagnosis, missed diagnosis, or misdiagnosis (Balogh et al., 2015; Croskerry et al., 2017). Diagnostic error was broadly defined in the 2015 IOM report as "the failure to establish an accurate and timely explanation of the patient's health problem…" (as cited in Balogh

et al., 2015, p. S-2). The operational definition of a diagnostic error given by Graber et al. (2005) is "a diagnosis that was unintentionally delayed, wrong, or missed…" (p. 1493). A general definition of diagnostic error is "if the diagnosis is incorrect or does not fully address the patient's problem…" (Thammasitboon et al., 2013, p. 228).

Despite challenges in identifying diagnostic errors, most Americans are at risk for experiencing a potentially devastating misdiagnosis or diagnostic error in their lifetime (Balogh et al., 2015). According to the 2015 IOM report, estimates for diagnostic error range from a conservative low of 5% in outpatient care up to 17% in hospitals (Balogh et al., 2015). Croskerry et al. (2017) indicated the occurrence of diagnostic care is widespread in healthcare settings, including emergency departments, in-patient/hospital areas including intensive care units, outpatient settings, and specialty clinics.

While there are several causes for error in the diagnostic process including lack of coordination of care, inadequate communication, the health care system, technologies, and tools (Balogh et al., 2015), Croskerry et al. (2017) indicated the most likely reasons for diagnostic errors originate from inadequate knowledge and flaws in thinking and reasoning, a failure in the clinician's cognitive processing. Hughes and Nimmo (2017) briefly described five types of errors in the diagnostic process that can result in diagnostic failure. The five types of errors are fault errors, system errors, errors due to knowledge gaps, errors resulting from use, misuse and not understanding results of diagnostic tests, and cognitive errors (Hughes & Nimmo, 2017).

Cognitive errors which account for most of the diagnostic errors, can occur in either Type 1 or Type 2 thinking but are most associated with the Type 1 mode (Croskerry et al., 2017). Most biases, fallacies, and failures in thinking originate in Type

1 or intuitive processing (Croskerry, 2013). While suboptimal decision-making due to bias is thought to appear primarily in Type 1 processes, bias also occurs in Type 2 processes due to purposeful analytic application of accepted flawed rules or strategies (Croskerry et al., 2013).

In a classic study, Graber et al. (2005) examined the incidence of diagnostic errors in 100 cases identified through autopsies, malpractice claims, quality assurance studies looking at diagnostic testing audits, and voluntary error-reporting systems. Each case was evaluated to identify the contribution of system-related, no fault, and cognitive factors to diagnostic error (Graber et al., 2005). Results of the study showed that of the three categories of errors, cognitive errors were present in 74 of the 100 cases, suggesting that errors in clinical reasoning and thinking were primary drivers of diagnostic errors (Graber et al., 2005). The authors concluded the most common cause of cognitive errors was in faulty synthesis of information available (Graber et al., 2005). The most common cognitive biases identified were premature closure and failure to consider possible diagnostic alternatives (Graber et al., 2005). Additional cognitive issues included errors from the use of heuristics, overestimating or underestimating usefulness of a finding, and faulty detection of a sign or symptom (Graber et al., 2005). Croskerry et al. (2017) discussed that the overall research findings regarding medical diagnostic error point to increased cognitive errors in situations where there is a high level of uncertainty or complexity, when there are unusual or ambiguous presentations, or when patients are new to the practitioners.

The study by Graber et al. (2005) reinforces the concept that errors in cognition or inadequate skill in cognition is common and more prominent than errors related to

deficits in knowledge. While errors in the processing biases are reported to be more strongly associated with the intuitive or Type 1 thinking mode, assigning diagnostic errors related to cognitive biases to one kind of thinking mode may limit the ability to understand how biases influence thinking and diagnosing (Croskerry et al., 2017). Common cognitive biases were identified and defined by Kahneman and Tversky in the 1970s (Kahneman, 2013). To appreciate the influence of diagnostic errors in medicine and the contribution of cognitive errors and biases, it is important to have a basic understanding of some of the more common examples of biases (Croskerry, 2014; Croskerry, 2017; Saposnik, Redelmeier, Ruff, & Tobler, 2016).

Common cognitive biases include availability, base rate neglect, conformation bias, premature closure, and representativeness (Croskerry et al., 2017; Saposnik et al., 2016). Availability is the tendency to judge diagnoses as more likely if they easily come to mind, and base rate neglect is the tendency to ignore the true rate of disease and to pursue unusual diagnoses (Croskerry et al., 2017). Confirmation bias is the leaning to seek data to confirm, not refute, the diagnosis, while premature closure is the tendency to stop too soon and not order the critical test or gather the necessary information to make a diagnosis (Croskerry et al., 2017). Representativeness is the propensity to be guided by usual features of disease and miss the irregularities (Croskerry et al., 2017).

Becoming alert to bias influence requires maintaining vigilance and mindfulness of one's own thinking (Croskerry, 2017; Croskerry et al., 2017). Once bias is identified, a deliberate decoupling from the intuitive mode is required to engage the analytic mode. Analytic processing involves retrieving the rules, procedures, strategies, and knowledge from memory to aid in the decision-making process (Stanovich, 2013). The ability to

recognize bias is dependent on critical thinking where there is engagement in purposeful, self-regulatory use of judgment using Type 2 processing (Croskerry et al., 2017). The ability to engage Type 2 processing is referred to as metacognition and self-reflection (Croskerry, 2013). The ability to engage Type 2 processing via monitoring the unconscious output of the unconscious Type 1 processing can result in a rational approach to problem solving that leads to reduction in the influence of cognitive biases (Croskerry et al., 2017).

Reasoning in Experts and Novices

Making a diagnosis is central in medicine and allied health disciplines and is accomplished by the cognitive process of clinical reasoning (Croskerry et al., 2017; Turpin & Higgs, 2017). Diagnosis requires knowledge, skill, and experience in problem-solving to enable the clinician to provide safe, high-quality care (Pinnock & Welch, 2014). Problem-solving ability is dependent on two kinds of knowledge, declarative and procedural (Pinnock & Welch, 2014). Declarative knowledge is learned from lectures, texts, in discussion with peers and teachers, and procedural knowledge is acquired by experience, coaching, direction, and feedback provided by others (Pinnock & Welch, 2014). In addition to the knowledge skills, clinical reasoning is dependent upon solid cognitive processes or thinking skills (Croskerry et al., 2017). Deliberate practice is essential to the development of any skill, including clinical reasoning (Benner, 2004; Norman, 2005). It is not enough to simply have knowledge; the skilled practitioner must be able to reason and make valued judgments and decisions with the acquired knowledge (Benner, 2004; Croskerry et al., 2017; Norman, 2005).

Clinical reasoning is acquired over time with deliberate practice and knowledge accumulation; however, it is dependent upon specific content knowledge and experience in a particular area or domain (Benner, 2004; Croskerry et al., 2017; Norman, 2005). It is recognized there are no generic problem-solving skills and the progression from novice to expert is context specific and poorly transferrable to other situations, areas, or domains (Benner, 2004; Dreyfus & Dreyfus, 1980; Norman, 2005; Schmidt & Mamede, 2015). Croskerry et al. (2017) noted physicians with a particular specialty is defined as narrowed and focused, exhibit higher levels of expertise and rates of success. The expert is characterized as one who has sufficient knowledge and experience specific to a domain and can apply the skills intuitively, while also able to recognize the need to call on the analytical or rational thinking modes when the situation is unusual, complex, or uncertain (Benner, 2004; Brush et al., 2017; Dreyfus & Dreyfus, 1980). It is generally agreed that expert clinical reasoning progresses through stages related to the accumulation of experience with specific clinical problems (Benner, 2004; Brush et al., 2017). Skylar (2014) differentiated the experts from those who are experienced, but lack real expertise, as having the skill to identify ill-defined, complex, or nondescript problems, and recognizing the need to have a different approach than the one used in typical pattern recognition situations.

The experienced clinician typically uses quick, unconscious reasoning processes to diagnose and solve clinical problems (Croskerry, 2009). According to Norman (2005), expert practitioners are more skilled at clinical reasoning than novices because they have knowledge networks that are readily available to use when diagnosing problems. The extensive experience that over time results in knowledge networks enables the expert to

rely on intuitive processes to a greater extent than novices (Norman, 2005). The intuitive approach depends on categories of previous experience and relies on the recognition of patterns occurring largely at an unconscious level (Brush et al., 2017; Croskerry et al., 2017).

As experienced clinicians gather data from and about the patient, they are able to construct abstract summaries by using previously learned illness scripts (Norman, 2005). The illness scripts contain knowledge of diseases, conditions, or syndromes relevant to the present problem (Croskerry et al., 2017; Norman, 2005). The expert then makes comparisons with diseases that have similar presentations to further confirm the diagnosis (Croskerry et al., 2017; Norman, 2005). Norman (2005) recognized the existence of experience-based knowledge, characterized by rapid retrieval of similar past situations, and contrasted this knowledge to the comprehension or understanding represented in analytical processing. It is thought that exposure to a variety of problems is important to create mental models and patterns, and reinforces understanding of disease mechanisms and the construction of illness scripts that link information to describe a presentation (Brush et al., 2017; Norman, 2005; Schmidt & Mamede, 2015; Skylar, 2014). In uncomplicated and routinely encountered problems, the expert relies on the intuitive, pattern-based reasoning, yet is also able to call on additional domain specific knowledge and experience when problems are more complex and rare (Brush et al., 2017; Norman, 2005).

When experienced clinicians encounter unfamiliar problems where they have had no similar experience, they often consult analytical reasoning and their knowledge from the basic sciences to understand and diagnose the problem (Brush et al., 2017: Norman,

2005; Skylar, 2014). Because novices have less experience, they rely on and use analytical processing to reason and are less reliant on intuitive processing (Hughes & Nimmo, 2017; Norman, 2005). The novice can look for additional information acquired through past learning and experience, follow available rules, carefully process data, and deliberately make a diagnostic decision (Tay et al., 2016). To reach a diagnosis, the novice typically follows a slow, deliberate, analytic approach that depends upon a basic understanding of pathophysiology (Skylar, 2014). The existence of few illness scripts for the novice results in consideration of many more potential diagnoses to rule in and rule out (Hughes & Nimmo, 2017). As novices gain experience, they increase the use of illness scripts and become more reliant on intuitive processes to generate possible diagnoses (Brush et al, 2017; Croskerry et al., 2017). As pattern recognition is established, the sense of what signs to look for and what steps to take becomes established (Benner, 2004; Dreyfus, 2004).

It is recognized that clinical reasoning is a process dependent upon the context and situation and diagnosing is not accomplished by use of only intuitive or analytical processing, but that both modes of thinking are required (Croskerry et al., 2017). Flexibility, adaptability, and combining multiple strategies to solve clinical problems characterize expert clinicians (Croskerry et al., 2017). Key to skilled intuitive decision-making is extensive domain specific knowledge and experience (Croskerry et al., 2017). Expertise is dependent upon deliberate practice where context and patient problems are varied and of significant volume over time (Norman, 2005; Pinnock & Welch, 2014). Consistent feedback is also important to facilitate the transfer of foundational knowledge

and to ensure an adequate experiential knowledge base (Hughes & Nimmo, 2017; Pinnock & Welch, 2014; Schmidt & Mamede, 2015).

It is unclear how the expert recognizes that a problem does not align with the typical problem presentation and there is a need to switch from one mode of thinking to another (Norman, 2005; Schmidt & Mamede, 2015). A possible explanation is the use of reflection, when the practitioner is able to increase awareness of the situation and recognize the atypical problem presentation (Schmidt & Mamede, 2015). Feedback on decision-making processes include thinking about thinking, or a metacognitive component ,and appear to be important contributors to expert intuition (Monteiro & Norman, 2013; Stark & Fins, 2014). Croskerry et al. (2017) argued reflective competence is required to monitor and modify output from the unconscious or intuitive mode of thinking. The ability to reflect on one's own unconscious competence is foundational to the rational thinker and can lead to identification of cognitive biases and faulty thinking (Croskerry et al., 2017).

Summary

Because clinical diagnostic reasoning is important in healthcare and specifically in nutrition, it is important to understand skill acquisition, dual process, and self-regulation theories to establish a framework to explain how decisions are made in practice (Lambe et al., 2016). Skill acquisition, dual process, and self-regulation theories illustrate the ability to self-regulate behavior by increased reflection and insight and may influence the thinking processes used to make clinical decisions (Benner, 2004; Croskerry et al., 2017; Zimmerman, 2008). The concepts of critical thinking, clinical reasoning, and clinical judgment as related to diagnosing were discussed to understand

the foundational skills required to make good clinical decisions. Frameworks for thinking, reasoning, and decision-making were investigated, along with a discussion of the characteristics and principles of the dual process approach to clinical decision-making and diagnosing. The concept of rationality as the preferred cognitive process in decision-making, the incidence of, and factors that influence diagnostic failure, along with reasoning in experts and novices was discussed.

In Chapter Three, the methodology applied to the study is described. Included in the chapter are an overview of the problem and purpose, research questions and hypotheses, research design, population and sample, instrumentation, and data collection procedures. The processes involved in analyzing the quantitative and qualitative data are presented.

Chapter Three: Methodology

The explanatory, sequential mixed methods research design is outlined in this chapter, along with the population and sample used in the study. The two survey instruments used to gather quantitative data, the SRIS and the REI-40, are described, as well as the qualitative focus group approach. Data collection methodology and analysis, including the statistical analyses used to answer research questions, are outlined. Finally, safeguards used to protect and assure confidentiality and anonymity of subjects and data gathered are discussed.

Problem and Purpose Overview

Critical thinking and reasoning are important skills in dietetics and nutrition practice (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004; Trostler & Myers, 2008). RDNs utilize a nutrition care process to identify nutrition-related health concerns where critical thinking skills are essential to ensure accuracy in nutrition assessment and diagnosing (Charney & Peterson, 2013). However, little is known about the progression of critical thinking skills among this population nor has the exact nature of critical thinking and reasoning been defined in this area (Charney & Peterson, 2013; Goodman et al., 2018).

Gates and Amaya (2015) discussed the need for self-assessment based on self-reflection as components required by dietitian nutritionists to maintain personal practice competence. Self-reflection along with self-regulation and insight are concepts largely undeveloped in dietetic practice and education (Gates & Amaya, 2015). While Pender and de Looy (2004), from the United Kingdom, described the need to reflect on the

nutrition assessment process, similar studies evaluating reflection have not been found in the United States.

Ongoing advances in technology and the healthcare workplace require dietitian nutritionists to possess critical thinking skills to identify and solve complex patient problems (Andersen et al., 2018; Brody et al., 2014; Charney & Peterson, 2013; Pender & de Looy, 2004; Trostler & Myers, 2008). As a result, there is an urgency for the development of these skills in dietetic education and the need to describe the skills of practicing professionals (Andersen et al., 2018; Trostler & Meyers, 2008). It is important to understand the practice concepts of self-reflection, insight, and critical thinking to ultimately understand the quality of thinking and clinical decisions in dietitian nutritionist practitioners (Croskerry et al., 2017).

The purpose of this explanatory, sequential mixed methods study was to evaluate reflection, insight, and thinking styles and investigate the possible relationship among these variables in graduates of a 10-month DI and of a 22-month combined nutrition diagnostics MND/DI. The intent of the study was to also investigate the possible relationship in the SRIS scores and the REI-40 scores between the DI and MND/DI groups. Then, also explored were the perceptions regarding the nutrition diagnostic process in a group of students nearing graduation from the 2018 MND/DI cohort. Investigation of the how reflection, insight, and thinking styles are different between the DI and the MND/DI graduates contributes to understanding, thinking, and clinical reasoning in graduates who have used an advanced practice approach to nutrition diagnosing in their post-baccalaureate training required to become RDNs. Because little is known about how graduates view their educational experiences, it was also important

to understand how graduates regard their educational experience in relation to their ability to diagnose nutritional problems (Palermo et al., 2017a; Pender & de Looy, 2004).

Research Questions and Hypotheses Statements

1. What difference, if any, exists between the Self-Reflection and Insight Scale (SRIS) reflection scores of graduates of a 10-month Dietetic Internship (DI) and graduates of a 22-month Master of Science/Dietetic Internship (MND/DI) program?

. $H1_0$: There is no significant difference in the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H1_a$: There is a significant difference in the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

2. What difference, if any, exists between the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H2_0$: There is no significant difference in the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H2_a$: There is a significant difference in the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

3. What difference, if any, exists between the Rational-Experiential Inventory-40 (REI-40) of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H3_0$: There is no significant difference in the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H3_a$: There is a significant difference in the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

4. Are SRIS reflection and insight scores correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program?

$H4_0$: The SRIS reflection and insight scores are not correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

$H4_a$: The SRIS reflection and insight scores are positively correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.

5. How do students who are nearing completion of an MND/DI program perceive the process of making a nutritional diagnosis?

Research Design

The aim of the explanatory, sequential mixed methods study was to triangulate information from qualitative and quantitative data to draw on the strength of both methods to help understand the complex issue of clinical reasoning and decision-making in dietetics and nutrition practice (Creswell, 2014; DePoy & Gotlin, 2016; Guetterman, Fetters, & Creswell, 2015). According to DePoy and Gotlin (2016), the use of more than one explanatory method can expand knowledge. Many unanswered and challenging issues in health cannot be addressed by the quantitative method alone, and the process can be strengthened by using an integrated approach (Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016). Creswell and Plano Clark (2018) indicated it is optimal for studies to draw upon one or more theoretical approaches. Mixed methods research design can be used to inform all phases of the study and provide opportunities for the

integration of data from different types of methodologies (Creswell & Plano Clark, 2018). Purposeful selection of design methods can complement the other and contribute to the overall understanding of the research questions (Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016).

Evaluation of reflection, insight, and thinking styles in dietetic practice was used to uncover information not previously reported (DePoy & Gotlin, 2016). As discussed by DePoy and Gotlin (2016), when the level of understanding about the area of interest is poorly understood, the study can benefit from both methods of inquiry. The SRIS and the REI-40 provided objective measures of reflection, insight, and thinking styles, while the focus groups added subjective perspective to further explore research questions (Boswell & Cannon, 2017; Grant et al., 2002; Pacini & Epstein, 1999).

A significant influence on the study design was the context within which the study was conducted (Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016). Due to the nature of the study, only samples of convenience were available, which limited sample numbers (Polit, 2010; Polit & Beck, 2016). Given the practical consideration of challenges in access to a large sample size, the mixed method approach assisted in increasing knowledge gained over the use of only the quantitative method (Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016).

The mixed methods research approach integrates strategies from both quantitative and qualitative methods in a single study, or in a multiphase series of studies, to collect and analyze data (Creswell, 2014; Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016). A mixed methods study allowed follow up to a quantitative study with a qualitative method to obtain more detailed, specific information and expand the results of

statistical analysis of the data (Creswell, 2014; Creswell & Plano Clark, 2018). Drawing on both objective numbers in quantitative methods and subjective knowledge gained in qualitative methods, allowed blending of perspectives to provide insight that may not otherwise be realized (Boswell & Cannon, 2017).

