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The Development of Critical Thinking Skills in Undergraduate Students

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This quantitative study investigated whether alternative instructional approaches to develop critical thinking, exemplified by different general education requirements in two different Minnesota State Colleges and Universities (MnSCU) institutions, impacted the development of critical thinking skills among undergraduate students. This study is framed by Ennis's classification of general, infused, immersed, and mixed instructional approaches.

St. Cloud State University and Winona State University, two MnSCU institutions, share a collective definition of critical thinking and a common goal of developing critical thinking in undergraduate students. St. Cloud State University and Winona State University do, however, differ in approaches to fulfilling the goal area of critical thinking.

This study followed a stratified random sampling of non-transfer, third-year students at each institution. Participants completed the Cornell Critical Thinking Test Level Z which measures the development of critical thinking in the areas of deduction, meaning and fallacies, observation and credibility of sources, induction (hypothesis testing), induction (planning experiments), definition and assumption identification, and assumption identification.

The overall results of this study indicate students who did not complete a critical thinking course obtained a higher mean score on the Cornell Critical Thinking Test Level Z than students who did complete a critical thinking course; however, the results of this study indicate the difference was not statistically significant.

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CHAPTER I:

DEVELOPMENT OF CRITICAL THINKING SKILLS IN UNDERGRADUATE STUDENTS

Higher education has always been concerned with preparing students to be successful future leaders. The Organisation for Economic Co-operation and Development (OECD) reported in its Education at a Glance: OECD Indicators 2012 that while the United States is one of the "most well-educated countries in the world, with 42% of all 25- to 64-year-olds having tertiary attainment, the United States trails the Russian Federation (54%), Canada (51%), Israel (46%), and Japan (45%), in the same age group" (p. 1). In the younger adult age group of 25- to 34-year-olds, "the United States ranks 14th out of the 37 OECD and G20 countries (OECD, 2012, p. 1). "Although overall tertiary attainment levels in the U.S. have been high for many years and remain well above the OECD average (30%), they are growing at a below-average rate compared to other OECD and G20 countries" (OECD, 2012, p. 2).

In addition to the lagging growth rate of tertiary attainment in education, the United States has experienced an economic shift. The 21st century has brought significant changes to the world economy. Trilling and Fadel (2009) described a "monumental shift from Industrial Age production to that of the Knowledge Age economy- [which is] information driven [and] globally networked . . ." (p. 3). "Our ability to compete as a nation—and for states, regions and communities to attract growth industries and create jobs—demands a fresh approach to public education" (Partnership for 21st Century Skills, 2008, p. 1). To be competitive in today's global economy, educators in the United States must continue to demand innovation by incorporating skills that include critical thinking, problem solving, communication, collaboration, and creativity into every aspect of our education system (Partnership for 21st Century Skills, 2011),

"creating an aligned, 21st century public education system that prepares students, workers, and citizens to triumph in the global skills race is the central economic competitiveness issue for the next decade" (p. 1). "We can no longer claim that the U.S. educational results are unparalleled. Students around the world outperform American students on assessments that measure 21st century skills" (National Education Association, 2012). Critical thinking is encompassed in both the description of 21st century skills and global skills and is often used interchangeable with these terms. It is imperative that higher education recognize and restructure, if necessary, the development of critical thinking skills to remain competitive in the global economy.

There is a sense of urgency that education reform must occur in order for the United States to compete in a global economy. Rotherham and Willingham (2009) "believe that we live in times that are so revolutionary that they demand new and different abilities. But in fact, the skills students need in the 21st century are not new" (p. 16). Silva (2008) also concluded that while the "nature of the economy and work has changed" (p. 2), "the idea that schools should focus on more than just the basics is not new" (p. 1). Senechal (2010) stated, "Citing changes in the global economy and national job market, they call for an emphasis on 21st-century skills in all of education, from elementary through college" (p. 4). These 21st century skills, "include broad concepts such as creativity, innovation, problem solving" (Senechal, 2010, p. 4). Regardless if 21st century skills have always been taught, or if it is a new concept in education reform, higher education is responsible for developing both the content knowledge of curriculum and essential skills such as: critical thinking, problem solving, communication, and collaboration.

The skills deemed 21st century skills, "echo progressive ideas of the past 100 years" (Senechal, 2010, p. 5). John Dewey, an American philosopher and educator, spearheaded the progressive education movement in which he "argued for an education system that teaches more than just the basics of core academic subjects" (Silva, 2008, p. 1). Rotherham and Willingham (2009) provided a description of the development of 21st century skills:

> Critical thinking and problem solving, for example, have been components of human progress throughout history, from the development of early tools, to agricultural advancements, to the invention of vaccines, to land and sea exploration. Such skills as information literacy and global awareness are not new, at least not among the elites in different societies. The need for mastery of different kinds of knowledge, ranging from facts to complex analysis? Not new either. (p. 16)

This leads to a debate of teaching 21st century skills or content knowledge. Hirsch (2009) is, "concerned that the emphasis on hands-on skill-projects will shift class time away from subject matter and therefore impair the skills students need to be productive citizens and participants in the workforce" (para.1). Ravitch (2009) stated that "the problem with skills-driven approaches to learning is that there are so many things we need to know that cannot be learned by hands-on experiences" (para. 19). The pedagogical approach to teaching skills, content, or a combination of skill and content, in higher education continues to be debated, adding to the controversy Tsui (2002) emphasized "little substantiated knowledge on effective pedagogy comes from research on critical thinking" (p. 741).

Statement of the Problem

Most educators agree that teaching critical thinking is an essential priority of higher education (Tsui, 2002). In fact, "a large number of empirical studies have examined the effect of different teaching strategies and interventions aiming at promoting critical thinking skills among college students. However, the findings regarding whether teaching these skills in content are effective remain inconclusive" (Behar-Horenstein & Niu, 2011, p. 25). Daud and Husin (2004) described higher education's instructional approach as often emphasizing, "what to think rather than how to think . . . an approach that is not effective enough in increasing students' competence in critical thinking" (p. 478). They summarized the controversial debate whether critical thinking skills can be developed when integrated in teaching subject specific curriculum or if critical thinking skills should be taught separately.

This quantitative study follows a causal-comparative research design to determine if alternative approaches to teaching critical thinking, exemplified by different educational requirements in two different Minnesota State Colleges and Universities (MnSCU) institutions, impact the development of critical thinking skills among undergraduate students. In a recent study, Arum and Roksa (2011a) found that undergraduates, during their first 2 years of college, are barely improved in their critical thinking and complex reasoning skills. This evidence suggests that higher education must identify if critical thinking could be taught through disciplinary content, general instruction, or as a generalized subset of skills. Abrami et al. (2008) concluded critical thinking, "skills and dispositions cannot be a matter of implicit expectations" (p. 1102). The lack of consensus on how critical thinking should be taught in higher education supports the need for further research.

Description and Scope of Research

This quantitative research study focuses on the development of critical thinking in undergraduate students at two institutions in the Minnesota State Colleges and Universities System (MnSCU). In 1994, MnSCU adopted the Minnesota Transfer Curriculum (MnTC), which is a "collaborative effort among all two- and four-year public colleges and universities to help students transfer their work in general education" (Minnesota Transfer Curriculum, 1994, p. 2). The Minnesota Transfer Curriculum defines student goals and competencies in 10 goal areas. The core goal areas are: Goal 1: Communication; Goal 2: Critical Thinking; Goal 3: Natural Sciences; Goal 4: Mathematics and Logical Reasoning; Goal 5: History and the Social and Behavioral Sciences; Goal 6: Humanities and Fine Arts; Goal 7: Human Diversity; Goal 8: Global Perspective; Goal 9: Ethical and Civic Responsibility; Goal 10: People and the Environment.

Goal 2: the focus of this study can be fulfilled in ways specified separately by each institution within MnSCU. *The Guidelines for the Review and Design of a Minnesota Transfer Curriculum* (MnSCU, 2008) require that each college establish their own process for the review of courses and that each course must address the competencies listed in at least one of the 10 areas of the curriculum. At a minimum, the course must address at least 51% of the competencies in a goal area and must be a significant focus of the course. All MnSCU institutions certify their courses meet the goals in the 10 areas of the Minnesota Transfer Curriculum.

This study investigates whether alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in two different MnSCU institutions, impact the development of critical thinking skills among undergraduate students and

focuses on Goal 2: Critical Thinking. All courses that meet the critical thinking requirement address the following student learning outcomes:

1. Gather factual information and apply it to a given problem in a manner that is relevant, clear, comprehensive, and conscious of possible bias in the information selected.
2. Imagine and seek out a variety of possible goals, assumptions, interpretations, or perspectives which can give alternative meanings or solutions to given situations or problems.
3. Analyze the logical connections among the facts, goals, and implicit assumptions relevant to a problem or claim; generate and evaluate implications that follow from them.
4. Recognize and articulate the value assumptions which underlie and affect decisions, interpretations, analyses, and evaluations made by ourselves and others. (Minnesota Transfer Curriculum, 1994, p. 10)

For this study, two MnSCU institutions were selected: St. Cloud State University and Winona State University. St. Cloud State University is a public university founded in 1869 and is the largest institution of the MnSCU system. St. Cloud State University is the second largest public university in Minnesota and has the following student enrollment and demographics: Total number of students served: 22,024; Full-time students: 69.4%; Part-time students: 30.6%; Percent female: 52.7%; Percent male: 47.3%; Percent students of color: 11.9% (Minnesota State Colleges and Universities, n.d.b, p. 71).