An explanatory, sequential mixed methods design, also known as a two-phase model, was the mixed methods approach used in this study (Creswell, 2014; Creswell & Plano Clark, 2018). The first collected were the quantitative data, followed by collection of qualitative data that helped explain and elaborate on the quantitative results (Creswell, 2014). As described by Creswell (2014), in the explanatory, sequential approach, quantitative results provided a broad picture of the research problem, while qualitative data collection helped refine, extend, and explain the broader picture. Obtaining quantitative results from a population in the first phase, followed by exploring the findings through the in-depth qualitative approach in the second phase, used the best of both quantitative and qualitative data (Creswell, 2014).

Quantitative data were prioritized and of greater weight than qualitative data (Boswell & Cannon, 2017; Creswell, 2014). Exploration of the quantitative data was emphasized more in the study purpose and received the most attention in the collection and analysis process (Boswell & Cannon, 2017; Creswell, 2014). Qualitative data served to explore results of the quantitative data in terms of differences between groups, and further explained data from individual perspectives and views (Boswell & Cannon, 2017; Creswell, 2014).

Due to the exploratory nature of the research questions, the quantitative approach was used to determine statistical differences between the concepts of reflection, insight,

and thinking styles in the two groups of dietetic practitioners: graduates of a 10-month DI and a 22-month MND/DI. The validated survey instruments, SRIS and REI-40, were scored using Likert scales. The lack of knowledge about characteristics of reflection, insight, and thinking styles in dietitian nutritionists established appropriateness of the qualitative method was useful in exploring topics about which little is known (Creswell, 2014; Creswell & Plano Clark, 2018; DePoy & Gotlin, 2016). Further, qualitative methods were useful in exploring perspectives of individuals in relation to their experiences (DePoy & Gotlin, 2016). Thus, a qualitative approach was selected because the researcher desired to explore perspectives and experiences of program graduates based upon their own first-person perspectives of clinical training (Creswell, 2014). According to Creswell (2014), data provided information relevant to the context of where experiences occurred and meanings of those experiences.

Population and Sample

The population setting for this study was a single purpose, private Midwest health science college. The institution is a private college of over 900 students with programs in Medical Billing and Coding, Associate of Science in Medical Assisting, Associate of Science in Radiography, Bachelor of Science in Diagnostic Imaging, Associate of Science in Nursing, Bachelor of Science in Nursing, Master of Science in Nursing, Master of Science in Nutrition Diagnostics, and Master of Science in Occupational Therapy. The college was selected because the institution has offered a DI program and currently offers a MND/DI.

The programs of particular interest for this study were the 10-month DI offered since 2006, and the 22-month MND/DI, established in 2013. The DI and MND/DI utilize

an advanced practice approach to nutrition diagnostics developed by Kight (Sandrick, 2002). Kight's advanced practice approach to nutritional diagnosing is an evidence-based ruling out and ruling in of nutritional health-related problems dietitian nutritionists are uniquely qualified to identify and process (Sandrick, 2002). The nutrition diagnostics approach to clinical nutrition practice utilized by both programs is the only programmatic approach of this kind accredited by the Accreditation Council for Education in Nutrition and Dietetics (ACEND) of the Academy of Nutrition and Dietetics (AND) (ACEND, n.d.).

Quantitative. In this study, a purposive sample was used to recruit participants. Fraenkel et al. (2014) stated researchers can use their knowledge of the population to determine whether a sample will be representative. Creswell (2014) also indicated purposive sampling techniques are used to intentionally select individuals and study sites to learn or understand the research study questions. Graduates of the 10-month DI and the 22-month MND/DI were the chosen population from which participants were recruited. Sample graduates were recruited because of their educational experience in diagnosing nutrition problems using Kight's advanced practice Nine-Step Nutrition Care Process.

Graduates of the 10-month DI have completed a baccalaureate program in dietetics or a related field and have completed all ACEND requirements prior to being eligible for admission into the DI. The program provided supervised practice experiences designed to meet the minimum standards for competence as outlined by ACEND (2018) for entry-level practice. The minimum number of supervised practice hours, 1,200 required by ACEND (2018), was exceeded in the DI by provision of 1,500 hours. All

graduates of the DI were working and are credentialed by the Commission on Dietetic Registration to work as RDNs in the United States. The DI graduates completed the programs in the years 2010, 2011, or 2012. Student numbers in the DI group totaled 30.

Graduates of the 22-month MND/DI also completed a baccalaureate program in dietetics or a related field and completed all ACEND requirements prior to being eligible for admission into the DI component of the program. The minimum number of supervised practice hours of 1,200 required by ACEND (2018) was exceeded in the combined program by provision of 1,466 hours. The 44-credit hour MND/DI program spans a 22-month time frame and provides the didactic foundation and advanced coursework required for the clinical practice of nutrition diagnostics.

The coursework in the MND/DI occurs over four full-time, 16-week semesters and an 8-week summer semester. All graduates of the combined 22-month program were working or had completed their final coursework and all assessment requirements of the MND/DI at the institution. Graduates were credentialed, or were ready to be credentialed, by the Commission on Dietetic Registration to work as RDNs in the United States. Graduates of the MND/DI completed the program in the years 2015, 2016, and 2017. The final cohort in the combined program graduated in May 2018. Student numbers in the four cohorts of the combined programs totaled 36 students.

Qualitative. In the qualitative phase, the researcher recruited a smaller, purposive sample of students from the 2016-2018 cohort in the 22-month MND/DI to participate in a focus group. The 2016-2018 cohort was selected as the focus group because the entire cohort was available and still in the region. A purposive sample was selected to provide information desired by the researcher (Fraenkel et al., 2014). The

researcher's choice of participants was based on the judgment that the sample was representative of the larger sample. The 2016-2018 cohort finished all program requirements of the MND/DI at the institution. Program requirements included meeting all ACEND competencies and learning outcomes required by the Commission on Dietetic Registration to take the Registration Examination for RDNs.

Instrumentation

Instruments that measured key variables in this mixed method study included two surveys used to gather quantitative data and directed open-ended questions in a focus group approach that yielded qualitative data. The SRIS and the REI-40 provided objective measures of reflection, insight, and thinking styles (Grant et al., 2002; Pacini & Epstein, 1999). The focus groups added subjective perspective to further explored the research questions (Boswell & Cannon, 2017).

Quantitative instruments. Grant et al. (2002) developed the SRIS to better measure aspects of self-awareness that relate to cognitive flexibility and self-regulation. The SRIS measured two components of self-regulation: self-reflection and insight, where self-reflection is the tendency to think about and evaluate thoughts, actions, and feelings and insight is the clarity of experience and self-knowledge (Grant et al., 2002). The second questionnaire, The REI-40, was developed by Pacini and Epstein in 1999. The REI-40 examined the preference for two decision-making styles: rationality and experientiality (Epstein et al., 1996). Both the SRIS and REI-40 were coded using the Qualtrics Survey software and platform. Data were collected using questionnaires and assisted in understanding the research questions. Each instrument will be discussed in the following sections.

The Self-Reflection and Insight Scale (SRIS). Developed by Grant et al. (2002), the SRIS is a self-administered, 20-item, closed questionnaire, which assesses self-reflection and insight (see Appendix A). Permission was obtained from the developer to use this assessment (see Appendix B). Respondents used a 6-point Likert scale, where 1= strongly disagree to 6 = strongly agree, to rank responses. Twelve items represented both engagement in self-reflection and the need for self-reflection and constituted the subscale of overall self-reflection (Grant et al., 2002). Eight items constituted the subscale of insight (Grant et al., 2002). Examples of self-reflection items include ‘‘I frequently examine my feelings’’ and ‘‘It is important for me to evaluate the things that I do,’’ while ‘‘I usually know why I feel the way I do’’ and ‘‘I’m usually aware of my thoughts’’ represent examples of insight items (Grant et al., 2002). Coding for the SRIS consisted of identifying 12 questions that represented the self-reflection subscale and the eight questions that represented the insight subscale (Grant et al., 2002). Questions were randomized and responses for the negative-worded questions were reversed scored (Grant et al., 2002). A score for each component of the questionnaire was calculated as follows: a) overall self-reflection: engaging in self-reflection and need for self-reflection, each with a maximum score of 36, equaling a total maximum possible score of 72, b) insight maximum possible score of 48 (Grant et al., 2002). A higher score indicates a higher level of self-reflection and/or insight (Grant et al., 2002).

Reliability and validity. Content validity for the SRIS was established by Grant et al. (2002), where Cronbach’s α for internal consistency for self-reflection was .71 to .91 and .82 to .87 for insight. Roberts and Stark (2008) validated the SRIS with medical students using a factor analysis that showed all items with good fit to the data, while

subscales demonstrated good internal reliability at greater than 0.8. Grant et al. (2002) established test-retest reliability (r = .75 to .77).

The Rational Experiential Inventory-40 (REI-40). The REI-40 is a questionnaire that includes two independent constructs which measure the ability to use, and preference for, two types of decision-making: experiential, Type I, and rational, Type II (see Appendix C) (Pacini & Epstein, 1999). Use of the REI-40 is open for research purposes as long as the original paper and researchers are cited (see Appendix D). Both dimensions of the REI, the rational dimension, or REI-R and the experiential dimension, or REI-E, are measured with 20 items (Pacini & Epstein, 1999). Respondents score each item on a 5-point Likert scale, from 1 = definitely false to 5 = definitely true (Pacini & Epstein, 1999).

In each dimension, 10 questions assess the ability to use the style, and 10 questions assess the favorability toward a style (Pacini & Epstein, 1999). Each item requires users to reflect on perceived ability or enjoyment associated with the following rational or experiential decision-making activities (Epstein et al., 1996). Examples of rational items are “I have a logical mind” and “I enjoy intellectual challenges, while “I believe in trusting my hunches” and “I tend to use my heart as a guide for my actions” are examples of experiential items (Epstein et al., 1996). Coding for the REI-40 involved identifying the 10 questions that addressed each of the dimensions: rational ability, rational engagement, experiential ability, and experiential engagement (Pacini & Epstein, 1999). Questions were randomized and responses for the negative-worded questions were reversed scored (Pacini & Epstein, 1999). Summation of the responses from the rational ability and engagement items provide a composite rational score, while

summation of the responses from the experiential ability and engagement items provide a composite experiential score (Epstein et al., 1996). Responses for questions in each of the dimensions of rational ability, rational engagement, experiential ability, and experiential engagement were summed and divided by 10 for the average for each participant for each category (Pacini & Epstein, 1999). Higher scores indicate a greater affinity for the particular style of thinking (Pacini & Epstein, 1999).

Reliability and validity. The REI-40 has been found to be consistent and reliable with a Cronbach's alpha of .74 to .91 (Björklund & Bäckström, 2008; Pacini & Epstein, 1999; Witteman, Van Bercken, Den, Claes, & Godoy, 2009). The REI-40 also has evidence for both divergent and convergent validity (Pacini & Epstein, 1999). More specifically and relevant to this study, examination of the two general constructs of rationality and experientiality, Cronbach's alpha showed evidence of reliability, where rationality ranged from .86 to .91 and experientiality ranged from .87 to .90 (Keaton, 2018).

Qualitative instrument. For the qualitative component of the study used a semi-structured, open-ended question instrument was used to guide the interview process in two focus groups, all with similar didactic and clinical practice experiences (see Appendix E) (Stalmeijer et al., 2014; Wilson, 2016b). Focus group questions were used to investigate participant perceptions regarding their thinking styles and abilities to diagnose nutrition problems. The purpose of using a focus group setting was to explore perspectives of the program graduates in relation to their clinical experiences (Creswell, 2014; DePoy & Gotlin, 2016). Participant interaction within the focus groups stimulated identification and sharing of individual and common perspectives, providing an

opportunity to triangulate the quantitative and qualitative data (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014; Kruger & Casey, 2014; Wilson, 2016a). Participants were recruited from the students in the May 2018 cohort of the 22-month combined MND/DI. The use of pre-existing groups was easier to recruit, had shared and similar experiences, and had a greater level of comfort that facilitated discussion (Stalmeijer et al., 2014).

The semi-structured question format was comprised of a number of key questions directed at the area of exploration (Stalmeijer et al., 2014). The format allowed the participants and the interviewer to provide additional details and to pursue similar ideas (Stalmeijer et al., 2014). The flexibility of the semi-structured approach provided an opportunity for discovery or elaboration of information that was important to participants but was not previously thought of as relevant by the researcher (Stalmeijer et al., 2014). The moderated group discussions were designed to encourage participants to share dialog and elaborate on the topic in a safe and controlled environment (Boswell & Cannon, 2017).

Participants in the focus group were asked questions to address their perceived approaches to thinking as related to making nutrition diagnoses. The participants were also asked to address development of skills in those areas while a student. Data were thematically analyzed (Creswell, 2014; Erlingsson & Brysiewicz, 2013). The proposed focus group questions were aligned with the qualitative research question.

Reliability and validity. Qualitative protocol requires establishment of reliability and validity (Polit & Beck, 2016). Questions were field tested with a group of individuals who were similar to the intended focus group to establish reliability and

validity (Krueger & Casey, 2015). Ensuring reliability of questions consisted of evaluation for readability, flow, and clarity with the intent for questions to be conversational and to elicit intended responses as related to the research question (Fraenkel et al., 2014; Krueger & Casey, 2015). The questions did not change through the series of focus groups to maintain internal validity and consistency, enabling comparison and contrast of patterns and themes that emerged from the data (Krueger & Casey, 2015).

As described by Fraenkel et al. (2014), to ensure reliability and validity, focus group interviews were recorded to compare participant's descriptions, and personal reactions to describe and document the overall content of the interviews. The focus group facilitator was instrumental in maintaining consistency and ensuring the topic was adequately addressed during the session (Boswell & Cannon, 2017). As an additional approach to examine the reliability and validity, interpreted information was compared to data acquired in the quantitative component through triangulation (Fraenkel et al., 2014).

Data Collection

Prior to data collection, permission was received from the participating institution as consent to use the college as the designated site to conduct research (see Appendix F). Study permission was also obtained from both the Lindenwood University and participating institution's Institutional Review Boards (IRB) prior to data collection in spring of 2018 (see Appendices G & H). Permission to conduct the study via approval by the IRB served as a protection for study participants and study data (Boswell & Cannon, 2017).

Data for this explanatory, sequential mixed methods study were collected through two self-administered online surveys, the SRIS and the REI-40, and through interviews using two smaller purposive focus groups (Creswell, 2014). All graduates of the DI program from the years 2011, 2012, and 2013, and the MND/DI from the years 2015, 2016, 2017, and 2018 were emailed a recruitment informational letter. The recruitment letter explained the study purpose and requested participation in the study. All program graduates from the years 2011, 2012, 2013, 2015, 2016, and 2017 received a recruitment letter explaining the study purpose and use of the two surveys (see Appendix I), while the group graduating in 2018, received a letter explaining the study purpose, the use of the surveys and the focus groups (see Appendix J). A total of 66 graduates of the same Midwest college were recruited; 30 graduates from the DI programs and 36 graduates from the MND/DI programs.

Quantitative. The following procedure was used to administer the two surveys, SRIS and REI-40, using the Qualtrics Survey software and platform. In an effort to encourage participation, participants were re-invited two additional times via follow-up emails re-explaining the purpose of the research and the importance of their participation (Polit & Beck, 2016). Informed consent was collected for participation in the surveys (see Appendix K). A nominal system of participant identification was implemented to maintain confidentiality and anonymity (Fraenkel et al., 2014). Graduates who agreed to participate in the study were provided a link for the Qualtrics generated surveys. Data were collected via the Qualtrics secure online survey system and the online analytic reporting service provided results.

Qualitative. Following the collection of the quantitative data, qualitative data were collected to gain a more holistic understanding of the problem (Creswell, 2014). The second phase explored quantitative findings through an in-depth qualitative approach, utilizing focus group interviews (Creswell, 2014). A smaller, purposive sample of 11 individuals from the 2016-2018 cohort in the combined MND/DI program was recruited. Individuals in the 2016-2018 cohort finished all program requirements of the MND/DI at the institution as an eligibility requirement to participate in the focus groups.

The individuals recruited to participate in the focus groups were emailed an informational letter to explain the study purpose, details of surveys, the focus group and request their participation in the study. Consent to participate in the surveys, the focus group, and to be audio-taped (see Appendix L) was obtained. A semi-structured, open-ended question approach was used and designed to interview two focus groups of 5-6 participants each, all with similar didactic and clinical practice experiences (Creswell, 2014; Kruger & Casey, 2014; Stalmeijer et al., 2014; Wilson, 2016b). Adequate in-depth data were generated, and saturation was achieved given the participants' ability to effectively reflect on and communicate their experiences (Polit & Beck, 2016).

To avoid power imbalance and potential difficulties for participants in their ability to be uninhibited in conveying their perspectives and experiences, the researcher was not the facilitator (Stalmeijer et al, 2014). The facilitator was an experienced RDNs faculty member with experience in nutrition diagnostics, who has an understanding of the study purpose (Kruger & Casey, 2014). It is not uncommon for faculty familiar to participants to serve as facilitators and may be advantageous given knowledge and understanding of

the learning experiences (Palermo et al., 2017a). Training for conducting the focus group sessions was provided to the facilitator both verbally and in a written protocol (see Appendix M).

Data Analysis

Quantitative analysis. Inferential analysis methodology is appropriate when research includes two or more variables and when generalizations are to be made regarding the characteristics of one or more populations (Polit & Beck, 2016). A *t*-test is an appropriate methodology when the research is limited to two groups where there are no covariates and test scores are expected to display a normal distribution (Polit & Beck, 2016). The *t*-test, at a level of significance of α at .05, was used to test differences in the group mean scores of the SRIS between the two groups, as well as the REI-40 scores between the two groups (Bluman, 2014; Polit & Beck, 2016).

A bivariate descriptive statistic method, or correlation, is employed when data are examined to demonstrate the relationship between two variables (Polit & Beck, 2016). This study sought to investigate the relationship between reflection, insight, and thinking styles by a group comparison that measures the SRIS and REI-40 scores between graduates of a 10-month DI program and graduates of a 22-month combined MND/DI program using the product-moment correlation coefficient or Pearson's *r* (Polit & Beck, 2016). However, the sample size for both the DI and MND/DI groups was insufficient to prevent risk of a Type II error (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016).

When the effect size for the power analysis, or the population correlation coefficent ρ estimates, are unavailable from prior research, or pilot data, Polit (2010)

recommended to estimate a small-to-medium effect of a ρ of .20, assuming $\alpha = .05$. The estimated ρ of .20 would require a sample size of 194 (Polit, 2010). A sample size smaller than 194 would result in a greater than 20% chance of a Type II error, or not supporting the alternative hypothesis (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016). The sample sizes of 19 and 31 for the SRIS in the DI and MND/DI, respectively, were much smaller than the required sample size for the desired power needed to prevent a Type II error (Polit, 2010). Likewise, sample sizes of 20 in the DI and 33 in the MND/DI for the REI-40 were also insufficient to estimate a small-to-medium effect and sufficiently reduce the risk for a false negative conclusion (Polit, 2010; Polit & Beck, 2016).

Qualitative analysis. An inductive process of narrowing data was used in the analysis of focus group interviews (Creswell, 2014). Data in the focus groups were gathered by a laptop recording of an audio file for each of the two focus group sessions, where each file consisted of interviews transcribed to text (Erlingsson & Brysiewicz, 2013). Digital audio files for each group were uploaded to a web-based transcription company, Trint (2018), for transcription to text. The researcher reviewed and edited each transcribed file. Data from the files for each of the two groups were merged into one Microsoft Word document and organized by questions asked in the focus group sessions. Patterns and themes were identified, coded, and evaluated for relevance to the broader research questions (Creswell, 2014; Erlingsson & Brysiewicz, 2013). Similarities and deviations from the patterns were investigated (Creswell, 2014). Patterns and themes that emerged were related to the quantitative data results (Creswell, 2014; Erlingsson & Brysiewicz, 2013).

Ethical Considerations

The IRB approvals were obtained prior to participation of graduates in the research. Potential participants were informed of the study purpose, their role in the study, and potential benefits, as well as risks (Polit & Beck, 2016). The specific procedures to be followed were outlined, including the maintenance of anonymity and confidentiality of data (Polit & Beck, 2016). Through an online survey, as autonomous agents, students agreed to participate in the research (Polit & Beck, 2016). Online surveys were de-identified, and focus group recordings were shared only with the interviewer and the researcher. Data were stored electronically on a separate USB or data device, and the data device was stored in a locked file. Data will be secured for three years following the completion of this study and will be destroyed.

Summary

The data collection and data analysis process for this research study was outlined in this chapter. A discussion of the use of quantitative versus qualitative research methods was conducted, along with support for the use of an explanatory sequential mixed methods approach (Creswell, 2014). Reliability and validity of research instruments were established with justification for the decision to use the SRIS and REI-40 instruments and focus groups to address the research questions.

The researcher used data received during the data collection phase of the study to determine what, if any, differences in SRIS and REI-40 exist between graduates of a 10-month DI program versus graduates of a 22-month MND/DI program. Results of the study may yield information future researchers might use to determine how metacognitive skills and thinking styles may result in higher critical thinking and

diagnostic skills in dietitian nutritionists. In Chapter Four an analysis of data is presented, findings related to the research questions and hypotheses are reported, and findings are summarized.

Chapter Four: Analysis of Data

This mixed methods study was designed to investigate clinical reasoning and decision-making in dietetics and nutrition practice (Creswell, 2014; DePoy & Gotlin, 2016). Specifically, the study was initiated to evaluate differences between self-reflection, insight, and thinking styles in graduates of a DI and of a MND/DI program. Critical thinking and reasoning are important skills in dietetics and nutrition practice (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004). However, little is known about the critical thinking and reasoning skills in practicing dietitians (Charney & Peterson, 2013; Goodman et al., 2018).

Despite adequate knowledge and good clinical skills, diagnostic error is not unusual in medical practice (Croskerry et al., 2017). Although the rate of diagnostic error is unknown, it is estimated to be in the range of 10% to 15% (Cooper & Frain, 2017). Experts estimate that as much as 74% of diagnostic failures can be attributed to clinician diagnostic thinking failures (Graber et al., 2005). Diagnostic errors reflect the complex interplay of system-related and cognitive factors, typically with multiple root causes (Graber et al., 2005). Cognitive factors are found in the majority of cases (Graber et al., 2005).

Because of the high prevalence of cognitive errors, much attention has been focused on the factors which influence, as well as minimize, these errors (Graber et al., 2005). Interventions to reduce cognitive errors include decision support tools, reflective practices, and training in metacognitive skills to recognize flaws in intuitive thinking (Croskerry, 2017; Croskerry et al, 2013b). Improved metacognition, or thinking about one's thinking, represents a strategy to promote reflection in practice (Croskerry, 2017).

Good metacognitive skills enable one to recognize when performance is not optimal, and then to realistically evaluate and critique one's work, otherwise known as self-regulation (Croskerry, 2017; Zimmerman, 2008). The ability to reliably self-monitor may enhance the ability to acquire knowledge or recognition of specific cognitive errors (Croskerry, 2017).

In this chapter, an analysis of the data are presented, findings related to the study hypotheses are reported, and information is summarized and interpreted. Specifically, data are used to determine what, if any, differences in SRIS and REI-40 exist between graduates of a 10-month DI versus graduates of a 22-month MND/DI program. Both quantitative and qualitative data were used to investigate research questions.

Demographics

The setting for this study was a single purpose, private Midwest health science college. The institution is a private college of over 900 students with programs in Medical Billing and Coding, Associate of Science in Medical Assisting, Associate of Science in Radiography, Bachelor of Science in Diagnostic Imaging, Associate of Science in Nursing, Bachelor of Science in Nursing, Master of Science in Nursing, Master of Science in Nutrition Diagnostics, and Master of Science in Occupational Therapy. The college was selected because the institution has offered a DI program and currently offers a MND/DI.

The programs of particular interest for this study were the 10-month DI program, offered since 2006 and the 22-month MND/DI, established in 2013. In the two-year combined MND/DI, clinical experiences are integrated with a didactic program in clinical nutrition diagnostics. Graduates of the 10-month DI from the years of 2011, 2012 and

2013 and graduates of the MND/DI from the years 2015, 2016, 2017 and 2018 were recruited to participate in the quantitative aspect of the study.

Participants for the qualitative component of the study were recruited from the 2018 cohort of the 22-month MND/DI program and were invited to participate during the last week of the program after all requirements for graduation were completed. Individuals in both programs consisted primarily of females. Females constituted 97% of participants in the DI, while 83% of participants in the MND/DI were female.

Data Analysis

Quantitative and qualitative analysis were conducted. The SRIS and the REI-40 were coded using Qualtrics Survey software and platform. Focus group data for the 12 focus group questions were coded and evaluated related to the broader research questions. Both quantitative and qualitative data are discussed separately in the following section.

Quantitative Analysis. All quantitative data analysis was conducted in Microsoft Excel. Questionnaires were excluded if respondents left items unanswered, eliminating the inability to calculate the component scores. Coded data were evaluated using descriptive statistics (Bluman, 2014). A two-tailed *t*-test was used to compare SRIS scores for self-reflection and insight between DI and MND/DI groups (Bluman, 2014). A paired *t*-test was also used to compare REI-40 scores between the DI and MND/DI groups (Bluman, 2014). Significance was established at $\alpha = .05$ (Bluman, 2014).

***Analysis of the SRIS*.** The overall response rate for the DI was 21 out of 30 students (70%); however, two surveys were excluded due to unanswered items. As a

result, data were coded and evaluated for 19 participants in the DI group. The MND/DI participants consisted of 33 graduates, with a response rate of 33 out of 36 (92%). Two surveys were excluded due to unanswered questions. The data from 31 graduates were coded and evaluated in the MND/DI group. Participants' scores for each item were reported in the two subscales of overall self-reflection and insight. The summary of the quantitative survey results for both groups of graduates is found in Table 1.

Table 1

Summary of Subscales of Self-Reflection and Insight Scores

Samples	Mean	*SD*	Minimum Score	Maximum Score	Maximum Possible	Median	Mode
SR-MND	58.39	10.168	35	72	72	59	64
SR-DI	56.89	7.810	42	68	72	60	51
I-MND	34.48	5.032	20	42	48	36	38
I-DI	36.11	5.547	24	45	48	37	40

Note. From the SRIS, scores were obtained for self-reflection and insight. Scores are noted for MND/DI graduates and DI graduates. SR = Self Reflection; I = Insight; M = MND/DI graduates; D = DI graduates. MND/DI graduates, $n = 31$; DI graduates, $n = 19$.

Analysis of the REI-40. Twenty-three DI graduates participated in the REI-40 for a response rate of 23 out of 30 (77%). Three surveys were excluded due to unanswered items. A total of 20 surveys were coded and evaluated for the DI group. Thirty-four MND/DI graduates completed the REI-40 surveys with a response rate of 34 out of 36 (94%); however, one survey was excluded due to unanswered questions. Data were coded and evaluated for 33 REI-40 surveys in the MND/DI group. Participants'

scores were reported in overall rationality and experiential subscales. The summary of the quantitative survey results for both groups of graduates is found in Table 2.

Table 2

Summary of Rational and Experiential Scores

Samples	Mean	*SD*	Minimum Score	Maximum Score	Maximum Possible	Median	Mode
R-M	40.21	5.908	26	50	50	41	45
R-D	39.55	6.156	24	50	50	40	38
E-M	32.06	5.531	17	48	50	33	35
E-D	31.13	6.741	14	45	50	32	33

Note. From the REI-40, scores were obtained for overall rational and experiential subscales. Scores are noted for MND/DI graduates and DI graduates. R = Rational; E = Experiential; M = MND/DI graduates; D = DI graduates. MND/DI graduates, $n = 33$; DI graduates, $n = 20$.

Subscale data for the REI-40 were divided into two areas. The two areas of rational and experiential make up the composite scores. In Table 3 the subscale scores which make up the rational score are presented.

Table 3

Summary of Subscales of Rational Scores

Samples	Mean	*SD*	Minimum Score	Maximum Score	Maximum Possible	Median	Mode
RA-M	4.07	0.559	2.6	5.0	5.0	4.2	4.5
RA-D	3.97	0.703	2.4	5.0	5.0	4.1	3.5
RE-M	3.97	0.626	2.6	4.9	5.0	4.1	4.4
RE-D	3.95	0.533	2.4	4.8	5.0	3.9	3.8

Note. From the REI-40, scores were obtained for rational subscales. Scores are noted for MND/DI graduates and DI graduates. RA = Rational ability; RE = Rational engagement; M = MND/DI graduates; D = DI graduates. MND/DI graduates, *n* = 33; DI graduates, *n* = 20.

Subscale scores are also presented for the experiential composite score. Subscale scores are presented in the area of experientiality. In Table 4 the four subscale scores are presented.

Table 4

Summary of Subscales of Experiential Scores

Samples	Mean	*SD*	Minimum Score	Maximum Score	Maximum Possible	Median	Mode
EA-M	3.33	0.621	1.7	4.8	5.0	3.4	3.5
EA-D	3.11	0.824	1.4	4.5	5.0	3.3	2.4
EE-M	3.08	0.451	2.3	3.9	5.0	3.1	2.6
EE-D	3.12	0.503	2.0	4.0	5.0	3.2	3.3

Note. From the REI-40, scores were obtained for experiential subscales. Scores are noted for MND/DI graduates and DI graduates. EA = Experiential ability; EE = Experiential engagement; M = MND/DI graduates; D = DI graduates. MND/DI graduates, *n* = 33; DI graduates, *n* = 20.

Qualitative analysis. Seven individuals in the 2018 MND/DI cohort participated in the focus groups. The response rate was 64% (7/11). There were three participants in the first group session and four participants in the second session. All participants were Caucasian. Seventy-one percent (5/7) of participants were female, and 29% (2/7) were male. Each session was audio recorded using a laptop computer. Digital audio files for each group were uploaded to a web-based transcription company, Trint (2018).

The two files were transcribed using automated speech-to-text algorithms (Trint, 2018). The researcher listened to each audio file and reviewed, verified, and edited the transcribed documents in Microsoft Word. Responses from the two documents were merged to compile all question responses into one document. Responses from seven individuals were coded from the 12 questions. Results of 12 focus group questions designed to address research question number five are discussed in the next section.

Focus group question one. *Tell me why you chose dietetics as your profession, and what you most enjoy when you are not studying or practicing dietetics* was the first focus group question. All participants expressed a personal interest in nutrition, health, and fitness. A specific desire to work in healthcare, to help others, while sharing knowledge, and a passion for health were also conveyed. Interestingly, all participants verbalized a preference to be in movement outside and in nature. Two individuals indicated the career choice would enable them to view work from a different perspective. Participant 3 noted, "I thought like if I do something that I enjoy, and I enjoy health, fitness, and nutrition, then I'll never really work." Participant 1 also supported the love of dietetics as a career when stating, "…loving what you do… you will not ever have to work a day in your life."

Focus group question two. When analyzing the second question, *Think back to your introduction to nutrition diagnostics and describe that experience,* the participants related varying degrees of understanding of nutrition diagnostics, but the group overall had little idea of what nutrition diagnostics meant and how the process was used in practice. Several individuals understood the process identified nutrition problems and expected to learn more about the process, while most participants related they knew so little they had no expectations of what they might learn in the program. Overall, nothing in the responses indicated a clear understanding of the diagnostic process.

Focus group question three. In the third focus group question, *Tell me how your thought process used in nutritional diagnosing has changed throughout this program related to using Kight's approach to nutrition diagnostics and the five axes of evidence,* despite no reference to the five axes of evidence, it was clear from responses that participants thought they experienced improvement in the use of the axes. Respondents referred to the overall diagnostic process in general, encompassing problems, etiologies, goals, and interventions. The five axes are inherent within the overall process, and improvement in use of the five axes is necessary to have improvement in diagnosing and improving interventions. Two participants commented specifically about progressing in use of the process and connecting with the relevance of the process. Participant 3 noted, "I feel like as the program progressed, I got better and better and saw the logic in that [Kight's process] more and more." Participant 1 also recognized the relevance of the diagnostic process, "Arguably, that is the base of everything, and it just really helps make your decisions and your interventions for the patient better… it's identifying the problem with accuracy and precision."

Focus group question four. When answering the fourth focus group question, *Building on the previous question, how has your thinking approach to nutritional diagnosing changed throughout this program related to using Kight's approach to nutrition diagnostics and the Nine Step Nutrition Care Process,* all participants indicated they had improved in using the process throughout the program. Specific areas where improvement was described was varied and included the ability to gather relevant information in the five axes of evidence and writing more sophisticated diagnostic statements. Prescribing more targeted interventions specific to the patient, setting realistic patient goals, and the ability to look back at proximal and distal goals to evaluate interventions were also described by participants as areas where improvement was experienced. Participants conveyed they were able to more easily diagnose problems and diagnoses were more advanced. Self-reflection and the ability to self-evaluate progress was evident in several responses and was illustrated by Participant 7:

> … throughout the program, I think I'm am able to see the patient as more of a whole instead of just like, oh, they lost weight. As we've progressed in the program, like we've learned about cachexia and sarcopenia, so it's very possible that you know, we were seeing cachexic and sarcopenic patients, and in the first year we really have no idea.

Focus group question five. In addressing the fifth question, *How has the Critical Thinking course impacted you in regard to nutritional diagnosing,* participants agreed the course was a good way to start out the program, but there was not agreement about the value of the course in being able to use the principles through the rest of the program. Participants 1, 3 and 4 were able to articulate positive attributes that did not explicitly

point to diagnosing, however, do relate to aspects of the process of diagnosing, such as asking relevant questions of the patient and about evidence-based approaches and interventions. Participants 1 and 3 were able to exhibit the ability to recognize a potential bias and reflect during the process. Participant 3 stated, "Sometimes I'll kind of stop myself ,and I wonder if there's maybe something a little bit better or a little bit more validated that I can do." Participant 1 revealed both the recognition of bias and an ability to self-reflect when stating:

> With the critical thinking course, I find that I acknowledge my biases a lot more than I used to, because I used to be, you know, I used to think, I'm right, shut out everyone else, and that just goes to my own immaturity. But I do think it's very helpful not only in being an effective clinician, but also being a better person… I find myself during patient interviews, like sitting there talking with a patient, and running in my mind in thinking about what it is that they are saying right in that moment and reflecting on what it is that I'm interpreting the message as. … I feel like it has made me more of an effective person at communicating, too.

Focus group question six. Responses to the sixth focus group question, *In what ways has the course, Advanced Nutrition Assessment, changed your thinking about nutrition diagnosing,* revealed participants thought the ability to take the time to investigate patient pathologies and mechanisms behind the pathologies (as part of the diagnostic process) was particularly helpful to identify problems earlier and then to provide the most appropriate, targeted treatments. According to Participant 2:

> … I feel like I look at a lot of disease states [as part of the diagnostic process] a little bit differently because of that course… makes it easier to catch it earlier and

> still feel like overall it really helps just having ,you know, that much more knowledge, that much for depth and breadth to be able to really identify these disease states and to know metabolically what's going on to make the best treatment decisions.

Focus group question seven. When answering the seventh focus group question, *Tell me how your thought process in regard to diagnosing nutrition problems has changed throughout this program related to the Advanced Applied MNT courses and approaches,* participants verbalized the advanced clinical courses in the second year of the program provided the time and opportunity to investigate patient issues at a higher level. The extra time enabled the participants to reinforce and expand the knowledge gained in the first year. Additional time allowed participants to gather more information and learn how that additional information contributes to the patient diagnosis and impacts interventions. Participant 1 emphasized how the extra time led to being more adept at addressing problems before they arose:

> …being able to do that, and being in more tune with the potential risk given to a patient's pathology, and also the nutrition data that we gather and synthesize, I like that we are able to do more proactive interventions.

The responses emphasized collaboration during the clinical courses was helpful to work through the process. Working with each other and hearing about the approaches used by peers was useful in measuring the participant's progress against the progress of others. According to Participant 7:

> I think that was really helpful, sitting down and talking about it, and then I think also, if we didn't have that patient, hearing about our peer's patient talking about that [patient] and keeping in mind like if I were to have a patient like this…

The participants conveyed that working through the whole process with others was valuable.

Focus group question eight. When addressing focus group question eight, *Based on your experiences in the second-year rotations and approaches, tell me how your thinking approach to nutritional diagnosing has changed*, several points were emphasized by participants as helpful in their learning and progress. Points emphasized as helping the learning process and the progress of diagnosing included staff relief experience, working with and mentoring first year students, and the additional practice with oversight and input from the clinical faculty. Repetition and additional practice in staff relief and the second-year experiences in general led to improved confidence and reinforcement of principles and knowledge. The terms *repetition*, *practice*, *extra time*, and *more time focusing* were consistent within participant responses. Working with and mentoring first year students in using the diagnostic process to see patients were especially helpful to several participants. In discussing the experience of working with first year students, Participant 2 stated, "… that really gave me an idea of like how far I'd come in the whole process and my own confidence and really talking through like the thinking process behind everything with a first year…" Likewise, Participant 1 stated, "Really knowing something, and being able to teach that to someone else reflects that you really are able to understand the concept…"

Focus group question nine. *In thinking about the approaches discussed previously, what has been the most helpful in facilitating your thinking approach,* was the ninth focus group question. Responses to this question were similar to responses in the previous two questions. Staff relief and time to build on previous experiences and knowledge were the primary responses. Participant 3 related that staff relief required critical thinking to prioritize the work and identify patient cases: "…that might need a little bit more of that critical thinking and others, which are maybe a little more typical that we can maybe do a little bit faster."

Focus group question ten. In addressing the tenth question, *In thinking about those same approaches previously discussed, what was not as valuable in facilitating your thinking approach,* two participants suggested the critical thinking course be carried through the program in a more formal manner versus only having a formal course in the first semester. The suggestions by participants were to focus and emphasize critical thinking in a way where it is explicitly talked about and discussed. Only one participant thought there was too much repetition and detail in the curriculum stating, "…that's not going to be useful to me later."

Focus group question eleven. *What learning activities presented in this program have been most useful to you in your learning to diagnose nutrition problems,* was the eleventh question. The staff relief experiences, case studies, constant practice, one on one interaction between experienced preceptors, and clinical faculty were the learning opportunities thought to be the most beneficial to growth in learning and diagnosing. According to Participant 2, progressive case studies and practice made a difference in being able to determine relevant diagnoses, "… I feel like just the constant practice has

probably been the most beneficial for kind of finding that diagnosis." Participant 8 stated, "I also think clinical Mondays you [referring to the facilitator] were also really good at kind of thinking of different, different (*sic*) ways to think about the diagnostic statements and get more out of them." Participant 7 also indicated the second-year assignments were helpful:

> …coming up with potential diagnostic statements was kind of helpful to keep those in mind as we were learning about certain diseases. I think during the first year it's very basic… and I think in the second year, we have the whole tool kit to use.