The Liberal Education Program (LEP) at St. Cloud State University "is committed to the ideal of liberal education that provides knowledge, skills, and experiences and promotes critical thinking and ethical values for a lifetime of integrative learning in a diverse and changing society" (St. Cloud State University, 2013). The LEP curriculum requires students to complete courses or experiences in the 10 goal areas of the Minnesota Transfer Curriculum earning at least 40 credits in liberal education course. The LEP provides a specific list of courses that meet each of the respective goal areas. At a minimum, students must complete the following number of courses in each of the goal areas:

Goal 1: Communication	2 Courses
Goal 2: Critical Thinking	1 Course
Goal 3: Natural Sciences	2 Courses
Goal 4: Mathematical/Logical Reasoning	1 Course
Goal 5: History and the Social and Behavioral Sciences	2 Courses
Goal 6: Humanities and Fine Arts	2 Courses
Goal 7: Human Diversity	1 Course
Goal 8: Global Perspective	1 Course
Goal 9: Ethical and Civic Responsibility	1 Course
Goal 10: People and the Environment	1 Course

St. Cloud State University courses that fulfill Goal 2 are: PHIL 110 Critical Thinking, CMST 306 Rhetoric in Popular Culture, CMST 318 Argumentation and Advocacy, ENGL 306 Rhetoric in Popular Culture, POL 191 Introduction to Political and Legal Reasoning, and POL 192 Critical Reasoning: Issues and Events in American Politics.

Winona State University is a comprehensive public university founded in 1858 and the oldest member of the MnSCU system. The following identify Winona State University student enrollment and demographics: Total number of students served: 9,691; Full-time students: 87.4%; Part-time students: 12.6%; Percent female: 60.9%; Percent male: 39.1%; Percent students of color: 7.9% (Minnesota State Colleges and Universities, n.d.b, p. 75.).

Winona State University has recently adopted the General Education Program (GEP) which is "designed to provide students with a broad base of skills and knowledge to prepare students for informed, responsible citizenship in a changing world" (Winona State University, 2011, p. 1). Prior to adopting the GEP requirements, Winona State University required undergraduate students to complete the Universal Studies Program (USP) which "provides a broad base of skills and knowledge to equip students for informed, responsible citizenship in a changing world" (Winona State University, 2012, p. 17). At a minimum under the GEP, students are required to complete:

Goal 1: Communication	7 credits
Goal 2: Critical Thinking	Fulfilled when all other goal areas are completed
Goal 3: Natural Sciences	7 credits
Goal 4: Mathematical/Logical Reasoning	3-4 credits
Goal 5: History and the Social and Behavioral Sciences	9 credits
Goal 6: Humanities and Fine Arts	9 credits
Goal 7: Human Diversity	3 credits
Goal 8: Global Perspective	3 credits
Goal 9: Ethical and Civic Responsibility	3 credits

Goal 10: People and the Environment 3 credits

Fulfillment for Goal 2 has remained consistent between the Universal Studies Program and the General Education Program with the requirements of Goal 2 Critical Thinking being met when all other goal areas have been completed.

St. Cloud State University and Winona State University offer two different approaches to developing critical thinking in undergraduate students. This study investigates if there is a difference in outcomes from different instructional approaches to developing critical thinking and is guided Ennis's (1989) critical thinking typology of four types of courses. Ennis's (1989) typology defines four classifications (general, infusion, immersion, and mixed) of instructional interventions related to instructional approaches. The general approach is to teach critical thinking separate from other subject matter content, "examples of the general approach usually do not involve content . . . and could take place in separate courses" (Ennis, 1989, p. 4). Consider that, "under the general approach, the emphasis on principles that are applied to content and emphasis on abstract principles depends at least on the nature of the content, the critical thinking dispositions and abilities being promoted, and the students" (Ennis, 1989, p. 4). St. Cloud State University follows the general approach by offering PHIL 194 Critical Thinking, a course that teaches critical thinking skills separate from the content of any discipline and meets the requirements of Goal 2. Other St. Cloud State University courses that follow the general approach include: CMST 318 Argumentation and Advocacy, POL 191 Introduction to Political and Legal Reasoning, and POL 192 Critical Reasoning: Issues and Events in American Politics. Winona State University also offers a stand-alone critical thinking course, PHIL 110 Critical Thinking fulfilling Goal 4. However, Winona State University allows Goal 2 to be fulfilled upon

completion of all other goal areas. If students elect to take PHIL 110 Critical Thinking at Winona State University, individual students could then be considered to be following the general approach, but it is not a requirement of the University.

Instruction may also follow the infusion approach where "critical thinking instruction in subject-matter is deep, thoughtful" (Ennis, 1989, p. 5) and critical thinking dispositions are made explicit in discipline-based courses. Each university and college in the MnSCU system certifies that course content meets the student learning outcomes in the goal area as defined by the Minnesota Transfer Curriculum. Therefore, any course that meets Goal 2 Critical Thinking and is following the infusion approach explicitly states the critical thinking student learning outcomes in the content of the discipline. According to St. Cloud State University's Catalog (2013), one discipline specific course meets the requirements of Goal 2. This course is offered in both the Communication Studies Department as CMST 306 Rhetoric in Popular Culture and the English Department as ENGL 306 Rhetoric in Popular Culture. This course meets two goal areas, Goal 2 Critical Thinking and Goal 6 Humanities and the Fine Arts. Based on the requirements of the Liberal Education Program and the course offerings available to meet Goal 2 Critical Thinking, it can be concluded that St. Cloud State University most closely matches the general approach.

At Winona State University, the General Education Program (GEP) curriculum requires students to complete 40 credits in nine of the 10 goal areas of the Minnesota Transfer Curriculum. The GEP provides a specific list of courses that meet each of the respective goal areas and according to WSU Minnesota Transfer Curriculum and General Education (Winona State University, 2014), there are no accepted courses listed under Goal 2 Critical Thinking.

Goal 2 is fulfilled when all other goal areas are completed. Based on the requirements of the General Education Program, no courses are identified as meeting Goal 2; therefore, it can be concluded that Winona State University does not follow either the general or the infusion approach because a stand-alone critical thinking course is not required to fulfill Goal 2 and critical thinking dispositions are not required to be made explicit in discipline-based courses.

The immersion approach is where there is "thought provoking kind of subject matter instruction in which students do get deeply immersed in the subject, but in which general critical thinking principles are not made explicit" (Ennis, 1989, p. 5). Based on the requirements of the General Education Program, it can be concluded that Winona State University most closely matches the immersion approach, where critical thinking is immersed in the subject matter, and critical thinking outcomes are not made explicit.

This study is guided by the Ennis, Millman, and Tomko (2005) definition of critical thinking as "reasonable and reflective thinking focused on deciding what to believe or do" (p. 1). This definition is also the working definition of the Cornell Critical Thinking Test Level Z. The participants, non-transfer third-year students from SCSU and WSU, completed the Cornell Critical Thinking Test Level Z which measures critical thinking ability in the areas of induction, deduction, observation, credibility, assumptions, and meaning. The test was administered in paper pencil format to all participants in the same semester. This quantitative study used Statistical Package for Social Sciences (SPSS) version 12 and a t-test for statistical analysis.

Research Question

This study investigates the following research question:

How do alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in different MnSCU institutions, impact the development of critical thinking skills among undergraduate students?

Research Hypotheses

The null hypothesis is that there is no significant difference between the Cornell Critical Thinking Test scores of non-transfer, third-year undergraduate students who complete different general education requirements at two different MnSCU institutions.

Purpose of the Study

This study determined how different instructional approaches to developing critical thinking impact the development of critical thinking skills in undergraduate students. The importance of this study extends far beyond the development of critical thinking in the college student. Our society is multifaceted and complex, in need of leaders who can engage in purposeful, self-regulatory judgment when dealing with the social, political, and ethical challenges (Abrami et al., 2008). This study has the potential to impact our greater society by contributing to the development of critical thinkers who can think for themselves in a manner that enhances a democratic society and ensures a competent workforce.

Assumptions of the Study

St. Cloud State University and Winona State University each apply different formats from Ennis' classification of instructional approaches to teaching critical thinking. The immersion approach is assumed to be practiced at all higher education institutions, and is, therefore, an institutional practice at St. Cloud State University and Winona State University.

Delimitations

While there is a vast amount of research on critical thinking, the literature suggests there is no universal definition of critical thinking. This study is guided by Ennis et al. (2005) in their definition of critical thinking and is not seeking a further definition. This study focused on the development of critical thinking by investigating two different approaches of developing critical thinking skills and measures the development of critical thinking using the Cornell Critical Thinking Test, Level Z.

St. Cloud State University and Winona State University have been selected to represent two different approaches to teaching critical thinking. This study does not focus on specific instructional strategies used to teach critical thinking in courses, but will measure if critical thinking skills have developed as students progress through college course requirements that are immersed in instruction or taught explicitly through a specific critical thinking course. This study focused solely on critical thinking development related to academic coursework and does not consider the impact other college experiences may have on critical thinking development.

Positionality Statement

This statement was created to acknowledge my affiliation with Winona State University, a member of the Minnesota Universities and Colleges System. From August 2010 to December 2013, I was employed as an instructor in the College of Education. I have been a strong advocate for career and technical education, guided by the principles that business and marketing educators prepare students to be both college and career ready. This preparation requires high levels of core academic skills and various technical skills.

As a secondary educator prior to becoming a university instructor, I worked very hard to make critical thinking, collaboration, creativity, and problem solving key outcomes of my instruction. I expected to see the same type of outcomes in my post-secondary curriculum, but was surprised at the lack of learning goals associated with critical thinking. This prompted me to review the general education requirements of undergraduate students at Winona State University. I discovered that Minnesota's universities and colleges can take different instructional approaches to develop critical thinking. I was curious about the effectiveness of different instructional approaches to teaching critical thinking and made this my focus of this study.

It is my position that all student outcomes be made explicit. I believe that outcomes serve a greater purpose and can be used as a gauge to determine instructional effectiveness. Based on this position, I expected higher critical thinking scores from students who completed a critical thinking course or courses that had explicit critical thinking outcomes.

Definition of Terms

Critical Thinking: "Critical thinking is reasonable reflective thinking that is focused on deciding what to believe or do" (Ennis et al., 2005, p. 1).

Critical Thinking Skills: Critical thinking abilities in the, "areas of induction, deduction, value judging, observation, credibility, assumptions, and meaning" (Ennis et al., 2005, p. 2).

General Approach: "An approach that attempts to teach critical thinking abilities and dispositions separately from the presentation of the content of existing subject-matter offerings, with the purpose of teaching critical thinking" (Ennis, 1989, p. 4).