Focus group question twelve. The last focus group question was, *Is there something about your thinking approach to nutritional diagnostics that I should have asked you about but did not?* The varied answers were not related to thinking approaches, with the exception of inclusion of agent, host, and environmental factors, which are elements within the Kight process. Participant 1 indicated the impact of the agent, host, and environmental factors in determining the most appropriate nutrition diagnosis "colored my thinking" and were new concepts not previously considered. A general comment with overall relevance, but not to the focus question posed, was offered by Participant 9, "I know for myself, I'm confident with starting out in clinical, for sure."

Examining the Research Questions

A detailed analysis of all five research questions is presented in this section. Both the quantitative and qualitative questions are explored and evaluated using data collected in the SRIS and REI-40 surveys and focus group sessions. Each research question is addressed individually.

Research question one. In research question number one**,** *What difference, if any, exists between the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program* was analyzed using a two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014). The *p-values* were calculated for overall self-reflection scores from the Self-Reflection and Insight Scale for DI graduates and MND/DI graduates. The *p-value* of .557 was greater than the confidence level of $\alpha = .05$. Because the value was greater than the confidence level, there was no statistically significant difference in the means of the DI graduates and the MND/DI graduates (Bluman, 2014). The null hypothesis was not rejected. Data did not support the alternate hypothesis that DI graduates' overall self-reflection scores are different than the overall self-reflection scores of MND/DI graduates.

Research question two. *What difference, if any, exists between the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program* was the second research question and was also analyzed by using a two-tailed *t* test comparison for means, with a 95% level of confidence (Bluman, 2014). The *p-values* were calculated for insight scores from the Self-Reflection and Insight Scale for DI graduates and MND/DI graduates. The *p-value* of .293 was greater than the confidence level of $\alpha = .05$. Because the value was higher than the confidence level set, a statistically significant difference in the means of the DI graduates and the MND/DI graduates could not be determined (Bluman, 2014). The null hypothesis was not rejected. Data did not support the alternative hypothesis that DI graduates' insight scores are different than the insight scores of MND/DI graduates.

Research question three. As in research questions one and two, the third research question, *What difference, if any, exists between the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program*, was also analyzed using a two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014). The *p-values* values were calculated for overall rationality and experientiality for DI graduates and MND/DI graduates. For overall rationality, the *p-value* of .583 was greater than the confidence level of $\alpha = .05$. Because the value was greater than the confidence level, there was no statistically significant difference in the means for overall rationality of the DI graduates and the MND/DI graduates (Bluman, 2014). For overall experientiality, the *p-value* of .439 was also greater than the confidence level of $\alpha = .05$. Because the value was greater than the confidence level, there was no statistically significant difference in the means for overall experientiality of the DI graduates and the MND/DI graduates (Bluman, 2014). In both rationality and experientiality, the null hypothesis was not rejected. Data did not support the alternate hypothesis that DI graduates' overall rationality and experientiality scores are different than the overall rationality and experientiality scores of MND/DI graduates.

A two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014), was also used to calculate the subscales of rational ability, rational engagement, experiential ability, and experiential engagement for DI graduates and MND/DI graduates. For each of the subscales of rational ability ($p = .540$) rational engagement ($p = .884$), experiential ability ($p = .264$), and experiential engagement ($p = .776$), there were no significant differences between the DI and the MND/DI groups. Data did not support the alternate hypothesis that DI graduates' REI subscales of rational

ability, rational engagement, experiential ability and experiential engagement scores are different from the MND/DI graduates.

Research question four. *Are SRIS reflection and insight scores correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program,* was the fourth research question. The small sample size was determined to present a substantial risk for being statistically underpowered to show a difference between the DI and the MND/DI, revealing an issue of statistical conclusion validity (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016). Specifically, the sample size for both the DI and MND/DI groups was insufficient to prevent risk of a Type II error when employing the product-moment correlation coefficient or Pearson's *r* (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016) to investigate the relationship between SRIS and REI-40 scores in the DI and MND/DI groups. As a result, the fourth research question remains unaswered.

Research question five. The fifth research question was qualitative and designed to investigate, *How do students who are nearing completion of a MND/DI program perceive the process of making a nutritional diagnosis.* Three core themes emerged from the focus group interview: confidence, competence, and coaching. More specifically, confidence grew throughout the program, staff relief experiences, and second-year experiences were valuable in providing additional cases and time to develop and assess competence in diagnosing skills. Coaching or mentoring first-year students served as a measure of progress and revealed thinking skills. Coaching provided by experienced practitioners was important in challenging thinking about diagnoses in different ways.

Theme #1: Confidence. Across both groups, participants conveyed a greater sense of confidence as they progressed in the program. Participants attributed confidence to repetition and additional time to practice during the second year, as well as additional knowledge gained through the coursework. Mentoring first-year students was a prominent sub-theme and thought to be instrumental by illuminating how further along they were in their skills and thinking than first-year students. As stated by Participant 9, "I liked peer mentoring… . So that was a confidence booster, and just to be able to help students get to where we are, it was a good feeling."

Theme #2: Competence building and evaluation. Improvement in diagnostic skills and thinking was consistently articulated by all participants. Improvement in skills was attributed to the additional time to learn and practice with patients, as well as using cases to provide the needed repetition for skill development. The staff relief experiences were also invaluable in that actual patient cases were significant in number, adding to the foundational skills required in the diagnostic process. Repetition in seeing additional patients, along with the additional advanced assessment and clinical courses in the second year contributed to competence. Additionally, participants recognized the change in competence, illustrating some ability to self-evaluate.

Responses in both groups revealed some evidence of the ability to self-measure competence. Recognition of the needed skills of thinking and problem-solving, and of students' own development of those skills and other skills in the diagnostic process was present. While participants were unaware of a particular thinking style as being relevant, several participants indicated an understanding of the need to think critically and to be able to evaluate the patient and themselves. Self-reflection was illustrated by some

participants in that they were able to recognize their level of skills in the first year and understand their improved ability to gather better information and synthesize that information to make better diagnoses and interventions as they progressed in the second year. Participant 7 stated that during the second year with extra hours in practice, "I felt like I actually knew what I was doing and talking about."

Theme #3: Coaching. Echoing from the first two themes, theme three strengthens the concepts of a sense of confidence, competence building, and assessment. Participants were able to recognize and appreciate the value of learning from and being coached by experienced practitioners and clinical faculty in the clinical rotations. According to Participant 1, "… I feel like that one-on-one interaction between experienced dietitians and the students themselves is of benefit." The one-on-one interaction with experienced dietitians challenged students to think about diagnoses in different ways, emphasized the use of evidence-based practice guidelines, and served to model the diagnostic process as a comprehensive approach to investigate the whole patient. Clinical faculty and practitioners helped participants to prioritize the most relevant and urgent nutrition problems and determine optimal interventions.

Coaching and mentoring first-year students was valuable as a means to self-evaluate participants' own progress and provided the opportunity to share their knowledge and skills with others. Participants appreciated the skills required to mentor another student. To really have the skills and knowledge and to understand the concepts required to help others in working through the diagnostic process, was recognized as important. The ability to articulate their own thought processes to other students was verbalized as a skill that served as a measure of participants' progress in the diagnostic

process. Coaching also served to add confidence by revealing progress and knowledge gained throughout the program.

Summary

An analysis of the data were presented, findings related to the study hypotheses were reported, summarized, and interpreted in this chapter. Both quantitative and qualitative data were used to investigate self-reflection, insight, and thinking styles in graduates of a 10-month DI program versus graduates of a 22-month MND/DI program. Data collected from the SRIS and REI-40 instruments were analyzed to answer the research questions and determine what, if any, differences in SRIS and REI-40 exist between graduates of a 10-month DI program versus graduates of a 22-month combined MND/DI program. Data were also collected from the audio recorded focus group sessions about perceptions of diagnostic thinking skills. Data were coded and evaluated for relevance to the broader research questions in terms of self-reflection, insight, critical thinking, and thinking styles. Focus group findings and analysis resulted in the emergence of three core themes: confidence, competence, and coaching.

In Chapter Five findings of the study are reviewed. Each research question and hypothesis is addressed. Study conclusions, implications for practice, and recommendations for conducting additional research are discussed.

Chapter Five: Summary and Conclusions

Clinical reasoning and decision-making are important in healthcare practice (Balogh et al., 2015). How clinicians think about and determine patient problems is an important area of study to gain insight into the causes of diagnostic error (Balogh et al., 2015). While medicine has devoted significant attention to diagnostic error, critical thinking, clinical reasoning, and decision-making over the past 15-20 years, the other allied health disciplines have fallen behind in discipline-specific research investigating how practitioners think and use the diagnostic process (Balogh et al., 2015; Graber et al., 2005). The discipline of dietetics and nutrition is especially lacking in knowledge about how dietitian nutritionists think and use the nutrition care process to make nutrition diagnoses (Charney & Peterson, 2013; Goodman et al., 2018).

The literature in medicine covers factors that influence thinking, diagnostic decision-making, and diagnostic errors (Balogh et al., 2015; Croskerry et al., 2017). Reflective practices and metacognitive skills are strategies thought to be important in helping clinicians understand and recognize when clinical performance and decision-making may not be optimal (Croskerry, 2017). The ability to self-regulate behaviors incorporating the reflective process can provide the needed insight to improve clinical performance and reduce diagnostic errors (Croskerry, 2017; Croskerry et al., 2013b). Self-monitoring is thought to be a strategy that leads to increased awareness of performance as well as the ability to gain knowledge or information that might be lacking in the clinical situation (Croskerry, 2017).

The area of critical thinking and clinical reasoning in dietetics practice has largely been unexplored in the dietetics and nutrition discipline (Charney & Peterson, 2013;

Goodman et al., 2018). To gain a better understanding of the concepts thought to be important in how dietitian nutritionists think and diagnose nutrition problems, this study drew primarily from the literature in medicine, but also in the other healthcare disciplines (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Turpin & Higgs, 2017). This study investigated the concepts of self-reflection, insight, and thinking styles in graduates of dietetic programs in nutrition diagnostics. Specifically, examined were differences in scores in self-reflection, insight, and rational and experiential thinking styles between graduates of a DI and of a MND/DI program.

In this chapter, findings of the study are reviewed and related to the four quantitative research questions and one qualitative question. Each research question and related hypothesis is addressed. Specifically, analyzed data from the SRIS and REI-40 scores are discussed, along with findings from the qualitative question investigating diagnostic perspectives. Study conclusions for each question are outlined. Implications for dietetics and nutrition practice and education are discussed. Recommendations for conducting additional research include further investigation of relationships between reflection, insight, and thinking styles in nutrition diagnostic students, dietitian nutritionist practitioners and in similar allied health graduates.

Findings

The present research was initiated to examine self-reflection, insight, and thinking styles in graduates of a DI and a combined MND/DI. The curriculum in both programs emphasized nutrition diagnostics. The first goal was to investigate the difference in self-reflection and insight between the two groups using scores from the SRIS. The second goal was to investigate the difference between the two groups in rational and experiential

thinking styles using scores from the REI-40. The next goal was to investigate the possible relationship in the SRIS scores and the REI-40 scores between the two groups. Lastly, the study examined perceptions of the MND/DI 2018 cohort regarding the process of nutritional diagnosing. Study findings are discussed below.

Research question one. *What difference, if any, exists between the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program* was analyzed using a two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014). The *p-value* of .557 was greater than the confidence level of $\alpha = .05$, indicating no statistically significant difference in the means for reflection in the DI graduates and the MND/DI graduates (Bluman, 2014).

Research question two. *What difference, if any, exists between the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program* was also analyzed using a two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014). The *p-value* of .293 was greater than the confidence level of $\alpha = .05$, indicating there was no statistically significant difference in the means for insight in the DI graduates and the MND/DI graduates (Bluman, 2014).

Research question three. *What difference, if any, exists between the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program* was also analyzed using a two-tailed *t* test comparison for means, with a 95% level of confidence (Bluman, 2014). For overall rationality, the *p-value* of .583 was greater than the confidence level of $\alpha = .05$, indicating no statistically significant difference in the means for overall rationality of the DI graduates and the MND/DI graduates (Bluman, 2014). For overall experientiality, the *p-value* of .439 was also greater than the confidence level

of $\alpha = .05$, indicating no statistically significant difference in the means for overall experientiality of the DI graduates and the MND/DI graduates (Bluman, 2014). A two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014), was also used to calculate the subscales of rational ability, rational engagement, experiential ability, and experiential engagement for DI graduates and MND/DI graduates. For each of the subscales of rational ability ($p = .540$) rational engagement ($p = .884$), experiential ability ($p = .264$), and experiential engagement ($p = .776$), there were no significant differences between the DI and the MND/DI groups.

Research question four. *Are SRIS reflection and insight scores correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program,* remains unaswered. The sample size for both the DI and MND/DI groups was insufficient to prevent risk of a Type II error when employing the product-moment correlation coefficient or Pearson's *r* (Boswell & Cannon, 2017; Polit, 2010; Polit & Beck, 2016) to investigate the relationship between SRIS and REI-40 scores in the DI and MND/DI groups.

Research question five. *How do students who nearing completion of a MND/DI program perceive the process of making a nutritional diagnosis* was investigated by focus group interviews. Three core themes emerged from the focus group interview: confidence, competence, and coaching. More specifically, confidence grew throughout the program. Staff relief experiences where the student takes on the role and practice responsibilities for the professional, and second year experiences were valuable in providing additional cases and time to develop and assess competence in diagnosing skills. Coaching or mentoring first-year students served as a measure of progress and

revealed thinking skills. Coaching provided by experienced practitioners was important in challenging thinking about diagnoses in different ways.

Conclusions

This is the first study to investigate decision-making characteristics or the ability to self-reflect and gain insight into how decisions are made in the discipline of dietetics and nutrition (Charney & Peterson, 2013; Goodman et al., 2018; Vivanti et al., 2017). Dietetics and nutrition literature indicate a lack of understanding regarding the kind of skills required to make clinical decisions (Charney & Peterson, 2013; Goodman et al., 2018; Vivanti et al., 2017). It is agreed that critical thinking is a needed skill, yet research in dietetics and nutrition has advanced little beyond the recognition of the importance of critical thinking (Charney & Peterson, 2013; Goodman et al., 2018; Vivanti et al., 2017). It is only with the recent study by Goodman et al. (2018) has the discipline begun to investigate critical thinking skills and disposition in a small group of dietitian nutritionist practitioners. While much study in critical thinking, clinical reasoning, and reflection has occurred and is occurring in other healthcare disciplines, there is still much to understand (Croskerry et al., 2017; Stiegler & Gaba, 2015; Turpin & Higgs, 2017). Studies have investigated reflection and insight (Asselin & Fain, 2013; Carr & Johnson, 2013; Chen et al., 2016; Eng & Pai, 2015; Pai, 2015; Pai, 2016; Pai, Ko, Eng, & Yen, 2017; Roberts & Stark, 2008), while other studies have investigated thinking styles and critical thinking (Calder et al., 2012; Domenech & Watkins, 2015; Djulbegovic et al., 2014; Jensen et al., 2016; McLaughlin et al., 2014; Nornoo, Jackson, & Axtell, 2017; Phillips et al., 2016; Sladek et al., 2008; Williams et al., 2016), but no

studies have investigated the relationship between metacognition, thinking styles, and how clinical decisions or diagnoses are made.

The current study revealed there were no differences between the groups regarding reflection and insight as measured by the SRIS. Various unmeasured factors may influence the metacognitive characteristics of reflection and insight (Croskerry et al., 2017; Dreyfus, 2004; Mamede & Schmidt, 2005; Schmidt & Mamede, 2015). No differences between the two groups were found in the thinking styles as measured by the REI-40. Like the reflective process, many factors not measured in this study are known to influence thinking (Croskerry, 2009; Croskerry et al., 2017; Furze et al., 2015b; Jensen et al., 2016). The literature does not provide evidence to elucidate nuances of metacognitive and cognitive processes that allow sufficient explanation of how the processes are interrelated and ultimately determine the desired skills of decision-making and diagnosing (Croskerry, 2017). In terms of perceptions of focus group participants regarding the process of nutritional diagnosing, insight was gained in terms of confidence, competence, and the importance of expert coaching and serving as a mentor to less experienced students.

Research question one. *What difference, if any, exists between the SRIS reflection scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.* The inability to show a statistically significant difference in the means for reflection in the DI graduates and the MND/DI graduates may be related to the likely heterogeneous make up of each group of graduates in terms of educational background, years, kind of experience, and the stage of skill acquisition attained by each individual within the groups. None of these factors were measured in the study and likely

influenced results. Because the metacognitive factor of self-reflection and reflective thinking have been considered surrogate terms for critical thinking, consideration of dispositions to critical thinking may also be important (Chen et al., 2016).

Both DI and MND/DI graduates' educational, training, and practice experiences included use of the Kight's advanced practice Nine-Step Nutrition Care Process as the foundation for learning the diagnostic process (Sandrick, 2002). The depth and breadth of education, training, and practice experiences using the Kight process was not the same in the DI and the MND/DI graduates (Sandrick, 2002). Kight's systematic process is rooted in hypothesis testing and deductive reasoning, requires critical thinking, and logical reflection for the student/graduate to successfully use the process and diagnose nutrition problems (Sandrick, 2002). Critical thinking in clinical practice is linked with reflection (Turpin & Higgs, 2017). Additional experience and the associated knowledge from experience results in improved critical thinking and reflection (Croskerry et al., 2014; Turpin & Higgs, 2017).

Work experience varied in both the DI group (average of seven years) and the MND/DI group (average of two years). Dreyfus and Dreyfus (2004) described the process of skill acquisition as ongoing with the individual acquiring skills in progression through the five stages: novice, advanced beginner, competence, proficiency, and expertise. Given the variability in years of experience within the groups, and between the DI and MND/DI groups, actual work experience may have been a factor influencing the results. In addition, given the small relative number of years of experience in both groups, it is not unrealistic to infer that both groups remain in the same or similar stages of skill acquisition, which also could have been a contributing factor to the inability to

reject the null hypothesis (Dreyfus, 2004; Persky & Robinson, 2017). The inability to describe the type, quality, and quantity of additional education and clinical work experiences within each group acquired in the years following graduation also increases variables that may contribute to the findings. Both education and work variables have the potential to influence self-reflection (Croskerry et al., 2017; Mamede & Schmidt, 2005; Schmidt & Mamede, 2015).

Self-reflection was a component of both programs. Each student completed a self-evaluation after each supervised practice rotation. The evaluation served as a mechanism for the students to reflect-on-action (Schön, 1987). The intention of the self-evaluations is rooted in critical thinking where experiences, behaviors, and decisions are reviewed and result in moving from unconscious to conscious thinking (Pai, 2015; Tsingos et al., 2015). The approaches to reflection in the curriculum were the same for both the MND/DI and DI programs and did not extend beyond the use of the self-evaluations, supporting the inability to reject the null hypothesis, ultimately concluding that there were no differences in self-reflection between the groups.

Lastly, one has to question the applicability of the SRIS to measure reflecting to improve judgements such as making correct diagnoses. The goals and intentions of how reflection is used within the healthcare domain are varied and may potentially increase the challenges of measuring reflection (Grant et al., 2002; Pai, 2015; Tsingos et al., 2015). The SRIS is designed to measure personal reflection to examine one's own thoughts, feelings, and behaviors (Grant et al., 2002), while reflecting to improve judgments and solve problems involves critical thinking skills has a different intention (Pai, 2015; Tsingos et al., 2015). Further contrasting the intentions encompassed by the

concept of reflection, Epstein (2008) stated the goals of reflection are insight, wisdom, and informed flexibility. While it is well established and agreed that reflection is important in healthcare practitioners and an essential component of lifelong self-learning, the intent or goals for reflection of a particular task may not be clear (Menard & Ratnapalan, 2013). The SRIS has been used to evaluate self-reflection and insight in healthcare practitioners (Asselin & Fain, 2013; Carr & Johnson, 2013; Chen et al., 2016; Eng, & Pai, 2015; Pai, 2015, 2016; Roberts, & Stark, 2008), yet relatively few studies have been carried out using the SRIS (Askun, & Cetin, 2017). The relevance of the SRIS tool as a measure of reflection in nutrition diagnostic graduates is unclear.

Research question two. *What difference, if any, exists between the SRIS insight scores of graduates of a 10-month DI and graduates of a 22-month MND/DI program.* Given the results of the first research question, it is logical to predict that the result of the second null hypothesis would also not be rejected in the investigation of a difference in insight scores for the same groups. While Grant et al. (2002) indicated the two metacognitive factors of reflection and insight are independent, they go on to say as part of the self-regulation process, those who routinely monitor thinking and actions should have increased levels of both reflection and insight. The current study did not investigate the relationship between reflection and insight and how routine monitoring of thinking by reflection are related, but it is logical to infer that as part of the self-regulation process reflection and insight may follow similar patterns. Increased self-awareness and reflection lead to insight and understanding about one's personal thoughts, feelings, and behaviors in general and in the decision-making process (Thammasitboon & Cutrer,

2013). Carr and Johnson (2013) indicated reflection on one's own level of knowledge and performance is required for insight.

While it is well recognized that self-reflection, along with insight or understanding is required for growth and change in practice via the self-regulation process, the literature is lacking about what may or may not influence insight, beyond the ability to reflect (Asselin & Fain, 2013; Zander, Öllinger, & Volz, 2016; Zimmerman, 2008). Zander et al. (2016) did elaborate on the definition of insight, stating it is an understanding of a problem that was previously impossible to understand. It is thought that prior knowledge is required to have insight (Zander et al., 2016). Solutions resulting from insight occur when pre-existing knowledge stored in short- or long-term memory is combined in a new way (Zander et al., 2016). Zander et al. (2016) provided support again for the requirement of a level of knowledge for insight, similar to that discussed regarding reflection. It follows that without sufficient knowledge, and likely domain specific knowledge, even if reflection does occur insight may not result from the reflective or self-regulatory process (Sanders, 2009). Without measuring or accounting for the level of domain knowledge in the DI and the MND/DI in the study, it is not possible to understand the influence on whether there is a difference in insight between the two groups.

Similar to the discussion about reflection, is the potential issue of how the SRIS tool is measuring insight and the particular intention of insight in the present study. According to Zander et al. (2016), insight is not only defined in a variety of ways, it is also very challenging to determine if it has occurred. Brown et al. (2014) posited a definition that insight is more than just being aware of self, but also includes a

recognition of motivation as important for actual change in behavior. Key in insight is the logical assessment and understanding of events or actions (Brown et al., 2014). As noted by Asselin and Fain (2013), the SRIS measures perceived personal insight, defined as understanding of one's thoughts, feelings, and behavior, in contrast to insight in a specific clinical situation. Like self-reflection, the relevance of the SRIS tool as a measure of insight in nutrition diagnostic graduates is unclear.

Research question three. *What difference, if any, exists between the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.* The inability to show a statistically significant difference in means for the REI-40 measures of rational and experiential styles, preferences and tendencies in the DI graduates and the MND/DI graduates may be attributable to unmeasured variables that have been associated with thinking styles (Croskerry, 2009). The numerous factors thought to influence healthcare practitioners' thinking styles and clinical decision-making were not considered in this study and may have influenced the results. The potential confounding variables include, but are not limited to age, gender, years of experience, context of experience, educational background, and personality characteristics (Croskerry, 2009; Croskerry et al., 2017; Furze et al., 2015b; Jensen et al., 2016).

The inability to control for and consider the influence of the numerous factors increases the possibility of not finding a statistical difference between the DI and MND/DI graduates in measures of both rationality and experientiality. In Croskerry's model for diagnostic reasoning, factors that influence Type 1 and Type 2 processes are further outlined (Croskerry, 2009). Factors with potential to influence Type 1 processing included hard wiring, ambient conditions, context, task characteristics, age, experience,

affective state, gender, and personality (Croskerry, 2009). Intellectual ability, education, training, critical thinking, logical competence, and rationality are the primary variables that Croskerry (2009) indicated influence Type 2 processing. Particularly relevant to this study are the factors of critical thinking, education, training, and experience. The DI graduates' education, training, and experience are different from that of the MND/DI graduates, with each variable having a potentially different influence on thinking styles. Critical thinking is imbedded in thinking styles but not directly measured in the study (Croskerry, 2017). It is unknown what specific relevance critical thinking has to the findings.

Research question four. *Are SRIS reflection and insight scores correlated with the REI-40 of graduates of a 10-month DI and graduates of a 22-month MND/DI program.* As noted earlier, this research question remains unanswered due to the small sample size for both the DI and MND/DI groups.

Research question five. The fifth research question was qualitative and designed to investigate, *How do students who are nearing completion of a MND/DI program perceive the process of making a nutritional diagnosis.* The three core themes of confidence, competence, and coaching emerged as particularly relevant to the participants from the 2018 MND/DI cohort.

Theme #1: Confidence. Participants in both focus groups conveyed a greater sense of confidence as they progressed in the program. Repetition via the additional time to practice during the second year, along with the additional knowledge gained through the coursework were factors that influenced confidence. Mentoring first-year students

was a prominent sub-theme and thought to be instrumental as a measure of progress when comparing skills and thinking to that of the first-year students.

As skill acquisition improves with practice and experiences, confidence improves as one progresses in the stages from novice practice to more expert practice (Dreyfus, 2004; Persky & Robinson, 2017). Persky and Robinson (2017) emphasized the importance of metacognitive development in assisting the individual to gain the self-awareness about the level of one's skills in order to increase confidence. Recognition of improvements in skill level by the focus group participants likely contributed to an increase in confidence.

A potentially relevant and important factor that may have influenced the level of confidence in participants is the use of simulation, where learning occurs in a setting that mimics a real patient care environment (Sorensen et al., 2017). The focus group questions did not specifically ask about simulation experiences nor did participants mention the simulation educational sessions. Simulation exercises were used throughout the 2018 MND/DI cohort program to assist in development of communication and foundational and specific diagnostic skills (Institutional Data, 2018). It has been well-established that simulation provides opportunities to build confidence in a non-threatening environment (Stunden, Halcomb, & Jefferies, 2015). Stunden et al. (2015) indicated exposure to the clinical environment and improvement of communication skills in simulation exercises increased confidence in nursing students. Specific practice of clinical skills also leads to increase in ability to perform the skills in practice, as well as the confidence in the skill performance (Stunden et al., 2015).

Improvement of clinical skills can enhance confidence, as illustrated by Pender and de Looy (2004), Pai (2016), and Stunden et al. (2015). Pender and de Looy (2004) evaluated levels of key skills required by dietetic students in a simulated clinical environment. Student anxiety level decreased, and students reported a positive experience with improvement in key clinical skills (Pender & de Looy, 2004). According to Hutchinson and Goodin (2013), anxiety interferes with critical thinking and learning. Reduction in anxiety through reflection can enhance critical thinking and learning outcomes (Hutchinson & Goodin, 2013). It follows that simulation prior to clinical practice experiences and throughout the educational program helps students not only prepare better for practice but also to increase confidence and cope better with an overall increase in performance in practice (Pender & de Looy, 2004; Stunden et al., 2015). Pai (2016) found that simulation experiences in nursing students that included self-reflection reduced anxiety, improved confidence in the technical practice skills, and improved clinical performance when using those skills with actual patients in the clinical setting. The MND/DI 2018 cohort may have benefitted from simulation exercises, contributing to the perceived confidence and performance in diagnostic skills.

An additional factor that may have led to an improvement in confidence as participants progressed through the program is the development of critical thinking skills. Confidence is an essential trait for success and learning to critically think, and results in improvements in confidence (Alfaro-LeFevre, 2017; Kong, Qin, Zhou, Mou, & Gao, 2014). Confidence in skills leads to further improvements in critical thinking skills (Alfaro-LeFevre, 2017; Turpin & Higgs, 2017). Confidence results in motivation and influences the desire to continue to grow and learn (Alfaro-LeFevre, 2017; Kong et al.,

2014). As discussed, the MND/DI cohort curriculum consisted of a critical thinking course with the objective of establishing a foundational critical thinking template. Critical thinking was also integrated throughout the curriculum. The Kight nutrition care process also relies on critical thinking as a key element in gathering the relevant patient information and synthesizing that information to determine a nutrition diagnosis (Sandrick, 2002).

Theme #2: Competence building and evaluation. Improvement in diagnostic skills and thinking was consistently articulated by all participants. As previously discussed, skill acquisition improves with practice and experiences, and competence improves as one progresses in the stages from novice practice to more expert practice (Dreyfus, 2004). Adequate development of knowledge structures is also required in order to be competent and improve clinical thinking (Turpin & Higgs, 2017).

Improvement in skills was attributed to the additional time to learn and practice with patients, as well as using cases to provide the needed repetition for skill development. Staff relief experiences consisted of caring for a significantly larger number of patient cases than typically seen in the regular clinical rotation experiences, adding to the foundational skills required in the diagnostic process. Repetition in seeing additional patients, along with the additional advanced assessment and clinical courses in the second year contributed to competence. The basic science knowledge as an important prerequisite for practice is likely integrated along with the experience from real clinical cases in practice, allowing the learner to form the required causal relationships to develop the foundational diagnostic skills and increase the level of competence (Carraccio et al., 2008). Because the students have been challenged by patient cases outside of their

comfort zone through the advanced clinical courses in the second year of the program, it is likely that higher-level clinical reasoning necessary for progression from advanced beginner to competent has occurred by program completion (Carraccio et al., 2008).

Additionally, participants recognized the change in competence, illustrating some ability to self-reflect and self-evaluate. Recognition of the needed skills of thinking and problem-solving and of their own development of those skills and other skills in the diagnostic process was present. It is possible participants have the metacognitive skills necessary to gain insight from observing and comparing their own skills with the skills of others (Schumacher, Englander, & Carraccio, 2013). Evidence of this can be found in the comments relating to value of mentoring first-year students and recognizing the difference in the competence and skill level between themselves and novice students. While participants were unaware of a particular thinking style as being relevant, several participants indicated an understanding of the need to think critically and to be able to evaluate the patient and themselves. In addition, self-reflection was illustrated by some participants in that they were able to recognize the skill attainment in the first year and understand their improved ability to gather better information and synthesize that information to make better diagnoses and interventions as they progressed in the second year.

In discussing changes in competency-based medical education, Carraccio and Englander (2013) emphasized that advancement toward expertise requires commitment to continually thinking about and analysis of practice that includes the metacognitive skills of mindfulness and reflection. The analysis of what one does, and what happens as a consequence, is the way to expertise and involves reflection in and on practice (Carraccio

& Englander, 2013). Reflective skills can be taught and learned as part of a systematic critical thinking approach to decision-making (Croskerry et al., 2017). Croskerry (2009) described the analytical process as a linear system that requires repetition, formal training, and refinement using critical thinking and logical reasoning. The novice is able to use deliberative and reflective thinking to progress through the stages using the analytical system to become increasingly competent (Croskerry, 2009; Dreyfus, 2004).

The Kight nutrition care process also draws from a systematic approach, requires critical thinking, logical reasoning, and ongoing evaluation of what is known and what needs to be known to make effective decisions or diagnoses. It is possible the critical thinking approach required of the Kight nutrition care process has as an inherent component in the nine steps that leads to growth in reflection by requiring analysis of what is being done and consequences of what happens as a result of the process. As stated by Epstein and Hundert (2002), habits of mind essential for professional competence include self-awareness, presence, curiosity, recognition of cognitive biases, and observation of one's own thinking. Kight's systematic approach to nutrition diagnosing encompass all of those habits of mind, some of which are reflected in the focus group participants' perceptions.

Theme #3: Coaching. The third theme of coaching and mentoring strengthens the concepts of a sense of confidence, competence building, and assessment. Participants were able to recognize and appreciate the value of learning from and being coached by experienced practitioners and clinical faculty in clinical rotations. Because the experienced practitioner has more domain specific knowledge, experienced preceptors

and clinical faculty instructors help the students see patterns and make connections in progressively challenging and complex patient situations (Persky & Robinson, 2017).

Students gain additional knowledge through both case-oriented and real patient applications, challenging the ability to link and relate information in different contexts (Monteiro & Norman, 2013; Persky & Robinson, 2017). The clinical days in the second year provided a mix of faculty modeling, opportunities for deeper discussion about relevant patient information, and a time to slow down to see the intricacies of the patient situation and determine the nutrition diagnosis and most appropriate intervention (Monteiro & Norman, 2013). The experienced preceptor or clinical faculty has a greater metacognitive ability that results in asking more relevant and probing questions of the students to stretch the students' thinking (Persky & Robinson, 2017).

The faculty or preceptor can challenge the student to apply the current patient situation to one in a similar situation. Faculty and preceptors challenge students to think about their thinking, to reflect on previous experiences to purposefully look at and think about what they are doing (Croskerry, 2017). Participants in the focus groups were able to reflect on clinical experiences and recognize challenges provided by the experienced dietitians to think about diagnoses in different ways. Faculty and preceptors also challenged the participants to use evidence-based practice guidelines, to prioritize the most relevant and urgent nutrition problems, and determine the optimal interventions. Coaching and modeling of the diagnostic process as a comprehensive approach to investigate the whole patient were valuable in building competence and confidence in use of the diagnostic process.

Coaching and mentoring first-year students as a component of the second-year clinical practice experiences were valuable as a means to self-evaluate participants own progress and provided the opportunity to share their knowledge and skills with others. The coaching and mentoring by the second-year students demonstrated progression in skill acquisition (Dreyfus, 2004). As discussed in previous sections, the development of expertise occurs over several stages in a linear process, where the learner progresses though each stage in moving from novice to expert (Dreyfus, 2004). The learner can exist in more than one stage at a time, demonstrating characteristics of multiple stages (Persky & Robinson, 2017).

In the clinical realm, progressive problem solving is required to increase the relevant acquisition of skills (Persky & Robinson, 2017). The second-year student progressed in the stages of skill acquisition beyond the novice stage where simple rule-following and knowledge acquisition is primary and has acquired sufficient knowledge and experience to be able to handle more complex problems (Dreyfus, 2004; Persky & Robinson, 2017). The second-year student was also typically able to provide solutions to problems and make decisions in situations that are familiar (Dreyfus, 2004; Persky & Robinson, 2017). The ability of the second-year student to be conscious and deliberate in efforts, to see the big picture, and operate more autonomously allowed him or her to assist the novice student who required guidance in basic, straightforward cases and relies upon feedback (Dreyfus, 2004; Persky & Robinson, 2017). The novice first-year student relies heavily on unconnected facts, while the second-year student is expanding the ability to make connections to previously learned domain-specific knowledge and experiences (Dreyfus, 2004; Persky & Robinson, 2017). The second-year students were

able to largely function independently to assist first-year students in working through the diagnostic process in clinical rotations.

Participants were able to reflect on second-year clinical experiences to recognize skills required to coach and mentor another student. The recognition of achieving more advanced skills is an illustration of metacognition, important for self-regulation and continued learning (Croskerry, 2017). To have the skills and knowledge and to understand the concepts required to help others in working through the diagnostic process were recognized as important by the focus group participants. The ability to articulate their own thought processes to other students was verbalized as a skill that served as a measure of the participants' progress and competence in the diagnostic process. Coaching also served to add confidence by revealing knowledge and skills gained throughout the program.

Implications for Practice

There is overwhelming agreement that the manner in which healthcare practitioners think, reason, and make decisions or diagnoses are essential skills in clinical practice (Alfaro-LeFevre, 2017; Cooper & Frain, 2017; Croskerry et al., 2017; Hakel-Smith & Lewis, 2004; Victor-Chmil, 2013). While critical thinking and reasoning are important skills for dietetics and nutrition practitioners, very little is known about how dietitian nutritionists think and make decisions in clinical practice (Brody et al., 2014; Charney & Peterson, 2013; Goodman et al., 2018; Pender & de Looy, 2004). In 2004, Hakel-Smith and Lewis indicated the need to further elaborate on the clinical judgment and critical thinking skills in the nutrition care process used to diagnose nutrition problems. However, more than 10 years later, little progress has been made in

understanding and describing critical thinking and reasoning skills among practitioners in the clinical nutrition discipline, nor has the nature of how decisions are made been described in this area (Charney & Peterson, 2013; Goodman et al., 2018; Vivanti et al., 2017).

It is thought metacognitive skills where practitioners are able to think about, monitor, and reflect on their thinking may be instrumental in the diagnostic process (Croskerry et al., 2017; Dhaliwal & Detsky, 2013; Simpkin, et al., 2017). Development of a metacognitive framework where one can reflect and gain insight to one's thinking is thought to be a self-regulatory component in the critical thinking and reasoning process that lead to diagnostic decisions (Croskerry et al., 2017; Huang, et al., 2016). Gates and Amaya (2015) emphasized the need for dietitian nutritionists to have the skills of self-assessment and reflection for practice competence, yet unlike the literature and practice in medicine and nursing, self-regulation, reflection, and insight are concepts largely unrecognized in dietetics and nutrition practice and education (Cooper et al., 2017; Gates & Amaya, 2015; Turpin & Higgs, 2017).

The current and future healthcare environment present challenges that require dietitian nutritionists to possess critical thinking and reasoning skills to identify and solve complex patient problems (Andersen et al., 2018; Brody et al., 2014; Charney & Peterson, 2013; Pender & de Looy, 2004). As a result, there is an urgency for the development of these skills in dietetic education and the need to describe the skills of practicing professionals (Andersen et al., 2018; Charney & Peterson, 2013; Trostler & Myers, 2008). The relationships among self-reflection, insight, and critical thinking are required to ultimately understand the quality of thinking and clinical decisions in dietitian

nutritionist practitioners (Croskerry, 2017; Gates & Amaya, 2015; Trostler & Meyers, 2008).

Despite the inability to show a difference between the reflection process and thinking styles of DI and MND/DI graduates as a result of the quantitative data, information from this study adds to current knowledge on decision-making by dietitian nutritionist practitioners. The study is potentially important for developing dietetics and nutrition program curriculum, as well as continuing education and clinical support tools for dietitian nutritionists. It is unknown specifically how dietetics and nutrition students and practitioners use the reflective process or which thinking style or particular strategy is ideal for different clinical situations (Charney & Peterson, 2013: Goodman et al., 2018). However, both dietetic and nutrition students and dietitian nutritionists can become more aware of the relevance of metacognition, and their thinking styles and can be trained to understand the benefits and trappings of each thinking style (Croskerry, 2017; Croskerry et al., 2017). Sklar (2014) stressed the importance of supervision by skilled and experienced faculty to guide the progression of the student through stages of skill acquisition where diagnostic expertise develops. Sklar (2014) also noted assessment of diagnostic skills through the stages needs to be tailored to the appropriate stage and that the educational objective of cognitive clinical expertise should be explicit and prioritized.