Global Skills: "Skills that include critical thinking, problem solving, communication, collaboration, and creativity" (Partnership for 21st Century Skills, 2011, p. 1). Also referred to as 21st Century Skills.

Infusion Approach: "Critical thinking instruction in subject-matter instruction is deep, thoughtful, well understood subject-matter instruction in which students are encouraged to think critically in the subject, and in which general principles of critical thinking dispositions and abilities are made explicit" (Ennis, 1989, p. 5).

Immersion Approach: "Critical thinking instruction in subject-matter instruction is deep, thoughtful, well understood subject-matter instruction in which students are encouraged to think critically in the subject, and in which general principles of critical thinking dispositions and abilities are not made explicit" (Ennis, 1989, p. 5).

Mixed Approach: "Consists of a combination of the general approach with either the infusion or immersion approaches" (Ennis, 1989, p. 5).

*Reflective Thinking: "*Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (Dewey, 1910, p. 6).

Tertiary Attainment: Highest completed level of post- secondary education.

Twenty-first Century Skills: "Skills that include critical thinking, problem solving, communication, collaboration, and creativity" (Partnership for 21st Century Skills, 2011, p.1). Also referred to as Global Skills.

Summary

A current educational reform movement is to develop critical thinking and problem solving skills in our future generations to ensure a prepared workforce, enhance a democratic society, and allow students the ability to compete globally (Partnership for 21st Century Skills, 2008). This study investigated the development of critical thinking skills in undergraduate students and focused on different overall instructional approaches to developing critical thinking.

The theoretical framework that guided this study is based on Ennis's (1989) typology, which defines the four classifications of instructional interventions related to instructional approaches as shown in Table 1.

Table 1

Ennis' Classification of Instructional Approaches

General Approach	Infusion Approach	Immersion Approach	Mixed Approach
Stand-alone critical thinking course separate from content of subject-matter	Critical thinking instruction in subject-matter with explicit objectives	Critical thinking instruction in subject-matter but objectives are not made explicit	Combination of the General Approach with either of the Infusion or Immersion Approach

This study is guided by the Ennis et al. (2005) definition of critical thinking as "reasonable and reflective thinking focused on deciding what to believe or do" (p. 1). This definition is the working definition of the Cornell Critical Thinking Test Level Z, used to measure the development of critical thinking skills in the areas of induction, deduction, observation, credibility, assumptions, and meaning.

This study is structured to give the reader a review of relevant issues related to critical thinking in chapter two, the literature review. The literature review supports Ennis' (1989) typology of four types of courses as the framework for this study to offer a classification for instructional interventions related to pedagogical approaches. Chapter III focuses on the method used to carry out this quantitative study which followed a causal-comparative research design. The Statistical Package for Social Sciences (SPSS) version 12 was used to produce a t-test for statistical analysis. The results of this study are presented in Chapter IV and include a synthesis of the findings with an overall conclusion of the study. Chapter V offers an overview of the conclusions of this study and furthers the discussion of whether institutions incorporate immersion or the general approaches to their curriculum can improve critical thinking outcomes.

CHAPTER II

REVIEW OF LITERATURE

This study investigates whether alternative approaches to teaching critical thinking, exemplified by different general education requirements in two different MnSCU institutions, impact the development of critical thinking skills among undergraduate students. The literature review explores the philosophical approach to critical thinking in the works of Socrates, Plato, and Aristotle, among others. The cognitive psychological approach explores the works of Piaget (1964), Perry (1970), and Vygotsky (1978), among others. The literature offers a historical summary of critical thinking as it relates to education in the works of Dewey (1916); Bloom, Englehard, Furst, Hill, and Krathwohl (1956); Ennis (1962); and Krathwohl, Bloom, and Masia (1964). Current studies related to critical thinking in higher education include the Wabash National Study of Liberal Arts Education (2013) and Arum and Roksa's (2011a) studies. The literature review indicates mixed results on the impact of pedagogical approaches to teaching critical thinking and includes several well-established standardized tests such as: The Watson-Glaser II Critical Thinking Appraisal (WGCTA), Cornell Critical Thinking Test (CCTT), Collegiate Learning Assessment (CLA), and The California Critical Thinking Skills Test (CCTST).

Since the late 1980s, critical thinking has been an important educational topic infused into the K-12 and post-secondary curricula (Facione, 1990a, p. 1). More recently, the Association of American College and Universities (2007) identified critical thinking as one of several innovating skills needed to prepare students for post-secondary education. There is little debate about the importance of critical thinking, but "agreement about teaching critical thinking persists

only so long as theorists remain at the level of abstract discussion and permit their use of the term to remain vague" (Bailin, Case, Coombs, & Daniels, 1999, p. 1). "The literature on critical thinking in higher education is constructed around the fundamental assumption that, while regarded as essential, is neither clearly nor commonly understood" (Lloyd & Bahr, 2010, p. 1). Despite the disagreements regarding defining and teaching critical thinking, there has been a history of analyzing critical thinking in the disciplines of philosophy and psychology (Lewis & Smith, 1993).

Philosophy Approach to Critical Thinking

The academic discipline of philosophy is aimed at the discovery of truth and the writings of Socrates, Plato, Aristotle, among others, represent a philosophical approach to critical thinking. Socrates took the process of thinking about thinking in a new direction that included questioning methodically and analyzing universal themes (Daniel & Auric, 2011). Plato shifted the direction regarding the concept of philosophy when he "established an explicit association between knowledge (episteme) and adulthood and between belief (doxa) and childhood" (Daniel & Auric, 2011, p. 417). Aristotle devised the rules of formal logic to better identify the framework for reflection on universal concepts and advanced the good thinking philosophy toward higher order thinking (Daniel & Auric, 2011, p. 417). The works of these philosophers laid the foundation for the philosophical approach of 'good thinking,' but it was not the only academic discipline that explored critical thinking. Found in the discipline of psychology, the cognitive psychological approach contrasts with the philosophical approach.

Cognitive Psychological Approach to Critical Thinking

The cognitive psychological approach was developed from applied cognitive psychology and has a deep rooted history spanning from the European works of the late 1800s (Hoffman & Deffenbacher, 1992). The cognitive psychological approach differs from the philosophical approach by focusing on how people actually think versus how they should think under ideal conditions (Sternberg, 1986). Sternberg (1986), a leader in American cognitive psychology, defined critical thinking as "the mental process, strategies, and representations people use to solve, make decisions, and learn new concepts" (p. 3). Jean Piaget "was the first psychologist to make a systematic study of cognitive development" (McLeod, 2012) and later "virtually all cognitive-structural theories . . . have their origins in Jean Piaget (1964)" (Pascarella & Terenzini, 2005, p. 33). Sternberg and Williams (2010) stated: "In some respects, Piaget's theory is incomplete, and in other respects it has been shown to be incorrect" (p. 41), but it remains the most influential to date.

The Neo-Piagetians approach is built on the strengths of Piaget's theory and disregards the weak or scrutinized parts (Sternberg & Williams, 2010). Like Piaget, Neo-Piagetians see development occurring from maturation and not learning, "the main area of difference is that some neo-Piagetian theorists have suggested stages that go beyond Piaget's final stage of formal operations" (Sternberg & Williams, 2010, p. 61).

In contrast to Piaget's theory and neo-Piagetian theory, Vygotsky's (1978) theory proposed that "cognitive development happens as children internalize information from their environment" (Sternberg & Williams, 2010, p. 61). Vygotsky's theory does not identify stages, but does describe internalization as a continuous process in which development can occur at

different rates in different domains (Sternberg & Williams, 2010). The most notable distinction between the Piaget and Vygotsky theories is the direction of development. Piaget's theory describes the direction of development from the inside, outward; and Vygotsky's theory describes the direction of development from the outside, inward (Sternberg & Williams, 2010). Perry (1970) expanded the work of Piaget's cognitive development theory to include adolescents transitioning into adulthood.

Cognitive Structural Theories

Cognitive structural theories, "examine the process of intellectual development during the college years (Evans, Forney, Guido, Patton, & Renn, 2010, p. 43). The theories focus on how college students think and make meaning of their experiences (Evans et al., 2010). "Cognitive structural theorists seek to describe the nature and processes of change, concentrating on the epistemological structures individuals construct to give meaning to their worlds" (Pascarella & Terenzini, 2005, p. 33). In this method, "the mind is thought to have structures, generally called stages, that act as sets of assumptions by which persons adapt to and organize their environments" (Evans et al., 2010, p. 43). Pascarella and Terenzini (2005) stated: "Cognitive structural theories assume that developmental change involves a chain of stimulus and response" (p. 34) with changes occurring with every new encounter of information or experience. Each of these characteristics is a common element in Piaget's theory of cognitive development.

Piaget's cognitive development theory "clearly defines the cognitive development of a child, emphasizes a child-centered approach, attaches importance to self-discovery, and provides guidance to children as to how they can build positive behaviors" (Başkale & Bahar, 2011, p. 265). Piaget's theory of cognitive development has three components: schemas, transitions from

one stage to another, and stages of development. During adolescence, children progress through, in sequence, four stages of developmental change: sensorimotor, preoperational, concrete operational, and the formal operational (Cherry, 2008). With the progression to each new stage, intellectual abilities develop along with a more complex understanding of the world (Benaroch, 2012). Piaget's theory laid the foundation for Perry to extend the research of cognitive development from adolescence into adulthood.

Perry (1970) sought to define the development "of a progression in certain forms in which students construe their experiences" (p. 1). In these forms or structures, "the students explicitly or implicitly impute to the world, especially those structures in which they construe the nature and origins of knowledge, of value, and of responsibility" (Perry, 1970, p. 1). Perry conducted a longitudinal study of liberal arts students and, "in 1953, the staff of the Bureau of Study Counsel at Harvard College undertook to document the experiences of undergraduates in Harvard and Radcliffe over their four years of college" (p. 3). Perry developed a measurement instrument called the Checklist of Educational Views (CLEV). This testing instrument was used in the 1953 to 1954 preliminary trials. The CLEV was administered to a random sample of 313 freshmen in the fall of 1954 and again with the same students in spring of 1955. Based on these scores, Perry invited 55 students to be interviewed of which 31 volunteered to participate in the study. "Initially, Perry sought personality variables that would emerge from the interviews but what he found were schemes of cognitive development process" (Simmons, 2008, p. 25). Perry (1970) conducted another study using freshmen from the classes of 1962 and 1963. This study yielded a sample of 109 students and resulted in 366 interviews and 67 complete four-year

reports “From this research, Perry developed a stage model with nine positions” (Simmons, 2008, p. 25).

Perry’s (1970) model emphasized that cognitive development “appears to us to manifest a logical order—an order in which one form leads to another through differentiations and reorganizations required for the meaningful interpretation of increasingly complex experience” (p. 3). The four major clusters of Perry’s nine positions are dualism, multiplicity, relativism, and commitment to relativism (Evans et al., 2010).

Dualism contains Position 1, basic duality and Position 2, multiplicity pre-legitimate. Position 1 “represents a mode of meaning making in which the world is viewed dichotomously: good-bad, right-wrong, black-white” (Evans et al., 2010, p. 86). Position 2 “delineates in closer detail the first steps in that journey from innocence forecast in broad terms in the latter part of the descriptions of Position 1” (Perry, 1970, p. 72). Pascarella and Terenzini (2005) defined Position 2 as an “uncertainty about what is or is not true creeps in, although the uncertainty an authority might introduce is sometimes seen as merely a heuristic device to prod students to learn on their own” (p. 35).

Multiplicity contains Position 3, multiplicity subordinate or early multiplicity and position 4, multiplicity correlate or late multiplicity (Perry, 1970). In Position 3, “the existence of multiple perspectives on any given issue is recognized, although alternative perspectives may be considered temporary in areas when authorities still search for answers (Pascarella & Terenzini, 2005, p. 35). In Position 4, “others holding an opinion contrary to one’s own are no longer seen as simply wrong but rather as entitled to their views” (Pascarella & Terenzini, 2005, p. 35).

Relativism contains Position 5, relativism correlate or contextual relativism, and Position 6, commitment foreseen or pre-commitment (Perry, 1970). In Position 5, "analytical thinking skills emerge, and in critiquing their own ideas and those of others, students recognize that not all positions are equally valid" (Pascarella & Terenzini, 2005, p. 35). Position 6 describes "commitments are creative in that through choice and affirmation the individual generates meanings and relationships neither presupposed nor entailed by the structure of the relativistic world itself" (Perry, 1970, p. 135).

Commitment to relativism contains Position 7, initial commitment; Position 8, orientation in implications of commitment; and Position 9, developing commitments (Perry, 1970). Position 7 describes "that state in a student's life in which he has undertaken to decide on his own responsibility who he is, or who he will be, in some major area of his life (Perry, 1970, p. 153). Position 8 "describes a level of experience in which the stylistic issues of Commitment have emerged in greater prominence over external forms" (Perry, 1970, p. 154). The final position, Position 9, "describes a maturity in which a person has developed an experience of 'who he is' in his Commitments both in their content and in his style of living them. Pascarella and Terenzini (2005) describe Positions 7-9 as "the individual makes commitments to ideas, values, behaviors, and other people" (p. 35).

The movement through these positions can also be influenced by three deflections from cognitive growth. Perry (1970) defined these three alternatives to cognitive growth as temporizing, retreat, and escape. These alternatives to growth allow for the development to be suspended, nullified, and or reversed. Perry's theory, "forms a bridge from the child and adolescent studies of Piaget, Vygotsky, and others to a more direct focus on early adulthood,

especially the early adulthood of college students" (Love & Guthrie, 1999b, p. 5). Like Perry's theory, Dewey (1916) focused on critical thinking development, but stressed the education system as a key contributor to the development of critical thinking skills.

Critical Thinking in Education

Beginning in the early 20th century, Dewey (1916) brought critical thinking to the forefront of education and considered critical thinking a necessary skill for all American citizens. His definition of critical thinking described it as a reflective process and "includes the sense of the problem, the observation of conditions, the formation of rational elaboration of a suggested conclusion, and the active experimental testing" (p. 177). "He particularly stressed the role of the educational system as being responsible for preparing its students with critical thinking skills so they could be prepared to work in an ever-changing world" (Becker, 2007, p. 20).

Dewey (1933) suggested a five-phase critical thinking model and described the phases as non-linear. Noting the phases were the "indispensable traits of reflective thinking" (p. 116) and the "sequence of the five phases is not fixed" (p. 115):

1. Suggestions, in which the mind leaps forward to a possible solution.
2. An intellectualization of the difficulty or perplexity that has been felt (directly experienced) into a problem to be solved, a question for which the answer must be sought.
3. The use of one suggestion after another as a leading idea, or hypothesis, to initiate and guide observation and other operations in collection of factual material.
4. The mental elaboration of the idea or supposition as an idea or supposition (reasoning, in the sense in which reasoning is a part, not the whole, of inference).

5. Testing the hypotheses by overt or imaginative action. (p. 107)

Bloom et al. (1956) made perhaps one of the most recognizable contributions to cognitive research. At the 1948 American Psychological Association Convention in Boston, college examiners formulated an idea to produce a theoretical framework that would stimulate research on examining education; and promote the exchange and ideas of testing materials. The result of their work was a classification of educational objectives for the cognitive domain, commonly referred to as *Bloom's Taxonomy*. Bloom's Taxonomy included six levels of cognition: knowledge, comprehension, application, analysis, synthesis, and evaluation. Progression through the levels required that mastery of the lower levels be achieved before advancing to the next.

During the 1990s, a former student of Bloom's led an assembly to update the taxonomy making it more relevant for the 21st century. Several major revisions occurred to the original version. The word form of the taxonomy was changed from a noun to a verb, the order of the categories was changed, and the terminology describing the critical thinking skills was revised. The six levels of the revised version were: remembering, understanding, applying, analyzing, evaluating, and creating (Anderson & Krathwohl, 2001).

The original 1948 committee actually identified three major parts of the taxonomy—the cognitive, the affective, and the psychomotor domains. Krathwohl et al. (1964) clearly identified the connection of the taxonomy to the philosopher and psychologist that serve as the foundation for critical thinking. This "threefold division is as ancient as Greek philosophy and that philosophers and psychologists have repeatedly used similar tripartite organizations: cognition, conation, and feeling; thinking, willing, and acting; etc." (Krathwohl et al., 1964, p. 7). Krathwohl et al. went on and described the behaviors of the affective domain to "emphasize a

feeling tone, an emotion, or a degree of acceptance or rejection" (p. 7) and included the levels of, "receiving, responding, valuing, organization, and characterization by a value or value complex" (p. 35). Collectively, Socrates, Plato, Aristotle, Dewey, Bloom, and Krathwohl contributed to the thought process of learning to reflect, and ultimately influenced the contributions of modern day philosophers (Daniel & Auriac, 2011).

The American philosopher, Robert Ennis (1962) once defined critical thinking as the, "correct assessing of statements" (p. 82). Recognizing the definition's vagueness, Ennis (1993) would later elaborate that critical thinking includes the ability to judge the credibility of sources and the quality of an argument; to identify conclusions, reasons and assumptions; to develop and defend a point of view; to ask relevant clarifying questions; to search for reason with an open-mind; etc. Ennis (1993) revised his definition to "critical thinking is reasonable reflective thinking focused on deciding what to believe or do" (p. 180). Ennis (2011) later described the ideal critical thinker as:

> Disposed to try to 'get it right,' to present a position honestly and clearly, and to care about others (this last being auxiliary, not constitutive); furthermore the ideal critical thinker has the ability to clarify, to seek and judge well the basis for a view, to infer wisely from the basis, to imaginatively suppose and integrate, and to do these things with dispatch, sensitivity, and rhetorical skill. (2011, p. 5)

Ennis (1987) identified five key ideas of critical thinking: practical, reflective, reasonable, belief, and action, but stated that "critical thinking is not equivalent to the higher order thinking skills" (p. 10). Higher order thinking skills is "too vague" and does not provide educational institutions with, "specific guidance" (p.10). Ennis (1987) concluded that "critical

thinking, a practical activity, includes most or all of the directly practical higher order thinking skills . . . and includes dispositions" (p. 10). Ennis (1987) defined critical thinking dispositions as:

- Seek a clear statement of the thesis or question
- Seek reasons
- Try to be well informed
- Use and mention credible sources
- Take into account the total situation
- Try to remain relevant to the main point
- Keep in mind the original and/or basic concern
- Look for alternatives
- Be open-minded
- Take a position (and change a position) when the evidence and reasons are sufficient to do so
- Seek as much precision as the subject permits
- Deal in an orderly manner with the parts of a complex whole
- Use one's critical thinking abilities
- Be sensitive to the feelings, level of knowledge, and degree of sophistication of others. (p. 12)

In addition to the critical thinking dispositions, Ennis (1987) also defined the basic areas of critical thinking abilities as clarity, basis, inference, and interaction. He reminded us "that there is much more cognitive material to be acquired in school" (p. 10) and "that we are urged to

go beyond in framing a curriculum that does justice to the full range of cognitive possibilities of students" (p. 10).

King and Kitchener's (1994) reflective judgment model of cognitive growth is "perhaps the best known and most extensively studied" (Pascarella & Terenzini, 1991, p. 123) theory, as it relates to the cognitive growth of individuals from late childhood through adulthood. Their reflective judgment model has "conceptual roots in the writings of John Dewey, Jean Piaget, Lawrence Kohlerberg, William Perry and others" (Pascarella & Terenzini, 2005, p. 36). King and Kitchener, critics of Perry's scheme of intellectual and ethical development, argued that the "Perry (1970) scheme shifts its focus between Positions 5 and 6 from cognitive or intellectual growth to identity development" (Pascarella & Terenzini, 1991, p. 32). The reflective judgment model (RJM) is a "stage model description of a cognitive process that is explicitly developmental and constructivist in its orientation" (Love & Guthrie, 1999a, p. 42). The reflective judgment model is focused on how "people's assumptions about what and how something can be known provide a lens that shapes how individuals frame a problem and how they justify their beliefs about it in the face of uncertainty" (King & Kitchener, 1994, p. xvi) and consists of a, "hierarchical, increasingly complex seven-stage sequence relating to what people 'know' or believe and how they justify their knowledge claims and beliefs" (Pascarella & Terenzini, 2005, p. 36). The stages of the RJM "is internally coherent and later stages build on earlier ones" (Love & Guthrie, 1999a, p. 42), "the seven stages may be clustered into pre-reflective thinking (Stages 1, 2, and 3), quasi-reflective thinking (Stages 4 and 5), and reflective thinking (Stages 6 and 7)" (Evans et al., 2010, p. 131).