The literature in medicine and nursing includes significant study and discussion regarding the skills needed for clinical decision-making over the past 10 to 15 years, yet the general agreement is disciplines have an incomplete understanding of what is required to think well and how to best acquire the skills (Cooper & Frain, 2017; Croskerry et al.,

2017; Norman et al., 2017). Literature in dietetics and nutrition practice is globally lacking in helping the discipline understand how dietitian nutritionists think and make clinical decisions (Charney & Peterson, 2013; Goodman et al., 2018; Trostler & Myers, 2008). While this research study failed to find significant differences in the reflection process and thinking styles between the DI and the MND/DI graduates, the study does provide insight into reflection and thinking via the qualitative research question. Data gathered using the SRIS and the REI-40 can also be used to gain insight into metacognition and thinking by comparing the scores to studies that have used the survey tools in the healthcare arena (Asselin & Fain, 2013; Calder et al., 2012; Carr & Johnson, 2013; Chen et al., 2016; Eng & Pai, 2015; Jensen et al., 2016; McLaughlin et al., 2014; Pai, 2016; Pai et al., 2017; Roberts & Stark, 2008; Sladek et al., 2008; Williams et al., 2016). The SRIS and REI-40 descriptive data can be useful in the future and serve as an introduction into the understanding of metacognition, critical thinking, and reasoning in dietetics and nutrition students and dietitian nutritionists.

Education. According to Croskerry (2017), textbooks and approaches in healthcare education are not directed at how one should think, but instead, at what should be known. Healthcare curriculum is often encumbered by the magnitude of content required, neglecting the need for critical thinking and reasoning (Croskerry et al., 2017). Croskerry et al. (2017) stated despite the recognized need for critical thinking and reasoning, there is a lack of ability to do just that, "to think, critically appraise evidence, write, reason, and communicate" (p. 33). The diagnostic process requires a critical thinker and skills for diagnosing are essentially the same as those needed for critical thinking (Croskerry et al., 2017). In addition to skills in critical thinking, Turpin and

Higgs (2017) emphasized the deep, relevant knowledge base and extensive experience required to gain clinical reasoning and clinical practice expertise.

Evidence of need for education. While results from the qualitative research question provided some insight into aspects important in decision-making, overall comments by the participants illustrated a limited connection to critical thinking. In considering the conceptions of, and reflections on, clinical reasoning and diagnosing, the dimensions were underdeveloped, disconnected, and absent. The ability to connect thinking, learning, and reasoning or diagnosing of most participants served to highlight the lack of recognition and adequate attention to critical thinking and reasoning in their educational experience in the classroom and in practice experiences. The focus group facilitator struggled at times in eliciting responses that addressed the actual questions posed. The results of the focus group reinforced the complexity and challenging nature of the multifaceted skills required to acquire the capability to critically think, reason, and illustrate the need to focus efforts on developing clinical reasoning skills.

Core dimensions. Clinical reasoning requires the core dimensions of knowledge, cognition, and metacognition (Turpin & Higgs, 2017). How one thinks requires strong discipline or domain specific knowledge in theory and experience (Turpin & Higgs, 2017). Cognitive or thinking skills are required to analyze, synthesize, and evaluate data (Paul & Elder, 2013; Turpin & Higgs, 2017). Metacognition or reflective awareness is needed to identify issues in information in terms of precision, accuracy, insufficiency, inconsistency, and uncertainty (Turpin & Higgs, 2017). Metacognition serves to monitor thinking and reasoning and to recognize when skills need improved, additional

knowledge is required, and when experience is insufficient to make an accurate and safe decision for the patient (Turpin & Higgs, 2017).

Design of curriculum for dietetic education should include foundational critical thinking concepts and principles but have the template for thinking be grounded in domain specific knowledge and experiences (Henderson Hurley & Hurley, 2013; Paul & Elder, 2013; Turpin & Higgs, 2017). To develop skills and ultimately expertise in a particular discipline, more knowledge of that discipline is required (Dreyfus & Dreyfus, 1980). Critical thinking about something is thinking about the specific subject content (Paul & Elder, 2013).

According to Paul and Elder (2013), effective critical thinking involves judgement that is context specific. Like skill acquisition, critical thinking is a gradual process that also develops in predicitable stages from the unreflective thinker to the accomplished thinker (Paul & Elder, 2013). Deep learning and progression as a more skilled thinker results from the ability to take ideas that have been learned and use those ideas in a domain specific way (Paul & Elder, 2013). Paul and Elder (2013) also emphasized the requirement for daily practice in the specific area where skill and understanding are desired. The domain specific knowledge, skills, experience, and expertise do not transfer from one area to another (Dreyfus, 2004). It follows that effective curriculum is designed to include domain specific knowledge and practice experiences, as well as metacognitive elements that support self-regulative learning which leads to real life-long learning (Henderson Hurley & Hurley, 2013).

Effective critical thinking and clinical reasoning education in the dietetics and nutrition discipline requires specific foundational knowledge in dietetics and nutrition,

the biological and medical sciences, as well as in critical thinking (Kicklighter et al., 2017; Price et al., 2014). Applied activities specific to nutrition and diagnosing that integrate learning across curriculum is important to improve skills specific to the discipline (Kicklighter et al., 2017; Palermo, Gibson, Dart, Whelan, & Hay, 2017b; Pender & de Looy, 2004). Repetition and specific practice are essential to develop the domain specific knowledge and skills (Dreyfus, 2004). Applied activities that incorporate metacognitive skills in the classroom and in actual clinical practice experiences are essential for the self-regulated learner (Zimmerman, 2008). Reflection-on-action can serve as a self-measure of skill development and contribute to further growth of thinking, problem-solving, and ultimately diagnosing skills (Croskerry, 2017; Schön, 1987).

Additional topics and approaches. Additional education for the dietetics and nutrition student and the dietitian nutritionist practitioner could include topics such as understanding metacognition as it applies to the dual process theory, followed by understanding and appropriate use of various decision-making strategies, awareness of cognitive biases, and investigation of strategies to reduce cognitive errors (Croskerry, 2017). Simulation could be structured such that simulated cases are designed as think aloud scenarios (Bowen & Ilgen, 2014). In the think aloud approach, participants are prompted to stop at each decision point and discuss the decision made, why they made it, and what thinking strategy was used (Bowen & Ilgen, 2014). Simulation strategies have the potential to raise student and practitioner awareness of their own thinking and cognitive errors (Bowen & Ilgen, 2014).

Clinical reasoning rubric. An innovative approach used in physical therapy education could be considered in nutrition diagnostics education, as well as other allied health professions education (Furze et al., 2015a). Furze et al. (2015a) developed a clinical reasoning grading rubric to evaluate the clinical reasoning of physical therapy students. The tool was created to allow both students and faculty to assess and track the progression of clinical reasoning skill development across the curriculum (Furze et al., 2015a). The rigorous three-year process for development of the rubric included feedback from four stakeholder groups to inform and validate the process (Furze et al., 2015a). The four stakeholder groups were interprofessional educators, physical therapy clinical educators, physical therapy education faculty, and content experts in clinical reasoning (Furze et al., 2015a). Stages of skill acquisition, content and procedural knowledge, conceptual reasoning, as well as metacognitive skills were considered and incorporated in the rubric (Furze et al., 2015a).

The approach not only serves to evaluate students, but according to the group who developed and use the rubric, as educators the process encourages a shared responsibility between the student and teacher (Furze et al., 2015a). Reflection and self-monitoring is also needed by the teacher to evaluate how to better assist the student in development of clinical reasoning skills (Furze et al., 2015a). Development of tools in the nutrition diagnostics education setting seems to be an essential element of the educational process of clinical thinking, reasoning, and diagnosing (Goodman et al., 2018). A rubric specific to nutrition diagnostics, modeled after the rubric developed by Furze et al. (2015a) would be a significant contribution to the dietetics and nutrition discipline.

Education of teachers. As Sklar (2014) pointed out, supervision by skilled and experienced faculty to guide the progression of the student through the stages of skill acquisition where diagnostic expertise develops is essential. Education of clinical faculty and preceptors regarding key elements required for clinical reasoning and diagnosing would be important to help ensure the critical development and examination of reasoning skills in faculty, preceptors, and students. According to Turpin and Higgs (2017) an educational focus on development of the core dimensions of knowledge, cognition, and metacognition is essential. Mentoring, teaching, training, coaching, and modeling by the educator should adapt to the actual knowledge level of the student (Cutrer et al, 2013; Mamede et al., 2014; Schmidt & Mamede, 2015).

Assessment of diagnostic skills through the stages of skill acquisition by the student and clinical instructors is also important and needs to be tailored to the appropriate skill stage (Sklar, 2014). Stages of development are contingent on progressive problem solving, which means students must engage in increasingly complex problems, strategically aligned with the learner's stage of development (Bowen & Ilgen, 2014; Dreyfus & Dreyfus, 1980). Evaluation of the student should include a reflection of their clinical experiences, representing problems already encountered, to provide a reliable and valuable representation of the student's reasoning skills (Bowen & Ilgen, 2014). Education for the clinical instructors regarding appropriate and systematic feedback to students could be another component of the process that ultimately supports the educational objective of development of cognitive clinical expertise.

Accreditation standards. A broader educational implication addresses the lack of theories or models to describe thinking processes in decision-making or diagnosing

beyond the nutrition care process in the dietetics and nutrition discipline (Hakel-Smith & Lewis, 2004; Sandrick, 2002; Vivanti et al., 2017). Ideally, training on the decision-making process and thinking styles should be included in the ACEND accreditation standards for undergraduate educational programs and DI programs (ACEND, 2018). Starting with specific criteria regarding both the nutrition care process and critical thinking would be an important addition to the educational standards and begin a path for faculty, students, and practitioners to understand and begin to develop the skills necessary to effectively critically think and make decisions and diagnoses using the nutrition care process.

The ACEND (2018) Accreditation Standards for Nutrition and Dietetics Didactic Programs include a component that requires the curriculum to include only knowledge of the principles of the nutrition care process. The ACEND (2018) Accreditation Standards for Nutrition and Dietetics Internship Programs include a competency that requires graduates to perform the nutrition care process. The accrediting body provides no criteria defining what competency means in terms of practice for the dietetic intern graduates (ACEND, 2018). The ACEND (2018) standards for both the didactic and internship programs also includes a requirement to apply critical thinking skills. The undergraduate didactic program requires the program curriculum to prepare students with the knowledge to apply critical thinking skills (ACEND, 2018). The internship competency states the graduate should be able to incorporate critical thinking in overall practice (ACEND, 2018). While ACEND (2018) outlines the required content for foundational dietetic training for undergraduates and interns, ACEND does not provide additional criteria to define critical thinking.

Despite the agreement that critical thinking and diagnosing nutrition problems are essential skills for the dietitian nutritionist, the dietetics and nutrition discipline has largely been unable to define and describe the skills necessary to critically reason and diagnose nutrition-related problems (Charney & Peterson, 2013; Trostler & Myers, 2008). A mandate of criteria-defined specific skills and subsequent education and training required to develop critical thinking and clinical reasoning skills by ACEND would be an overdue and essential step to begin to bring the dietetics and nutrition discipline more in line with other allied health disciplines. To undertake this significant change, the discipline has to commit to conducting the needed research and studies to understand how to define the skills.

Implications may be particularly timely given the increasing scope of dietetics and nutrition practice and the adoption of the nutrition care process and diagnosing, and the expanding roles of dietitian nutritionists. Understanding how dietitian nutritionists think and make decisions has the potential to help inform education of dietetics and nutrition students. Development in thinking and decision-making skills in practicing dietitian nutritionists via ongoing education is also relevant to the advancement of the diagnosing nutrition practitioner.

Recommendations for Future Research

Given that no research exists on reflective practice and thinking styles or decision-making in dietetics and nutrition education or in the dietetics and nutrition discipline, the recommendations that follow are all potentially significant in adding to the understanding of how students and practitioners think and reason to make clinical decisions and nutrition diagnoses. A difference in rational and experiential thinking

styles emerged from the study as a relevant area to further investigate. Given the influence of factors that impact both the reflective process and thinking styles, it is important future studies investigate the specific factors of experience and domain-specific knowledge, and potentially age, gender, and personality characteristics.

A measure of critical thinking may be another attribute to investigate in terms of the relationship between reflection, thinking styles, and ultimately clinical decision-making. The potential relationship between reflection and thinking styles, as was intended in the current study, deserves consideration for future investigation. Lastly, examination of decision-making characteristics and preferences of graduate students using the SRIS and REI-40 upon entry into the MND/DI, mid-way through the program and upon completion would be interesting to determine how decision-making skills change over time in an educational setting. Measuring the same variables in a similar allied health program, and investigation of differences between the two groups would be valuable in advancing the understanding about how allied health students and practitioners think and make clinical decisions.

Rational vs. experiential thinking styles. Arguably, the most exciting finding emerging from the study was the difference between rational and experiential thinking styles within the DI and the MND/DI graduates. While the research questions did not address the difference between rational and experiential thinking, it became obvious when investigating the data there was a difference. Scores for rational and experiential thinking were analyzed using a two-tailed *t*-test comparison for means, with a 95% level of confidence (Bluman, 2014). Overall, both DI and MND/DI graduates scored rational thinking style questions higher ($p < 0.01$) than experiential thinking style questions. The

scores for rational thinking and experiential thinking for the DI graduates were 3.96 and 3.11, respectively. The MND/DI graduates' scores were 4.02 for rational thinking styles and 3.20 for experiential thinking styles. Likewise, both groups scored higher ($p < 0.01$) in engagement toward (3.94 vs. 3.12 for DI; 3.97 vs. 3.08 for MND/DI) and ability to use rational thinking ($p < 0.01$) over experiential thinking (3.96 vs. 3.11 for DI; 4.07 vs. 3.33 for MND/DI).

Data from the study suggested both DI and MND/DI graduates perceived they had the ability to use rational more than experiential thinking, and that they preferred rational thinking over experiential thinking. Both DI and MND/DI graduates scored experiential thinking higher than the mid-point of the scale, indicating they likely used both experiential and rational thinking strategies. In line with the dual process theory and Croskerry' model, critically thinking clinicians are able to move between the two processes effectively, described by Croskerry (2009) as calibration.

Given the systematic and analytic processes associated with nutrition diagnostics practice using the Kight model, it is not surprising that graduates from the DI and the MND/DI programs favor rational thinking styles. While it is unknown how clinical decisions are made in the dietetics and nutrition discipline, the rational tendencies and preferences noted in this study may be consistent with the emphasis on critical thinking approaches and use of the Kight model (Sandrick, 2002). Further study investigating the ability and preference for rational versus experiential thinking is warranted in both dietetics and nutrition students and practitioners. Differences in preferences for rational versus experiential thinking has been investigated in paramedic students and working

paramedics (Jensen et al., 2016). A similar study could be conducted in dietetics with nutrition students and dietitian nutrition practitioners.

Experience. Experiential processes are positively related to domain-specific expertise (Croskerry et al., 2017). The relative lack of clinical experiences and professional confidence in graduates and even in competent practitioners is believed to strongly influence experiential decision-making, with a resultant reliance on rational or Type 2 thinking process (Croskerry et al., 2017). Additional information regarding quantity and quality of experiences is needed to fully understand the thinking disposition of students and practitioners. Design of future studies should include the demographic data to ascertain existence, quantity, and quality of domain-specific work experiences to understand the relevance of those experiences in making clinical decisions and diagnoses.

Metacognition and thinking styles. Further investigation into thinking styles along with reflection and insight is warranted, especially given the fact that research question four intended to examine the relationship between reflection and insight, and thinking styles was not possible due to small sample size. It seems logical there is a relationship between the ability to reflect and the ability and preference to use rational versus experiential thinking. Higher scores on the SRIS indicate a greater ability for reflection and subsequent insight, with presumably more inspection and evaluation of personal thoughts, feelings, and behaviors, along with a clearer understanding of thoughts, feelings, and behaviors (Grant et al., 2002). According to Zimmerman (2008), in the self-regulatory process, reflection occurs after each learning effort. With additional learning, knowledge, and experience, thinking approaches and styles may change

(Croskerry et al., 2017). The researcher is unaware of any studies that have investigated the relationship between the constructs of reflection, insight, and thinking styles.

Investigation of other relevant factors that may significantly impact both the reflective process and thinking styles is necessary. Those demographic factors would include age, gender, educational experience, and type and years of practice experience. In addition, an actual measure of critical thinking, as well as a measure of domain-specific knowledge would add more rigor to the study.

Critical thinking and reflection. Reflective thinking and critical thinking are thought to be linked, with reflective thinking used as a surrogate term for critical thinking (Alfaro-LeFevre, 2017; Chen et al., 2016). Chen et al. (2016) found a significant positive relationship between SRIS scores and critical thinking in nursing students. Understanding the self-reflection and insight of dietitian nutritionists may be important in developing critical thinking disposition (Chen et al., 2016). The SRIS may be used to evaluate the degree to which reflective or critical thinking is limited or enhanced in making nutrition diagnoses. Inclusion of a critical thinking measure to simply investigate critical thinking of dietetics and nutrition students and dietitian nutrition practitioners would be valuable and has not yet been studied. Using the study by Chen et al. (2016) as a template, a similar study could be designed to understand the relationship between critical thinking and reflection in dietetics and nutrition students, as well as dietitian nutrition practitioners.

Longitudinal and cross discipline study. It one would be valuable to understand how skill acquisition progresses in nutrition diagnostic students. Sequential scores for self-reflection, insight, and thinking styles in the same group of students could

be investigated in the MND/DI students. Scores could be obtained at the beginning of the first academic year, at the end of the first year of the program, and then upon program completion to the end of the second academic year. The same data could be collected, and comparisons made between the MND/DI students and students in the graduate program in occupational therapy that resides at the same Midwest college as the MND/DI.

The graduate programs in nutrition diagnostics and occupational therapy are similar in that they are preparing students for entry level practice (Institutional Data, n.d.) The curriculum in both programs includes theoretical and clinical practice courses that are designed to provide the domain-specific knowledge and experiences for entry level practice (Institutional Data, n.d.). Understanding of the underlying constructs that influence decision-making in future students can provide insight into teaching and learning strategies that promote accurate decision-making and diagnosing. A comparison of the SRIS and REI-40 scores between the nutrition diagnostic students and occupational students would add to the understanding of clinical reasoning and decision-making in the healthcare professions and would be the first study to investigate the skills of reflection, insight, and thinking styles between the professions.

Summary

This mixed methods study begins to advance the knowledge and understanding of critical thinking in the dietetics and nutrition discipline. Specifically, the investigation into reflection, insight, and thinking styles is the first study about critical thinking and decision-making in dietetics and nutrition education or in the dietetics and nutrition discipline. The concepts of reflection, insight, and thinking styles serve as means to

engage in critical thinking in dietetics and nutrition practice. There is a need for examination of thinking to see why humans do what they do in order to interpret and understand our experiences to gain new knowledge as we make diagnostic decisions.