King and Kitchener (1994) explicitly stated it is their assumption "that teaching students to think reflectively is an institutional goal that is best met when it is built into the whole curriculum and co-curriculum of the college, not when it is seen as the sole purview of one group" (p. 230). They summarized:

> Development of any aspect of a person occurs within the broader context of the individual's total life experience, and the individual draws from these experiences in deciding how to make sense of how to respond to the educational opportunities presented on college campuses. (p. 230)

King and Kitchener (1994) noted that educators concerned with the development of reflective thinking should consider the following assumptions:

1. Individuals actively interpret and attempt to make sense of what they experience.
2. How individuals interpret events is affected by their epistemic assumptions.
3. People's ways of making meaning develop over time.
4. Individuals function within a 'developmental range' of stages (n.d.a, 1980).
5. Interactions with the environment strongly affect an individual's development.
6. Development is stimulated when an individual's experiences do not match his or her expectations.
7. Development is reflective thinking occurs within the context of the individuals background, previous educational experiences, and current life situation. (p. 226)

These assumptions of critical thinking bring awareness to the progression of developing critical thinking skills in students and identify the impact of experiences in the development of critical

thinking. The process of measuring the development of critical thinking skills began with the idea of developing a consensus definition of critical thinking and its cognitive skills.

The Delphi Research Project

The Delphi Research project was conducted by the American Philosophical Association (Facione, 1990b) and was perhaps the best known broad-based, systematic inquiry to achieve consensus around a definition for critical thinking and its core cognitive skills. Forty-six multidisciplinary experts participated in the two-year project, which identified a conceptualization of critical thinking in terms of cognitive and affective dispositions. Accordingly, the consensus statement regarding critical thinking was:

> We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. (Facione, 1990a, p. 3)

The ideal critical thinker is:

> habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. (Facione, 1990a, p. 3)

The relationship then to education is that:

> CT [critical thinking] is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, CT [critical thinking] is a pervasive and self-rectifying human phenomenon...thus, educating good critical thinkers' means working toward this ideal. It combines developing CT [critical thinking] skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (Facion, 1990a, p. 3)

The APA took interest in "analyzing the concept of CT, designing college level academic programs in CT, and in assisting with efforts to introduce CT into the K-12 curriculum" (Facione, 1990a, p. 1). While the Delphi Project achieved consensus on the definition of the critical thinker, the ideal critical thinker, and the relationship to education, it was not universally adopted in higher education. Research regarding critical thinking did continue at the higher education level.

Current literature on critical thinking in higher education advances the research in areas of critical and creative thinking (Bergman, 2010; Manzo, 1998; Paul, 1993), development of critical thinking skills (Durkin & Main, 2002; Halpern, 1999; Hanley, 1995; Ivie, 2001; McBride & Reed, 1998; Thomas, 2011; Wolcott, 1999), and assessment of critical thinking (Angelo, 1995; Brookfield, 1997; Cheung, Rudowicz, Kwan, & Yue, 2002; Ennis, 1985, 1994; Facione, Facione, & Giancarlo, 2000; Halpern, 2001). Critical thinking continues to be a central focus of higher education and has been brought to the forefront by our government under both the Bush and Clinton administrations. During the 1990s, the commission of the national education agenda identified the following United States education goal to be attained by the year 2000: "The proportion of college graduates who demonstrate an advanced ability to think critically,

communicate effectively, and solve problems will increase substantially" (National Education Goals Panel, 1993, p. 115). Unfortunately, no funding was ever provided to further the accomplishment of this goal; regardless, critical thinking continues to play an important role in higher education, and "many colleges and universities in North America now offer courses specifically designed to enhance their students' ability to think critically, as part of the general education requirements" (Halpern, 1999, p. 70). While critical thinking is present in the curriculum, it is assumed that college level students would then develop the skill of critical thinking.

Research on Critical Thinking in Higher Education

Between 2006 and 2009, the Wabash National Study of Liberal Arts Education (2013) conducted a large scale, longitudinal study examining the factors that affect a liberal arts education. The educational conditions and experiences related to the outcome of critical thinking was a main focus of the study. Students completed the Collegiate Assessment of Academic Proficiency (CAAP) Critical Thinking test during three points during their college education—when they first arrived on campus, at the end of their first year, and at the end of their fourth year. The Wabash National Study of Liberal Arts Education study found that "although students' improvement on the CAAP Critical Thinking test was statistically significant, the change was so small (less than 1% increase) that it was practically meaningless" (Blaich & Wise, 2009, p. 2). Pascarella and Blaich (2013) concluded: "There was a statistically significant, positive association between students' perceptions of being exposed to clear and organized instruction in their coursework overall and four-year gains on both measures" (para. 2) as measured by the CAAP critical thinking test and the Need for Cognition scale. "Students' exposure to clear and

organized instruction enhanced not only their general cognitive skills such as critical thinking but also their orientation toward inquiry and continuing intellectual development" (Pascarella & Blaich, 2013, para. 2). Currently, Wabash National Study has launched another study that began in the fall of 2010 and concluded in the fall of 2013. This debate regarding whether college graduates have developed critical thinking skills was addressed by another study conducted by Arum and Roksa (2011a), who presented their findings from a four-year study in which they followed 2,322 traditional age students from the fall of 2005 to the spring of 2009.

Arum and Roksa's (2011a) study suggested "undergraduates are barely improving their CLA-measured skills in critical thinking, complex reasoning, and writing during their first two years of college" (p. 54) and reported, "at least 45% of students in our sample did not demonstrate significant improvement" (p. 121) during the first 2 years of college. Students improved on average "only 0.18 standard deviations" (Arum & Rosksa, 2011a, p. 35). In addition, the "study indicated that 36% of students did not show any significant improvement over four years (Arum & Roksa, 2011b, para. 2). Students improved on average "0.47 [standard deviations] over 4 years" (Jaschik, 2011, para. 2).

Critics of Arum and Roksa's (2011a) study question the ability to evaluate its findings without the ability to examine the statistical procedures (Astin, 2011). Astin challenged the failure of reporting how many students showed any degree of improvement, actual student scores, and how many scores declined. Pascarella, Blaich, Martin, and Hanson (2011) reported their findings closely match those reported by Arum and Roksa (2011a). Pascarella et al. (2011) made two distinct cautions regarding, "interpreting change scores as indicators of actual effect of college" (p. 7) and concluded: "One cannot validly use an average gain score during college as

an accurate estimate of the value-added effect of college" (p. 7). They further stated that the findings of Arum and Roksa's (2011a) study have "issued an important wakeup call to American higher education" (p. 8) and "need to be taken seriously" (p. 1).

Pedagogical Approach to Developing Critical Thinking

Extending beyond definitions and development theories of critical thinking, a significant portion of research conducted on critical thinking focuses on pedagogical approaches. Terenzini, Springer, Pascarella, and Nora (1995) conducted a study on the "relative and unique effects on changes in critical thinking of three dimensions of students' college experience: curricular exposure, formal classroom and instructional experiences, and out-of-class experiences" (p. 23). It is noted the results of this study yielded discouraging findings that have led some researchers to conclude that teaching method does not impact the development of critical thinking. Terenzini et al. stated: "The courses students took during the first year were not related to gains in critical thinking abilities" (p. 35). In a study conducted by Cotter and Tally (2009), the findings supported the conclusion that differences in teaching method do not impact the development of critical thinking and concluded "critical thinking assignments did not have a positive effect on either formal operational thought or critical thinking skills" (p. 3).

Tsui (1999) acknowledged that the failure to find a positive effect on the development of critical thinking skills through instructional techniques may be a result of "too brief a lapse of time between pretest and posttest, small sample sizes at single institutions, and broad measurement instruments" (p. 188). Cotter and Tally (2009) suggested possible reasons may include critical thinking exercises may be poorly connected to the skills measured by assessments, and textbook exercises labeled as critical thinking may not be connected to the

development of critical thinking skills. In addition, "data regarding the connection of exercises to objective measures of critical thinking are not routinely provided" (Cotter & Tally, 2009, p. 10), and they acknowledged "a more standardized definition of critical thinking would also lead to improved strategies for measuring it" (p. 10).

Ennis (1989) provided a classification of instructional interventions related to different instructional approaches. Ennis's (1989) critical thinking typology of four types of courses offer a classification for instructional interventions related to instructional approaches. The four approaches are general, infusion, immersion, and mixed. According to Ennis (1989), the general approach "attempts to teach critical thinking abilities and dispositions separately from the presentation of the content of existing subject-matter offerings, with the purpose of teaching critical thinking" (p. 4). The primary purpose of the general approach "is to teach students to think critically in nonschool context" (p. 4). Ennis (1989) defined the infusion approach as the:

> Infusion of critical thinking instruction in subject-matter instruction is deep, thoughtful, well understood subject-matter instruction in which students are encouraged to think critically in the subject, and in which general principles on critical thinking dispositions and abilities are made explicit. (p. 5)

Similar to the infusion approach is the immersion approach. The immersion approach follows "thought provoking kind of subject-matter instruction in which students do get deeply immersed in the subject" (Ennis, 1989, p. 5). The difference between immersion and infusion is that under the immersion approach the, "critical thinking principles are not made explicit" (Ennis, 1989, p. 5) in the subject matter content.

Abrami et al. (2008) conducted a study that analyzed instructional approaches using Ennis's critical thinking typology. They concluded: Whether it [critical thinking] is taught separately of content or embedded within content seems like a less important distinction empirically" (p. 1121). The Abrami et al. findings indicated a larger instructional effect when critical thinking is clearly a part of course design. "Developing CT [critical thinking] skills separately and then applying them to course content explicitly works best; immersing students in thought-provoking subject matter instruction without explicit use of CT principles was least effective" (p. 1121).

The mixed approach "consists of a combination of the general approach with either the infusion or immersion approaches" (Ennis, 1989, p. 5). The mixed approach includes both subject specific and general critical thinking instruction. Under this approach critical thinking principles are made explicit and use both subject matter content and other content in instruction (Ennis, 1989).

Ennis (1989) cautioned about the ambiguity surrounding the definition of the word "subject" (p. 5), "sometimes the word 'subject' is used to refer to some subject taught in school. Sometimes it refers to the topic under consideration" (p. 5). Ennis(1989) stated it is a mistake, "to infer from the fact that critical thinking is always about some subject (that is, topic) that critical thinking teaching can take place only in school subjects" (p. 5). To avoid the vagueness of the word "subject" Ennis (1989) replaced "subject" with "domain" based on the common use of "domain" among cognitive scientists in discussion of subject specificity. Ennis (1989) describes the three principles that characterize subject specificity as:

1. Background knowledge. Background knowledge is essential for thinking in a given domain.
2. Transfer. (a) Simple transfer of critical thinking dispositions and abilities from one domain to another domain is unlikely. (b) However, transfer becomes likely if, but only if, (1) there is sufficient practice in a variety of domains and (2) there is instruction that focuses on transfer.
3. General instruction. It is unlikely that any general critical thinking instruction will be effective. (p. 5)

Ennis (1989) further defined three versions of subject specificity: "Epistemological subject specificity notes that there are significant interfield differences in what constitutes a good reason" (p. 9). The foundation of this version is that critical thinking varies from field to field. The epistemological subject specificity concludes "that only the immersion approach to critical thinking instruction would be appropriate" (Ennis, 1989, p. 7). Ennis (1989) described the conceptual subject specificity version as having, "no basis and is too vague" (p. 9) and "general instruction in critical thinking is inconceivable" (p. 8). Conceptual subject specificity "does not even make sense to speak of critical thinking or critical thinking instruction outside of a subject-matter area, and the idea of general critical thinking ability is meaningless" (Ennis, 1989, p. 8). The domain specificity version "sees the importance of deliberate teaching for transfer combined with frequent application of principles in many different areas" (Ennis, 1989, p. 9). With the domain specificity version, Ennis (1989) cautioned "that a critical thinking aspect demonstrated in one situation will not necessarily be applied in another" (p. 9).

In relation to pedagogy, Abrami et al. (2008) stated: "Impacts of CT [critical thinking] were smallest when the intention to improve students' CT was only listed among the course objectives and there were no efforts at professional development or elaboration of course design and implementation" (p. 1121). Winter, McClelland, and Stewart (1981) suggested that greater growth in critical thinking occurs when curriculum was focused on an integrative theme encompassing different disciplines. The greatest impact on critical thinking development in students' occurred when instructors received advanced training in preparation for teaching critical thinking skills (Abrami et al., 2008). To maximize the development of critical thinking skills "requires both a willingness to incorporate CT instruction and explicit strategies and skills to do it effectively" (Abrami et al., 2008, p. 1121).

Elder and Paul's (1994) stage theory support explicitly teaching critical thinking in the classroom and stated "critical thinking is not something additional to content, but rather integral to it" (p. 34). The stage theory defines critical thinking development of individuals as they progress as thinkers and include the following six stages: the unreflective thinker, the challenged thinker, the beginning thinker, the practicing thinker, the advanced thinker, and the master thinker (Paul & Elder, 1997, p. 34). They made the following assumptions regarding critical thinking and instruction:

1. There are predictable stages through which every person who develops as a critical thinker passes.
2. Passage from one stage to the next is dependent upon a necessary level of commitment on the part of an individual to develop as a critical thinker, is not automatic, and is unlikely to take place subconsciously.

3. Success in instruction is deeply connected to the intellectual quality of student learning.
4. We cannot expect students to develop as critical thinkers unless we bring critical thinking into instruction at the foundational level. (p. 34)

Elder and Paul (1994) described:

> Those who teach a subject well that is, so that student learn to think within the logic of the subject have, therefore, two needs: (a) to become clear about what critical thinking is, and (b) to become adept at facilitation learning so that critical thinking is understood as the means by which students process content. (p. 34)

"Therefore, our most fundamental responsibility as instructors is to challenge student thinking and to introduce them to the workings of their minds" (Paul & Elder, 1997, p. 35). Elder and Paul (2010) stated:

> It is crucial that we as teachers and educators discover our own 'thinking,' the thinking we do in the classroom and outside the classroom, the thinking that gets us into trouble and the thinking that enables us to grow. As educators we must treat thinking--quality thinking--as our highest priority. (para. 3)

Minnesota State Universities identified critical thinking as a general education requirement; yet, it remains difficult to determine the best method for teaching critical thinking skills and assessing gains in critical thinking. Strong debates exist over what instructional methods produce the best critical thinkers. Each approach is supported by proponents such as: Sternburg and Bhana (1986) of the general approach (separate, stand-alone critical thinking course); Glaser (1984), and Resnick (1987) of the infusion approach (explicitly states critical

thinking outcomes in a discipline specific course); McPeck (1981) of the immersion approach (critical thinking outcomes are not made explicit, but imbedded in the instruction); and Ennis (1989), and Perkins and Salomon (1989) of the mixed approach. Ennis (1989) defined the mixed approach as a combination of the general approach with either the infusion or immersion approach. The underlying argument is centered on whether critical thinking is a generic skill taught as the explicit content of a specific course, a domain specific skill taught as one explicit skill within the context of discipline focused courses, or a domain specific skill immersed within the context of disciplinary content.

Halpern (2001) stated: "Despite all of the difficulties in assessing gains in critical thinking, there is a diverse body of evidence showing that thinking can be improved with instruction that is specifically designed for that purpose" (p. 277). Furthermore Halpern (2001) explained: "Critical thinking skills do not necessarily develop as a by-product of discipline-specific coursework" (p. 278), suggesting an instructional approach that explicitly states critical thinking learning outcomes in discipline specific courses (infusion approach) or in a separate, stand-alone critical thinking course (general approach) can improve critical thinking.

Tsui (1999) investigated how different types of courses and instructional techniques affect critical thinking and stated: "Simply studying courses or disciplinary major without considering the effects of instruction may produce some misleading conclusions" (p. 195). There is substantial research on the development of critical thinking skills in relation to specific pedagogical methods, but the research yielded mixed results. Smith (1977) found student participation, encouragement, and peer-to-peer interaction techniques as being positively and significantly related to critical thinking. Bailey (1979) conducted a study that compared courses

taught in a more traditional format to courses taught that emphasized critical thinking and problem solving instructional strategies. Bailey found greater gains of critical thinking scores for students in the courses that emphasized critical thinking and problem solving instructional approaches. Gibson (1985) found greater gains for students using instructional approaches of searching for meaning through reading, writing, and class participation. Eason (1986) found greater gains for students using out-of-class assignments designed to increase critical thinking. Tsui (1999) found writing assignments with instructor feedback, independent research projects, group projects, and essay exams seem to enhance critical thinking skills. Aizikovitsh and Amit (2010) conducted a study that evaluated the infusion approach to the teaching of critical thinking skills through mathematics and used the Cornell Critical Thinking Test instruments. They found considerably improvement in the critical thinking abilities and dispositions of the experimental group.

In contrast, some studies found no significant effects on the development of critical thinking skills in relation to specific pedagogical methods. For example, Mentkowski and Strait (1983) conducted an extensive longitudinal and cross-sectional study utilizing several measures of critical thinking at Alverno College. Critical thinking is the foundation of the curriculum at Alverno and followed an infused approach where courses specified critical thinking objectives as outcomes and included systematic assessments. They found no significant gains in critical thinking skills of the cohort groups in the cross-sectional comparison and no significant gains in critical thinking skills using two other testing instruments. Norton (1985) conducted a study that compared the development of critical thinking ability of students using an independent laboratory investigation approach and found no significant effect on the development of critical

thinking skills. West (1994) conducted a study comparing the development of critical thinking skills in political science students. Both groups were exposed to traditional lecture, but one group received implicit (immersion approach) critical thinking instruction and the other received explicit (infusion approach) critical thinking instruction. West (1994) found no significant gains of critical thinking skills for either of the groups. Terenzini et al. (1995) conducted a study on how curriculum, formal classroom instruction, and out-of-class experiences affected the development of critical thinking skills. This study examined several instruction-related variables and found no significant effects on the variables when precollege critical thinking ability was controlled. Forbes (1997) conducted a study that analyzed the cognitive critical thinking skills of college calculus students using an active learning environment approach and found no significant effect on the development of critical thinking skills. Johnson, Tenenbaum, and Archibald (2010) conducted a study that investigated if online social annotations effect the development of reading comprehension, critical thinking, and meta-cognitive skills in second semester freshman English classes. The results of this study found no significant difference between the online social annotation approach and the control group.

In addition to the mixed results regarding critical thinking and the effects of instructional approaches, it is worthy to note studies that found significant effects on the development of critical thinking pertaining to educational levels, programs, and courses. Pascarella (1989) conducted a study on the influence of the first year in college on the development of critical thinking and found that students with one year of college had significantly higher critical thinking scores when compared to students who did not attend college. Mines, King, Hood, and Wood (1990) conducted a study that measured the gain in critical thinking skills beyond the first

year of college. Using the Watson-Glaser Critical Thinking Appraisal and the Cornell Critical Thinking Test, Mines et al. found seniors had a significantly higher critical thinking score on both testing instruments. Consistent findings in studies conducted by Keeley (1992), Spaulding and Kleiner (1992), and McDonough (1977) among others found significant growth in critical thinking skills by college students. Dressel and Mayhew (1954) found the greatest gains in critical thinking occurred where courses were specifically developed for general education programs with an emphasis on integration. Winter et al. (1981) found significant gains in critical thinking in programs that integrate themes and ideas in courses across disciplines. Shim and Walczak (2012) found posing challenging questions in class, frequent in-class explanations by the teacher and well-organized presentation in class contributed to the development of critical thinking abilities. Defining and developing critical thinking skills in higher education continues to be a debatable topic, but the review of literature would not be complete if measuring the development of critical thinking skills were not investigated.