According to Sloman and Fernbach (2017), humans are error-prone, often ignorant, and lacking in rational thinking. Humans operate under an illusion that one understands, yet the reality is humans, "frequently don't know what we don't know" (Sloman & Fernbach, 2017, p. 15). Complexity in the world and healthcare is expanding, increasing the need to recognize our ignorance and flawed thinking in order to solve our most complex problems (Paul & Elder, 2013; Sloman & Fernbach, 2017). Two Institute of Medicine reports (Balogh et al., 2015), one in 2000 and the follow-up in 2015, highlighted the significance of diagnostic error in patient safety. Cognitive errors or flaws in thinking and reasoning are thought to be the most common source of errors in making diagnostic decisions (Croskerry et al., 2017).

In the discipline of dietetics and nutrition, very little is known about critical thinking, clinical decision-making, and nutrition diagnosing, despite the adoption of a nutrition care process that includes diagnosis as the central component and goal of the process (Charney & Peterson, 2013; Goodman et al., 2018; Hakel-Smith & Lewis, 2004; Lacey & Pritchett, 2003; Trostler & Myers, 2008; Vivanti et al., 2017). The dietetics and nutrition discipline acknowledges the importance of diagnosing and critical thinking in the nutrition care process, yet has only begun to define and describe the necessary skills required to critically reason and diagnose nutrition problems (Charney & Peterson, 2013; Goodman et al., 2018; Swan et al., 2017; Trostler & Myers, 2008). Because information about how practitioners in dietetics and nutrition clinically reason, think about, and make

decisions is largely unexplored (Goodman et al., 2018; Trostler & Myers, 2008), the researcher relied on the literature in medicine and other allied health disciplines to provide background and lay a foundation to understand clinical reasoning and diagnosing (Croskerry et al., 2017; Furze et al., 2015a; Nikopoulou-Smyrni & Nikopoulos, 2007).

The theoretical basis for the study was informed by three theories in skill acquisition, self-regulation, and thinking styles (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008). The Dreyfus model of skill acquisition served to outline the stages of clinical competence and illustrate the level of experience and knowledge linked to how decisions might be made (Benner, 2004; Dreyfus & Dreyfus, 1980). An experienced expert is described as having significant knowledge and expertise and relies more on intuitive decision-making, while the beginning practitioner is reliant on analytical thinking and decision-making (Benner, 2004; Dreyfus & Dreyfus, 1980).

Croskerry's dual process model of diagnostic reasoning categorizes thinking processes into intuitive or experiential processes and analytical or rational processes (Croskerry, 2009). The experiential process is typically associated with more experience and knowledge, while the rational process is thought to be used in more complex situations and by less experienced and knowledgeable practitioners (Croskerry et al., 2017). The ability to engage the appropriate thinking process by reflection is thought to be important in making more conscious and reasoned decisions (Croskerry et al., 2014). Self-reflection and insight are two metacognitive components of self-regulation that can assist in promoting problem-solving (Clark & Zimmerman, 2014).

Zimmerman's model of self-regulation consists of strategic thinking and action before, during, and after a clinical task (Zimmerman, 2008). The three models of skill

acquisition, dual process, and self-regulation indicate the ability to self-regulate behavior by increased reflection and insight may influence the thinking processes used to make clinical decisions by both novice and expert practitioners (Croskerry, 2009; Dreyfus & Dreyfus, 1980; Zimmerman, 2008).

Critical thinking is agreed to be essential for all healthcare practitioners and is important in solving clinical problems, diagnosing, and ultimately reducing diagnostic errors (Facione & Facione, 2008; Huang et al., 2014; Sharples et al., 2017). Facione and Facione (2008) described critical thinking as a term that describes the cognitive processes required for clinical reasoning. Critical thinking lacks a common definition, often represented by other concepts including clinical reasoning; clinical decision-making; diagnostic reasoning; clinical judgment; critical appraisal; reflective thinking; rational reflection; and rational, reflective thinking (Alfaro-LeFevre, 2017; Croskerry et al., 2014; Ennis, 2015; Furz et al., 2015b; Huang et al., 2014; Turpin & Higgs, 2017; Victor-Chmil, 2013). What seems important in defining critical thinking is the inclusion of the concepts of analysis, evaluation, and self-reflection (Facione, 1990; Foundation for Critical Thinking, n.d.; Huang et al., 2014)

Paul and Elder (2013) defined critical thinking as thinking about thinking, or metacognition. The metacognitive skills of self-monitoring and self-regulation, or specifically, reflection and insight, have been identified as being among the most important skills in making good diagnostic decisions (Croskerry, 2017). The ability to monitor and evaluate one's thought processes is a characteristic of higher quality thinking, self-regulation, and improved decision-making (Croskerry, 2017; Paul & Elder, 2013; Zimmerman, 2008).

The exploration of experiences, self-awareness, self-monitoring, and insight provide the required foundation for critical thinking and connect the concept of thinking styles (Croskerry, 2017; Croskerry et al., 2017; Huang et al., 2014, 2016). Critical thinking using self-reflection where experiences, behaviors, and decisions are reviewed, results in moving from unconscious to conscious thinking (Pai, 2015; Tsingos et al., 2015). Unconscious thinking is analogous to Type 1, intuitive, or experiential processing, while conscious thinking is described as Type 2, analytical, or rational processing in Croskerry's universal model of diagnostic reasoning (Croskerry, 2009). The principal characteristics of Type 1 processes include the features of low awareness, high automaticity, fast processing, associative, low effort, high capacity, low reliability, and error prone with risk for cognitive bias (Croskerry, 2009; Evans, 2013). Type 2 processing is described as high awareness and control, rule based, high effort, low capacity, high reliability with rare errors, and normative reasoning (Croskerry, 2009; Evans, 2013).

Croskerry's model mapped out the two types of processing as related to diagnostic thinking to include integrated cognitive and metacognitive constructs (Croskerry, 2009). The universal model includes consideration of biases, heuristics, pattern recognition, monitoring, and calibration (Croskerry, 2009). Skill acquisition results from repetitive analytic processing that leads to and allows intuitive processing (Croskerry et al., 2013). While the experiential process is the primary default mode where excessive reliance on the intuitive process prevents reflection and use of the rational process, effort directed at analytic reasoning using metacognitive skills can

override unconscious negative biases allowing the clinician to move back and forth between the two systems, calibrating one's thinking (Croskerry et al., 2013, 2017).

To evaluate reflection, insight, and thinking styles, and to investigate the possible relationship among reflection, insight, and thinking styles in graduates of a 10-month DI and of a 22-month combined nutrition diagnostic MND/DI program, this mixed methods study drew on the strength of both qualitative and quantitative data. The quantitative approach used validated survey instruments, the SRIS and REI-40, to determine statistical differences between the concepts of reflection, insight, and thinking styles in the two groups of dietetics and nutrition practitioners: graduates of a 10-month DI and a 22-month MND/DI. The SRIS measured two components of self-regulation: self-reflection and insight, where self-reflection is the tendency to think about and evaluate thoughts, actions, and feelings, and insight is the clarity of experience and self-knowledge (Grant et al., 2002). The second questionnaire, the REI-40 examined the preference for two decision-making styles: rationality and experientiality (Epstein et al., 1996).

The qualitative component of the study used a semi-structured, open-ended question instrument to guide the interview process in two focus groups, all with similar didactic and clinical practice experiences (Stalmeijer et al., 2014; Wilson, 2016b). The focus group questions were used to investigate participant perceptions regarding their thinking styles and abilities to diagnose nutrition problems. Participants were recruited from students in the May 2018 cohort of the 22-month combined MND/DI.

A paired *t*-test was used to compare SRIS scores for self-reflection and insight between DI and MND/DI groups (Bluman, 2014). A paired *t*-test was also used to

compare REI-40 scores between the DI and MND/DI groups (Bluman, 2014). There were no significant differences in the scores for self-reflection and insight between the DI and the MND/DI groups. The REI-40 scores for overall rationality and experientiality, as well as for the subscales of rational ability, rational engagement, experiential ability, and experiential engagement were also not different between the DI and the MND/DI graduates.

The qualitative analysis of perceptions of nutrition diagnosing resulted in the emergence of three core themes from the focus groups: confidence, competence and coaching. A greater sense of confidence with progression through the two-year program appeared to be due to additional time in clinical experiences, as well as additional knowledge gained from the second-year coursework. Development of critical thinking skills and metacognitive development may also have contributed to the confidence in the cohort participants, along with mentoring of first-year students that provided a measure of skill comparison.

The participants verbalized an improvement in competence in clinical skills and attributed that improvement to the additional time to learn and practice with patients. The repetition in seeing more patients, along with the advanced assessment and clinical courses in the second year were contributors to improvement in clinicals, and by extension, diagnostic skills. Again, critical thinking and the metacognitive skill of self-awareness and reflection may have contributed to the improvement in competence.

The coaching and mentoring theme appeared to triangulate the first two themes of confidence and competence. The value of learning from and being coached by more experienced faculty and preceptors served to help knowledge and skill development,

challenging students' thinking and ultimately contributing to improved confidence and competence.

The second aspect of the theme experienced by cohort participants was serving in a coaching and mentoring role to the first-year students. Second-year students recognized their own growth in experience and knowledge and were able to assist first-year students in working through the diagnostic process. Participants recognized the increase in their ability to work independently and guide less experienced and skilled first-year students. Croskerry (2017) indicated the ability to recognize the achievement of advancement in skills as metacognition, important for continued learning and self-regulation.

Despite the inability to show a difference between the reflection process and thinking styles of DI and MND/DI graduates as a result of the quantitative data, information from this study adds to the current knowledge on decision-making by dietitian nutritionists and is potentially important for developing dietetics and nutrition program curriculum, as well as continuing education and clinical support tools for practitioners. The qualitative component of the study provides some insight into how students perceive educational experiences that include critical thinking principles, as well as application of those principles to practice via the Kight nine step nutritional care process where the diagnosis is central to the process. Results of the focus groups served to highlight the lack of a real connection to critical thinking. Conceptions of, and reflections on, clinical reasoning and diagnosing were underdeveloped, disconnected, and absent. The lack of connection reinforced the complex and challenging nature of the

multifaceted skills required to acquire the capability to critically think and reason and illustrate the need to focus efforts on developing clinical reasoning skills.

Designing effective critical thinking and clinical reasoning education in the dietetics and nutrition discipline requires specific foundational knowledge in nutrition and dietetics, the biological and medical sciences, as well as in critical thinking (Kicklighter et al., 2017; Price et al., 2014). Repetition of discipline specific application across the curriculum is needed to develop the required domain-specific knowledge and experience (Dryefus, 2004 Kicklighter et al., 2017). Inclusion of metacognitive skill development, along with application to the dual process theory, is important. A foundational understanding and appropriate use of various decision-making strategies, awareness of cognitive biases, and investigation of strategies to reduce cognitive errors seems relevant for both students and practitioners (Croskerry, 2017).

The potential for further studies is exciting with many possibilities, given the void in the understanding of, and study in, critical thinking, metacognition, and decision-making in the dietetics and nutrition discipline. Further studies investigating the difference in rational and experiential thinking styles between students and practitioners is an important area relevant to understanding how dietetics and nutrition students and practitioners make clinical decisions and nutrition diagnoses. Inclusion of demographics that may influence thinking such as experience and domain-specific knowledge, and potentially age, gender, and personality characteristics in those studies would be important.

A longitudinal study examining the SRIS and the REI-40 in the two-year MND/DI program to ascertain changes over time related to the educational experiences

would provide additional insight into diagnostic skill acquisition. Students in a two-year graduate program in occupational therapy at the participating institution could be added to the two-year study to investigate differences between the two disciplines. Measurement of critical thinking in dietetics and nutrition students and practitioners using validated tools would also be important to describe actual critical thinking skills and disposition and to compare to other studies and healthcare disciplines.

Kahneman (2013) characterized humans as not being irrational but requiring help to be better decision makers. Kahneman (2013) maintained improvements in judgments and decision-making require considerable intentional effort and stated, "my intuitive thinking is just as prone to overconfidence, extreme predictions… as it was before I made a study of these issues" (p. 417). The ability to develop skilled experiential thinking requires repetition in terms of sufficient domain-specific practice opportunities, along with quality and timely feedback to recognize limits and failings of expertise otherwise not illuminated (Kahneman, 2013).

According to Kong (2014), critical thinking development requires long-term training with ongoing monitoring and evaluation. The health and safety of patients, of which nutrition is a significant component, requires sound clinical reasoning (Alfaro-LeFevre, 2017; Croskerry et al., 2017; Turpin & Higgs, 2017). Clinical reasoning is determined by core dimensions of knowledge, cognition, and metacognition as part of a complex domain specific system of skill acquisition, self-regulation, and ongoing clinical calibration of thinking (Croskerry, 2009; Turpin & Higgs, 2017). The significant efforts to make improvements in the core dimensions are worthwhile in helping humans optimize health and well-being.

Appendix A

Self-Reflection and Insight Scale

SRIS

Please read the following questions and circle the response that indicates the degree to which you agree or disagree with each of the statements. Try to be accurate but work quite quickly. Do not spend too much time on any question.

THERE ARE NO "WRONG" OR "RIGHT" ANSWERS – ONLY YOUR OWN PERSONAL PERSPECTIVE
BE SURE TO ANSWER EVERY QUESTION ONLY CIRCLE ONE ANSWER FOR EACH QUESTION

		Disagree Strongly	Disagree	Disagree Slightly	Agree Slightly	Agree	Agree Strongly
		1	2	3	4	5	6
1.	I don't often think about my thoughts						
2.	I am not really interested in analyzing my behaviour						
3.	I am usually aware of my thoughts						
4.	I'm often confused about the way that I really feel about things						
5.	It is important for me to evaluate the things that I do						
6.	I usually have a very clear idea about why I've behaved in a certain way						
7.	I am very interested in examining what I think about						
8.	I rarely spend time in self-reflection						
9.	I'm often aware that I'm having a feeling, but I often don't quite know what it is						
10.	I frequently examine my feelings						
11.	My behaviour often puzzles me						
12.	It is important to me to try to understand what my feelings mean						
13.	I don't really think about why I behave in the way that I do						
14.	Thinking about my thoughts makes me more confused						
15.	I have a definite need to understand the way that my mind works						
16.	I frequently take time to reflect on my thoughts						
17.	Often I find it difficult to make sense of the way I feel about things						
18.	It is important to me to be able to understand how my thoughts arise						
19.	I often think about the way I feel about things						
20.	I usually know why I feel the way I do						

Appendix B

SRIS Permission

From: **Kristen Williams**
Date: Sun, Jul 2, 2017 at 8:37 PM
Subject: Self-Reflection and Insight Scale (SRIS)
To: anthonyg@psych.usyd.edu.au

Hello Dr. Grant,

I am a doctoral student and am interested in the possibility of using your SRIS in my dissertation. I am working to try and determine a dissertation topic with my advisors at this time. I am a dietitian and direct a master's program in nutrition diagnostics. I am interested ultimately in determining the skills of graduates in making accurate diagnoses.

The medical literature talks about the relationship of cognitive failures and misdiagnosing. I came across your work in looking at the literature re: the cognitive errors and the thinking that mindfulness and/or being self-aware may be helpful in reducing the errors.

Is your SRIS available for use in an application that I am considering? If so, is there a cost?

Thanks so much!
Kristen Williams

PS- I work at a small single purpose college that educates healthcare providers.

On Fri, Jul 7, 2017 at 3:35 AM, Anthony Grant <anthony.grant@sydney.edu.au> wrote:

Hi Kristen

Good to hear from you. Please feel free to use the SRIS. I am attaching some papers that might be of interest.
Warm regards,
Tony Grant

ANTHONY M GRANT PhD | Associate Professor
Director: Coaching Psychology Unit | School of Psychology
THE UNIVERSITY OF SYDNEY

Room 424, First Floor Brennan Building (A18)
The University of Sydney | NSW | 2006 | Australia
T +61 2 9351 6792 | **M** 0413 747 493
E anthony.grant@sydney.edu.au

Appendix C

Rational-Experiential Inventory-40

Instructions: Using the following scale, please rate the extent that these items refer to you.

1	2	3	4	5
Definitely true of myself				*Definitely not true of myself*

Rationality scale

Rational Ability

1) I'm not that good at figuring out complicated problems.*
2) I am not very good at solving problems that require careful logical analysis.*
3) I am not a very analytical thinker.*
4) Reasoning things out carefully is not one of my strong points.*
5) I don't reason well under pressure.*
6) I am much better at figuring things out logically than most people.
7) I have a logical mind.
8) I have no problem thinking things through carefully.
9) Using logic usually works well for me in figuring out problems in my life.
10) I usually have clear, explainable reasons for my decisions.

Rational Engagement

11) I try to avoid situations that require thinking in depth about something.*
12) I enjoy intellectual challenges.
13) I don't like to have to do a lot of thinking.*
14) I enjoy solving problems that require hard thinking.
15) Thinking is not my idea of an enjoyable activity.*
16) I prefer complex problems to simple problems.
17) Thinking hard and for a long time about something gives me little satisfaction.*
18) I enjoy thinking in abstract terms.
19) Knowing the answer without having to understand the reasoning behind it is good enough for me.*
20) Learning new ways to think would be very appealing to me.

Experientiality scale

Experiential Ability

21) I don't have a very good sense of intuition.*
22) Using my gut feelings usually works well for me in figuring out problems in my life.
23) I believe in trusting my hunches.
24) I trust my initial feelings about people.
25) When it comes to trusting people, I can usually rely on my gut feelings.
26) If I were to rely on my gut feelings, I would often make mistakes.*
27) I hardly ever go wrong when I listen to my deepest gut feelings to find an answer.
28) My snap judgments are probably not as good as most people's.*
29) I can usually feel when a person is right or wrong, even if I can't explain how I know.
30) I suspect my hunches are inaccurate as often as they are accurate.*

Experiential Engagement

31) I like to rely on my intuitive impressions.
32) Intuition can be a very useful way to solve problems.
33) I often go by my instincts when deciding on a course of action.
34) I don't like situations in which I have to rely on intuition.*
35) I think there are times when one should rely on one's intuition.
36) I think it is foolish to make important decisions based on feelings.*
37) I don't think it is a good idea to rely on one's intuition for important decisions.*
38) I generally don't depend on my feelings to help me make decisions.*
39) I would not want to depend on anyone who described himself or herself as intuitive(-).
40) I tend to use my heart as a guide for my actions.

Note: Labels should be removed and items randomized prior to administration. Items marked with an asterisk (*) should be reverse coding prior to scoring. Subscale scores are computed by averaging the 10 composite items.

(Pacini & Epstein, 1999)

Appendix D

Rational Experiential Inventory Open Use

http://www.psytoolkit.org/survey-library/thinking-style-rei.html

Rational Experiential Inventory (REI)

main|survey library|copyright

Introduction

People seem to have two different modes of thinking:

1. fast intuitive automatic thinking
2. slower logical thinking

The Rational Experiential Inventory measures to what degree people engage in these two modes of thinking. According to the model of the developers (Pacini & Epstein, 1999), the thinking style reflects part of people's personality. This work is based on Epstein's theoretical work, known as the Cognitive Experimental Self Theory (CEST). You can read more about this here and here.

> Thinking, Fast and Slow is a famous book by Daniel Kahneman, a Nobel Prize winning psychologist. This book focuses on the distinction between two modes of thinking: System 1 is fast and intuitive. System 2 is slower and more logical. Great video with Kahneman explaining the theory.