Critical Thinking Assessments

A review of literature suggests there are several, well-established measures of critical thinking skills as shown in Table 2. Each assessment is an objective standardized test of critical thinking used to measure the link between exposure to postsecondary education and increased levels of critical thinking.

Table 2

Standardized Critical Thinking Assessments

Assessment	Year Developed	Author
Watson-Glaser II Critical Thinking Appraisal (WGCTA)	1925	Watson and Glaser
A tool for evaluating cognitive ability.		
Cornell Critical Thinking Test (CCTT)	1985	Ennis and Millman
A measure of critical thinking skills in the areas of induction, meaning and fallacies, induction (hypothesis testing), induction (planning experiments), and definition and assumption identification.		
The California Critical Thinking Skills Test (CCTST)	1990	Facione
A measure of critical thinking skills in the area of analysis, evaluation, inference, deduction, and induction.		
Collegiate Learning Assessment (CLA)	2000	Council for Aid to Education
A performance-based measure of higher order thinking skills that includes faculty training on how to create performance tasks.		

The Watson-Glaser II Critical Thinking Appraisal (WGCTA) has a long history of development. Created by Goodwin Watson and E.M. Glaser in 1925, it was initially testing fair-mindedness. Significant revisions occurred to the test in 1941, 1944, and 2009 all aimed at improving the test that notably had a long history of use in business, government, and education; mostly used to select employees (Pearson Education, 2012). Considered a "premier tool for evaluating the cognitive ability of professionals" (para. 1) it was designed to assess critical thinking ability and decision making.

The Cornell Critical Thinking Test (CCTT) was developed in 1985, revised in 2004, and again in 2005, by Ennis, Millman, and Tomko to help teachers determine the critical thinking abilities of their students and was based on the conception of the Cornell/Illinois Model developed by Ennis et al. (2005) at Cornell University and the University of Illinois. The

Cornell/Illinois model was guided by "reasonable and reflective thinking" with a focus on "deciding what to believe or do" (p. 1). Fisher and Scriven (1997) stated: "This test appears to be the most sophisticated on the market" (p. 129). The CCTT is "part of our continuing work in the area of critical thinking, which is concerned not only with critical thinking testing, but also with conceptualizing critical thinking and with critical thinking instruction and curriculum development" (Ennis et al., 2005, p. 1). There currently are two forms or levels of the CCTT, X and Z (Ennis, Millman, & Tomko, 2005). Level X is for students in Grades 4-14. Level Z, is for advanced and gifted high school students, undergraduates, graduate students, and adults. Ennis et al. (2005) developed the Cornell Critical Thinking Test in addition to conceptualizing critical thinking with instruction and curriculum and found that more time spent on critical thinking, the more critical thinking improved. Their critical thinking testing approach "sees three types of inferences to beliefs (induction, deduction, and value judging); and four types of bases for such inferences which are: 1) the result of other inferences, 2) observations, 3) statements made by others, and 4) assumptions" (p. 2).

The California Critical Thinking Skills Test (CCTST) was developed by Facione (1990b) as a result of a two-year Delphi research project sponsored by the American Philosophical Association (Pike, 1997). Today it is considered "one of the premier instruments to evaluate critical thinking" (Leach & Good, 2011, p. 3). "The CCTST is an objective, standardized test of critical thinking that measures an individual's skills in analysis, evaluation, inference, deduction, and induction" (Pascarella et al., 2011, p. 157). "Significant relationships between CCTST and other measures including the GRE total, GRE-analytic, GRE-Verbal, GRE-Quantitative, the

WGCTA, and the SAT Math and Verbal have been reported" (Behar-Horenstein & Niu, 2011, p. 28).

The Collegiate Learning Assessment (CLA), developed by the Council for Aid to Education, "focuses on general skills such as critical thinking, analytical reasoning, and written communication" (Roksa & Arum, 2011, p. 35). The test consists of three components: "One performance task and two analytic tasks—make-an-argument and critique-an-argument. All three tasks are designed to measure how well students evaluate and analyze information and draw conclusions on the basis of that analysis" (Possin, 2013, p. 8). Roksa and Arum (2011) cited the performance task as the "CLA's most innovative component" (p. 35). Possin (2013) recognized the publicity the CLA has received including "the Spellings Commission on the Future of Higher Education suggested using the CLA universally as a means of achieving better accountability in higher education to ensure no undergraduate student left behind" (p. 8). Steedle, Kugelmass, and Nemeth (2010) noted the "CLA was not designed to produce reliable individual scores but only reliable institutional data" (p. 35).

Current research studies using the Cornell Critical Thinking Test (CCTT), Level Z, focus on the development of critical thinking in community colleges (Ashworth, 1992; Luckett, 1991; Solon, 2001, 2003) or have a specific concentration in one discipline such as nursing, computer science, or calculus (Dugan, 1985; Hanson, 1986; Jones, 1991; Yarema, 1995). Yet few studies have addressed if different teaching methods impact the development of critical thinking skills in undergraduate students. To further investigate, this study measured the development of critical thinking skills in non-transfer, third-year students in two different MnSCU institutions that have different instructional approaches to developing critical thinking skills.

Summary

It is suggested that critical thinking has always been a main focus in education and is a desirable goal of most higher education institutions. The literature suggests that critical thinking theories and models can guide the development and assessment of critical thinking skills in higher education students. King and Kitchener (1994) concluded that teaching students to think critically is an "institutional goal" and can be accomplished when it is part of the whole curriculum of the institution (p. 230). College wide studies such as Arum and Roksa (2011a) and the Wabash National Study of Liberal Arts Education (2013) both yielded only small improvements in the development of critical thinking skills as measured by standardized tests.

It can be concluded from the literature that studies involving the development of critical thinking skills through instructional approaches have produced inconsistent results. For example, studies conducted by Terenzini et al. (1995) and Cotter and Tally (2009) suggested that the pedagogical approach to teaching critical thinking has no effect on the development of critical thinking. While, studies by Ennis (1989), Abrami et al. (2008), and Winter et al. (1981) concluded the pedagogical approach to teaching critical thinking is most favorable to the development of critical thinking when critical thinking skills are first taught separately then applied to course content. These inconsistent results support the need for additional research in the area of developing critical thinking skills through instructional approaches.

This study investigates whether alternative instructional approaches impact the development of critical thinking skills in undergraduate student, particularly, non-transfer students in their third year of higher education at St. Cloud State University and Winona State University. This study may advance the empirical research regarding instructional approaches

and critical thinking development. The results may generate additional critical thinking research specific to instructional approaches. This quantitative study follows a causal comparative design. Chapter III, Method, defines the participants of this study, identifies the instrument for data collection, details the research design and data collection procedures, and describes the procedures for analysis.

CHAPTER III

METHOD

The literature suggests a long history of critical thinking development in education that includes a vast amount of research. Higher education does not question the importance of critical thinking development, but research findings often suggest complex and conflicting results. This study is intended to contribute to the empirical research on critical thinking and pedagogical approaches. The focus of this investigation is to determine whether alternative instructional approaches to developing critical thinking, exemplified by different general education requirements at different MnSCU institutions, impact the development of critical thinking skills among undergraduate students. The specific aims of this study are to compare the development of critical thinking skills between non-transfer, third-year undergraduate students at St. Cloud State University and Winona State University.

The methodology for this research study is quantitative and is appropriate for the causal-comparative research design.

> Causal-comparative research is a type of non-experimental investigation in which researchers seek to identify cause-and-effect relationships by forming groups of individuals in whom the independent variable is present or absent—or present at several levels–and then determining whether the groups differ on the dependent variable. (Gall, Gall, & Borg, 2003, p. 296)

This design allows the opportunity to analyze the relationship among variables in a single study by comparing the critical thinking test scores between non-transfer, third-year students who have

taken a critical thinking course with those who are not required to take a critical thinking content based course as part of their general education requirements.

The Method section is organized to give the reader a detailed and focused description of the design of this investigation. The Method section defines the participants of this study, the Cornell Critical Thinking Testing instrument, the causal-comparative research design, data collection, analysis procedures, human subject approval, and the procedures and timeline.

Participants

This study focuses on the development of critical thinking skills in Minnesota undergraduate students; therefore, the more specific target population of this study is all undergraduate students enrolled in Minnesota four-year State Universities. All universities share a common definition of critical thinking, but can be categorized into two distinct instructional approaches to developing critical thinking. Minnesota State University, Moorhead; Southwest Minnesota State University; and St. Cloud State University require a specific course in critical thinking. Bemidji State University; Minnesota State University, Mankato; Metropolitan State University; and Winona State University maintain critical thinking develops as a result of the completion of general education requirements.

The researcher chose St. Cloud State University because it is the largest university in the MnSCU system to represent the accessible population of students required to take a specific course in critical thinking. The researcher chose Winona State University because it specifically promotes an "in-depth knowledge base along with the critical thinking and communication skills" (Minnesota State Colleges & Universities, n.d.a.) needed in careers and advanced studies. Winona State, the oldest university in the MnSCU system, represented the accessible population

of students not required to take a specific course in critical thinking. The accessible population is defined as all undergraduate students enrolled in St. Cloud State University and Winona State University.