There were earlier versions of the REI. This PsyToolkit implementation uses the improved REI (Pacini & Epstein, 1999). This scale has 40 Likert items.

The scale results in 2 main scales (rationality and experientiality, 1 and 3 below), and 4 subscales (numbers 2,3, 5, and 6 below):

1. Rationality
2. Rational Ability
3. Rational Engagement
4. Experientiality
5. Experiential Ability
6. Experiential Engagement

Interestingly, in most of these scales (except Rational Engagement), there is a difference between men and women. Men score higher on rationality and women on experientiality (see Table 5 of the Pacini and Epstein paper; some of these data are in the table below).

Table 1. Average scores of men and women (315 women, 75 men, 9 unknown).

Scale	**Men**	**Women**
Rationality	3.54	3.36
Rational Ability	3.54	3.29
Rational Engagement	3.55	3.42
Experientiality	3.33	3.57
Experiential Ability	3.35	3.53

Table 1. Average scores of men and women (315 women, 75 men, 9 unknown).

Scale	Men	Women
Experiential Engagement	3.31	3.61

In the Pacini and Epstein paper, the scale is described as running from "from 1 (definitely not true of myself) to 5 (definitely true of myself)." (p. 974). In this PsyToolkit implementation, the scores between those two have been labeled as well by me, and the way they have been labeled is being used elsewhere as well. It is unclear if they did this in the original study.

Run the demo

Click here to run a demo of the survey

Legal stuff

It seems that the improved REI, described in Pacini and Epstein's article (1999), can be used by researchers as long as the original paper and authors are acknowledged.

Technically

This is a fairly standard type of scale question in which some items are reverse scored. Because the scale's runs from 1 to 5, the score does not need to be explicitly set in the scale, because the default scoring starts with 1.

Also note that the code has two lines starting with a # sign. These are comment lines which the computer ignores, but which are handy for humans trying to understand the code.

Appendix E

Focus Group Questions

The purpose of this focus group is to understand more about your thought processes when you make nutritional diagnoses. I would like to hear about this area from each of you and make this a conversation. It is ok to present a different view or build on what others have to say in regard to the questions being asked. You may want to jot down some notes about what you think as you listen and reflect on other's comments as well.

1. Tell me why you chose dietetics as your profession and what you most enjoy when you are not studying or practicing dietetics.
2. Think back to your introduction to nutrition diagnostics and describe that experience.
3. Tell me how your thought process used in nutritional diagnosing has changed throughout this program related to using Kight's approach to nutrition diagnostics and the 5 axes of evidence.
4. Building on the previous question, how has your thinking approach to nutritional diagnosing changed throughout this program related to using Kight's approach to nutrition diagnostics and the Nine Step Nutrition Care Process?
5. How has the Critical Thinking course impacted you in regard to nutritional diagnosing?
6. In what ways has the course, Advanced Nutrition Assessment, changed your thinking about nutrition diagnosing?

7. Tell me how your thought process in regard to diagnosing nutrition problems has changed throughout this program related to the Advanced Applied MNT courses and approaches.
8. Based on your experiences in the second-year rotations and approaches, tell me how your thinking approach to nutritional diagnosing has changed.
9. In thinking about the approaches discussed previously, what has been the most helpful in facilitating your thinking approach?
10. In thinking about those same approaches previously discussed, what was not as valuable in facilitating your thinking approach?
11. What learning activities presented in this program have been most useful to you in your learning to diagnose nutrition problems?
12. Is there something about your thinking approach to nutritional diagnostics that I should have asked you about but did not?

Appendix F

Study Institution Acknowledgment Letter

Dear Lindenwood University,

Please accept this letter as approval for Kristen Williams to conduct her research using alumni from the Dietetic Internship, the Master's of Nutrition Diagnostics/Dietetic Internship and students from the current Master's of Nutrition Diagnostics/Dietetic Internship cohort that will graduate in May 2018. understands the mixed methods study will include two administered online surveys, the SRIS and the REI-40, and the use of student interviews in a focus group format.

Sincerely,

President,

Appendix G

LINDENWOOD

LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

DATE:	March 8, 2018
TO:	Kristen Williams, M.S.
FROM:	Lindenwood University Institutional Review Board
STUDY TITLE:	[1145918-1] Reflection, Insight and Critical Thinking in Nutrition Diagnostic Graduates
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	March 8, 2018
EXPIRATION DATE:	March 7, 2019
REVIEW TYPE:	Expedited Review

Thank you for your submission of New Project materials for this research project. Lindenwood University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review (Cat. 7) based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the completion/amendment form for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of March 7, 2019.

Please note that all research records must be retained for a minimum of three years.

If you have any questions, please contact Michael Leary at 636-949-4730 or mleary@lindenwood.edu. Please include your study title and reference number in all correspondence with this office.

If you have any questions, please send them to IRB@lindenwood.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Lindenwood University Institutional Review Board's records.

Appendix H

TO: Kristin Williams
STUDY #: SP201806
COMMITTEE ACTION: Approval
ACTION DATE: 3.15.2018

STUDY TITLE: *Reflection, Insight and Critical Thinking in Nutrition Diagnostics Graduates*

This study qualifies as expedited. You described your study as:

The primary purpose of this study is to evaluate reflection, insight and thinking styles in graduates of a 10-month Nutrition Diagnostics Dietetic Internship and of a 22-month combined Nutrition Diagnostics Master of Science/Dietetic Internship program. Understanding the skills of reflection, insight and the preferences toward, and perceived ability to use, experiential and rational thinking styles can provide insight into the quality of thinking and clinical reasoning in graduates who have used an advanced practice approach to nutrition diagnosing in their post baccalaureate training required to become Registered Dietitians.
The primary aim of this study is to begin to address the large void in the dietetics and nutrition literature and practice regarding how practitioners think and reason in making decision. The current and future healthcare environment present challenges that will require dietitian nutritionists to possess critical thinking and reasoning skills to identify and solve complex patient problems (Brody, et al., 2012; Charney & Peterson, 2013; Pender & de Looy, 2004). As a result, there is an urgency for the development of these skills in dietetic education and the need to describe the skills in practicing professionals. The relationships between self-reflection and insight, and critical thinking is required to ultimately understand the quality of thinking and clinical decisions.

This means you may implement your research as described in the application. Any deviations or changes in implementation must be reported to the HRPC as these changes may alter approval status. You must also report any problems or complaints promptly to the HRPC. This approval is valid for one year from the date indicated above. Please inform the HRPC when the study is completed. If the study is still in progress after one year, you will need to provide an update to the HRPC.

Please retain a copy of this letter for your records.

HRPC CHAIR:

Director of Compliance and Assurance

NSTITUTIONAL OFFICIAL:

Appendix I

Recruitment Letter - Surveys

Dear Graduate of Nutrition Diagnostics Program,

I am conducting a dissertation study entitled, "Reflection, Insight, and Critical Thinking in Nutrition Diagnostics Graduates." This email is to request your participation in this research. The purpose of this study is to investigate self-reflection, insight, and thinking styles as factors that potentially influence nutritional diagnosing.

Your participation in this study will involve completing two short surveys. The SRIS scores the characteristics of self-reflection and insight and will take 10-15 minutes. The REI-40 measures two independent dimension of information processing or thinking - rational and experiential. This survey also takes approximately 10-15 minutes to complete.

Your consent to participate in the surveys is included in the link to each of the surveys. The surveys will be anonymous, and you will not be asked to provide any contact information.

The risks to you as a participant in this study are minimal. To ensure anonymity, no identifiers will be collected during the study. You can choose not to participate, and you may withdraw from the study at any time. There are no direct benefits to you for participating; however, the dietetics discipline may benefit from your participation.

The results of this study may be published in a newsletter or academic journal, as well as used to improve coursework in the Nutrition Diagnostics programs. The results of the study will be reported as group data and will always remain anonymous. Again, at no time will you be asked to report your name or identity.

If you have any questions regarding this study, please contact me or my dissertation chair, Dr. Rhonda Bishop. If you have any questions regarding your rights as a participant, please contact Michael Leary, Director of the Lindenwood Institutional Review Board at 636-949-4730.

Please complete the surveys by clicking the link/s:

Thank you in advance for participating in this research.
Sincerely,

Kristen Williams, MS, RD, LD
Doctoral Student
School of Education
Lindenwood University

Appendix J

Recruitment Letter - Surveys and Focus Group

Dear May 2018 Graduate of Nutrition Diagnostics Program,

I am conducting a dissertation study entitled, "Reflection, Insight, and Critical Thinking in Nutrition Diagnostics Graduates." This email is to request your participation in this research. The purpose of this study is to investigate self-reflection, insight, and thinking styles as factors that potentially influence nutritional diagnosing.

Your participation in this study will involve completing two short surveys and participation in a focus group. The two surveys will each take approximately 10-15 minutes to complete and the focus group session will be about one hour in length.

The first survey, the Self-Reflection and Insight Scale (SRIS), scores the characteristics of self-reflection and insight. The second survey, the Rational Experiential Inventory-40 (REI-40), measures two independent dimensions of information processing or thinking - rational and experiential.

Your consent to participate in the surveys is included in the link to each of the surveys. The surveys will be anonymous. You will not be asked to provide any contact information.

In the second aspect of the study you will participate in a focus group consisting of 5-6 individuals from your MND/DI cohort. To extend the understanding of how you think about making clinical decisions, you will be asked questions about your perceptions of the process of nutritional diagnosing. A facilitator will conduct the one hour focus group session. The session will be audio recorded and analyzed after you have graduated.

The risks to you as a participant in this study are minimal. To ensure anonymity, no identifiers will be collected during the study. However, despite all efforts to protect your anonymity, it is possible your responses may be recognized due to the small sample size. You can choose not to participate, and you may withdraw from the study at any time. There are no direct benefits to you for participating; however, the dietetics discipline may benefit from your participation.

The results of this study may be published in a newsletter or academic journal, as well as used to improve coursework in the Nutrition Diagnostics programs. The results of the study will be reported as group data and will always remain anonymous. Again, at no time will you be asked to report your name or identity.

If you have any questions regarding this study, please contact me or my dissertation chair, Dr. Rhonda Bishop. If you have any questions regarding your rights as a participant, please contact Michael Leary, Director of the Lindenwood Institutional Review Board at 636-949-4730.

Please sign the attached consent form for the focus group session and return to me. I will notify you of the location, day, and time of the focus group session. Thank you in advance for participating in this research project.

Sincerely,

Kristen Williams, MS, RD, LD
Doctoral Student
School of Education
Lindenwood University

Please complete the surveys by clicking the link/s:

Appendix K

LINDENWOOD

Survey Research Information Sheet

You are being asked to participate in two surveys conducted by Kristen Williams and Dr. Rhonda Bishop at Lindenwood University. We are doing this study to investigate self-reflection, insight and thinking styles as factors that potentially influence nutritional diagnosing. The first survey will ask questions that measure aspects of self-awareness that relate to cognitive flexibility and self-regulation, while the second survey will ask questions about the ability to use, and preference for, two decision making styles: rational and experiential. It will take about 10-15 minutes to complete each survey.

Your participation is voluntary. You may choose not to participate or withdraw at any time by simply not completing the survey or closing the browser window.

There are no risks from participating in this project. We will not collect any information that may identify you. There are no direct benefits for you participating in this study.

WHO CAN I CONTACT WITH QUESTIONS?

If you have concerns or complaints about this project, please use the following contact information:

Kristen Williams

Dr. Rhonda Bishop

If you have questions about your rights as a participant or concerns about the project and wish to talk to someone outside the research team, you can contact Michael Leary (Director - Institutional Review Board) at 636-949-4730 or mleary@lindenwood.edu.

By clicking the link below, I confirm I have read this form and decided I will participate in the project described above. I understand the purpose of the study, what I will be required to do, and the risks involved. I understand I can discontinue participation at any time by closing the survey browser. My consent also indicates that I am at least 18 years of age.

You can withdraw from this study at any time by simply closing the browser window. Please feel free to print a copy of this information sheet.

Appendix L

LINDENWOOD

Research Study Consent Form

Reflection, Insight, and Critical Thinking in Nutrition Diagnostics Graduates

Before reading this consent form, please know:

- Your decision to participate is your choice
- You will have time to think about the study
- You will be able to withdraw from this study at any time
- You are free to ask questions about the study at any time

After reading this consent form, we hope you will know:

- Why we are conducting this study
- What you will be required to do
- What are the possible risks and benefits of the study
- What alternatives are available, if the study involves treatment or therapy
- What to do if you have questions or concerns during the study

Basic information about this study:

- We are interested in learning about the characteristics of self-reflection, insight and thinking styles as factors that potentially influence nutritional diagnosing.
- You will be asked questions about your perceptions of the process of making a nutritional diagnosis.
- Risks of participation include a possibility of your responses being recognized due to the small sample size, despite efforts to protect your anonymity.

LINDENWOOD

Research Study Consent Form

Reflection, Insight, and Critical Thinking in Nutrition Diagnostics Graduates

You are asked to participate in a research study being conducted by Kristen Williams under the supervision of Dr. Rhonda Bishop at Lindenwood University. Being in a research study is voluntary, and you are free to stop at any time. Before you choose to participate, you are free to discuss this research study with family, friends, or a physician. Do not feel like you must join this study until all of your questions or concerns are answered. If you decide to participate, you will be asked to sign this form.

Why is this research being conducted?
We are doing this study to investigate self-reflection, insight and thinking styles as factors that potentially influence nutritional diagnosing. We will be asking about 10 other people to answer these questions.

What am I being asked to do?
You will be required to answer questions in a small focus group of 5-6 individuals from your Master's in Nutrition Diagnostics/Dietetic Internship cohort. The focus group will consist of one session. Questions will be asked by a facilitator and the sessions will be audio recorded for analysis by the researcher after you have graduated.

How long will I be in this study?

Your participation will consist of one focus group session and should be one hour in length.

Who is supporting this study?
This is a no cost study. No members of the research team have a financial conflict of interest.

What are the risks of this study?

- Privacy and Confidentiality:

We will be collecting data that could identify you, but each response will receive a code so that we will not know who answered each question. The code connecting you and your data will be destroyed as soon as possible. However, despite all efforts to protect your anonymity, it is possible that your responses may be recognized due to the small sample size.

What are the benefits of this study?

You will receive no direct benefits for completing this survey. Results of the study could yield information future researchers might use to determine what thinking skills and styles result in higher critical thinking and diagnostic skills in dietitian nutritionists.

Will I receive any compensation?
There is no compensation for participating in the study.

What if I do not choose to participate in this research?

It is always your choice to participate in this study. You may withdraw at any time. You may choose not to answer any questions or perform tasks that make you uncomfortable. If you decide to withdraw, you will not receive any penalty or loss of benefits. If you would like to withdraw from a study, please use the contact information found at the end of this form.

What if new information becomes available about the study?

During the course of this study, we may find information that could be important to you and your decision to participate in this research. We will notify you as soon as possible if such information becomes available.

How will you keep my information private?

We will do everything we can to protect your privacy. We do not intend to include information that could identify you in any publication or presentation. Any information we collect will be stored by the researcher in a secure location. The only people who will be able to see your data are: members of the research team, qualified staff of Lindenwood University, representatives of state or federal agencies.

How can I withdraw from this study?

Notify the research team immediately if you would like to withdraw from this research study.

Who can I contact with questions or concerns?

If you have any questions about your rights as a participant in this research or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the Lindenwood University Institutional Review Board Director, Michael Leary, at (636) 949-4730 or mleary@lindenwood.edu. You can also contact the researcher, Kristen Williams as well as Dr. Rhonda Bishop.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my participation in the research described above.

_____	_____
Participant's Signature	**Date**
_____	
Participant's Printed Name	

_____	_____
Signature of Principal Investigator or Designee	**Date**
_____	
Investigator or Designee Printed Name	

Appendix M

Facilitator Instructions

Thank you for agreeing to be the facilitator for this study. Please follow the instructions given to establish and maintain consistency and reliability. You are encouraged to ask questions to clarify and simplify the process as needed.

1. Each of the two focus group sessions will consist of five to six participants.
2. Review the consent form with the group prior to starting the session. Remind participants there is no obligation to respond to every question, and they can stop their participation at any time.
3. Participants will sit at tables arranged to face the facilitator. Each participant will be identified by consecutive numbers from one to eleven via table tents arranged on the tables. Once the participants are seated with a numbered table tent ask them to speak their number. Participants will speak their number prior to answering each focus group question.
4. Both focus groups' questions and answers will be audiotaped using an IPad. Please encourage participants to speak clearly and with enough volume to ensure their responses are captured in the recording.
5. Inform the participants the intended duration of the session is one hour, and encourage them to answer questions as thoroughly and precisely as possible.
6. Establish a warm and friendly environment and start with the first question to create rapport and begin the session.
7. Control reactions to participants to remain neutral and nonbiased or leading. Be attentive and aware of both verbal and nonverbal responses. Avoid head nodding and provide only short verbal responses while avoiding comments like "that's good" or "excellent."
8. The questions should be asked so they are clearly articulated, followed by a short pause, and repeated to ensure the question is heard and understood. Clarification by participants is encouraged.
9. If the participant does not address the question as intended, ask for clarification. The question may need to be repeated with additional explanation or context provided. Sufficient detail is needed to establish themes from the answers and draw conclusions in the analysis process. You can use your judgment to ask or probe for additional details or clarification. Periodic summarization of information and questioning participants to clarify and ensure accuracy is encouraged. Possible probes include: "Would you explain further?" "Would you give an example?" "I don't understand."
10. During the sessions you can help the researcher by taking notes that capture themes, ideas, specific comments and any observations that provide insight into the intention behind the questions. The notes can be type-written on the computer and emailed to the researcher upon the end of the session.
11. Once all of the questions have been posed and answered, inform the participants the session is about to end, review the purpose, and ask for any additional comments the participants might have that are relevant to the research question and focus group questions.

12. Stop the audio recording, saving it to the device with the file name ‘Focus Group Session 1’ or ‘Focus Group Session 2’.
13. Email both the audio recording and the session notes to the researcher. Delete the files from the recording device and from the source computer.

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Vita

Kristen Williams has been a practitioner and educator in the dietetics and nutrition field for over 30 years. She began her education in community nutrition, earning her Bachelor of Science from Kansas State University. Williams completed her dietetic internship in clinical dietetics at the University of Kansas Medical Center, followed by completion of a Master of Science in Nutrition, graduating Cum Laude from Kansas State University. Additional graduate studies in exercise physiology and nutrition were completed at the University of Kansas. She completed the Nutritional Injury-Specific Diagnostic Residency, where she studied under Dr. MaryAnn Kight, and earned a certificate as a Certified Nutritional Injury Specialist. Williams' educational background gained in the residency with Dr. Kight provided the foundation for creating the DI and the combined MND/DI at Cox College.

Williams' professional experiences as a dietetic and nutrition practitioner include practice as a clinical dietitian, college sports nutritionist, wellness dietitian, and a clinical nutrition manager. She has taught nutrition courses to athletic trainers, medical students, nursing students, and dietetic students at the undergraduate and graduate level. Williams is currently employed at Cox College in Springfield, MO, where she was the director of the Nutrition Diagnostics DI. She is now Chair of the Nutrition Diagnostics Department and was instrumental in creation of the combined MND/DI. She directs and teaches full-time in that program.