This study investigated whether alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in different MnSCU institutions, impacted the development of critical thinking skills among non-transfer, third-year undergraduate students. St. Cloud State University and Winona State University each offer a different approach to teaching critical thinking in their general education programs. Students typically complete most of the general education requirements in the first 2 years of college at four-year universities and concentrate course work in their majors in the third, fourth, and subsequent years of college. This study focused on the specific goal area of critical thinking. Most St. Cloud State University and Winona State University students by the end of their third year of college have completed the requirements to satisfy the critical thinking goal area; therefore, third-year undergraduate students were the population of this study. To measure if the approach to teaching critical thinking impacted the development of critical thinking in students this study excluded transfer students. Transfer students could have taken a critical thinking course prior to enrolling in St. Cloud State University or Winona State University and been exposed to an unknown approach to critical thinking instruction.

To obtain the sample population, this study followed a stratified random sampling of the accessible population focusing on third-year, non-transfer undergraduate students. Using a stratified random sampling narrowed the sample population to non-transfer, third-year undergraduate students, providing equal opportunity of participation with a randomizing of all

potential variables of the sample population. The number of participants invited to participate in this study was 1,504 SCSU students and 1,211 WSU students. With an estimated response rate of 20%, or a SCSU sample size of 300 students and a WSU sample size of 242 students, would be obtained. Working with the institutional research departments, the researcher obtained the email addresses of third-year, non-transfer students as of the 2013 fall term at each respective college (defined by credits 60-90). These lists were used to contact, by email, potential participants in this research study. In addition, the researcher set up informational tables at each respective campus to recruit and provide information on this research study to potential participants. Facebook was also utilized to provide information to participants in this research study. Fliers were displayed on campus bulletin boards as an additional recruiting tool.

Participants who completed the Cornell Critical Thinking Test were eligible to receive a Samsung Galaxy Tab 3 or a Visa Card. Prizes were awarded equally at each campus to participants who completed the Cornell Critical Thinking Test Level Z. Participants completed an entry form (see Appendix A) to enter into a drawing to win one of the following:

- Samsung Galaxy Tab 3 (1 per campus)
- $100.00 Visa Card (1 per campus)
- $50.00 Visa Cards (2 per campus)
- $25.00 Visa Cards (2 per campus)

Prizes were awarded to the winners of the drawing after all testing sessions were completed. All prizes were sent via USPS on or before April 4, 2014 to the address submitted on the entry form.

Instrument for Data Collection

The Cornell Critical Thinking Test (CCTT), Level Z, was used to measure the development of critical thinking skills in undergraduate students (see Appendix B for a sample question). The CCTT is an established and valid testing instrument; therefore no pilot study was conducted to test the adequacy of the testing instrument. The CCTT was administered in a face-to-face classroom setting using a test booklet and scantron sheet. No pilot was conducted to test the procedures of administering the test due to the experience of the researcher in proctoring standardized tests. The CCTT is a general critical thinking ability test used to determine the critical thinking abilities of students (Ennis et al., 2005). The test evaluates and predicts student skills in critical thinking. Level Z, is for advanced and gifted high school students, undergraduates, graduate students, and adults and tests critical thinking in the areas of induction, deduction, observation, credibility, assumptions, and meaning (Ennis et al., 2005). Ennis (1996) defined these categories: induction is "reasoning that is either generalizing or best-explanation reasoning" (p. 397). Deduction is "reasoning in which the conclusion is supposed to follow necessarily from the reasons" (Ennis, 1996, p. 396). Observation is "to notice or perceive something" (Ennis, 1996, p. 397). Credibility is "the degree to which that source deserves to be believed in the making of that statement" (Ennis, 1996, p .395). Assumptions are "a proposition that is taken for granted in a situation and that backs up a conclusion" (Ennis, 1996, p. 395). Meaning is "concerned with the more verbal and linguistic aspects of argument" (Ennis et al., 2005, p.46). The test is structured as a multiple choice test where students are presented with a passage in which certain conclusions are underlined. Students then determine if the conclusions follow logically, contradict or do neither. The Cornell Critical Thinking Tests Administration

Manual provides both an answer key and explanation of the answers to the questions presented in the Level Z test. The CCTT was administered as a testing instrument and no parts of the test were reproduced; therefore, this study required no additional permission to administer this test.

The CCTT is scored using the total number of right answers. No subset scores in the areas of induction, deduction, observation, credibility, assumptions, and meaning are calculated. Ennis et al. (2005) recommended "for rough diagnostic purposes, it is possible to compute subtest scores. Such subset scores, since they are composed of a small number of items, should not be used to make individual comparisons" (p. 7).

In this study, induction was measured in Items 17 and 26-42; deduction was measured in Items 1-10 and 39-52; observation was measured in Items 22-25, credibility was measured in Items 22-25; assumptions was measured in Items 43-52; and meaning was measured in Items 11-21 and 43-46. "Although aspects of critical thinking are listed separately, there are considerable overlap and interdependence among them in the actual process of critical thinking" (Ennis et al., 2005, p. 2). The assumption aspect of critical thinking are listed under both assumption and deduction question items "because deduction is useful in identifying likely candidates for an assumption in a given line of reasoning" (Ennis et al., 2005, p. 2). Another argument is basic deduction could be a matter of just knowing the meaning of words and statements; therefore an assumption can be made that deduction items could also be classified under meaning (Ennis et al., 2005). Additional overlap is found in observation and credibility, Items 22-25. Ennis et al. (2005) stated:

> Observation statements made by another person, a description that fits many of these items, are subject to credibility criteria as well as criteria for making observation

statements. The rest of these items are straight credibility items. So, all of these items are classified under credibility, with most also classified under observation. (p. 3)

Ennis et al. (2005) shared "four usable published reports of experimental studies using Level Z" and "each of these studies used the Cornell/Illinois model, or something comparable, and all showed statistically significant improvement or difference, favoring the group that was taught under this model" (p. 39). Ennis et al. reported: "These experimental studies jointly provide strong evidence for the validity of Level Z . . . given the circumstances, and if critical thinking was taught well . . . we would expect to find significant improvements. These were found" (p. 40).

Reliability estimates for Level Z, using the Spearman-Brown approach, have ranged from .49 to .87 (Ennis et al., 2005). Ennis et al. (2005) used another measure of internal consistency defined as the "set of correlations between parts of the test and the total score" (p. 16). Known as the Kuder-Richardson approach, it "provides an index of internal consistency, not of ability to provide the same results repeatedly" (Ennis et al., 2005, p. 16). The part-score for internal consistency KR-18 estimates for Level Z were .76, .66, .60, .55, .72, .65, and .65 with an overall total score of .76. Ennis et al. (2005) stated the scores were "almost as high as the internal consistency estimate (.76) for the whole test with the same administration of the test" (p. 17).

The validity of the Level Z test is based on criterion-related evidence and the correlation between level Z and other critical thinking and reasoning tests. Of the 11 critical thinking tests, Ennis et al. (2005) reported that "seven correlations between Level Z and other critical thinking tests ranged around .50" which indicated a "reasonable degree of relationship, given the differences in approach of different test makers" (p. 32). Additional correlations of Level Z and

other variables (IQ/Aptitude/Admissions, gender, academic accomplishments, grade level, personality, socio-and economic status) supported the "consistency and generalizability of these relationships, provid[ing] strong support for the construct validity of Level Z" (Ennis et al., 2005, p. 38).

The Cornell Critical Thinking Test provides a specific 50 minute time limit for Level Z. Ennis et al. (2005) stated: "More than 90% of students taking Level Z should finish in 50 minutes" (p. 4). It is necessary to adhere to the time constraints to accurately compare the results to the norms provided for Level Z. The test was administered in a 50-minute, face-to-face setting using printed testing booklets with fillable scantron sheets to record answers.

Research Design

This study followed a causal-comparative research design and investigated if alternative instructional approaches to developing critical thinking skills, exemplified by different general education requirements in two different MnSCU institutions, impacted the development of critical thinking skills in undergraduate students. This study compared two institutions, St. Cloud State University and Winona State University, the independent variable, with the scores of the Cornell Critical Thinking Test, the dependent variable. This study compared the scores between St. Cloud State University third-year, non-transfer students and Winona State University third-year, non-transfer students.

This study followed a stratified random sampling of the accessible population focusing on third-year, non-transfer undergraduate students. This study followed a post-test-only design. The post-test-only design can control threats to internal validity by eliminating the chance for the pre-test scores to affect the post-test scores. The post-test-only design can also control threats to

external validity by shortening the length of the study, therefore, reducing the chance for participants to withdraw from the study.

Pre-conditions among the groups were similar in that the groups were roughly equal at the beginning of enrollment in college in averages reported on such variables as average ACT scores (SCSU; 21 and WSU; 23), average high school GPA (SCSU; 3.12 and WSU 3.3), class rank (SCSU 24% top quarter of high school rank and WSU 32% top quarter of high school rank) (College Data, 2013), and on high school preparation curriculum (each college requiring 4 units of English, 3 units of Mathematics, 3 units of Science, 2 units of Foreign Language, and 3 units of Social Studies. In addition, WSU requires 1 unit in Academic Electives). While these pre-conditions are similar, there are some differences. These differences may be substantial enough to affect the results on the Cornell Critical Thinking Test Level Z.

Data collection. Students completed the Cornell Critical Thinking Test in paper-pencil format. Student identification was verified prior to testing using their email address. No other identifying information of the participants was collected or recorded. Each of the SCSU participants completed a course completion form (see Appendix C) indicating if they have completed PHIL 194 Critical Reasoning, CMST 306 Rhetoric in Popular Culture, CMST 318 Argumentation and Advocacy, ENGL 306 Rhetoric in Popular Culture, POL 191 Introduction to Political and Legal Reasoning, and POL 192 Critical Reasoning: Issues and Events in American Politics. Each of the WSU participants completed a course completion form (see Appendix D) indicating if they have completed PHIL 110 Critical Thinking. In each testing session, students were given a testing booklet and scantron form. The testing booklet, course completion sheet, and scantron were collected at the end of the testing session. The scantron number, a yes or no

indicator of completion of a critical thinking course, and scores from the scantron were manually entered in Statistical Package for Social Sciences (SPSS) for statistical analysis. Data was stored electronically.

Analysis

The results of this study were analyzed using a test of statistical significance. "The t distribution is used to determine the level of statistical significance of an observed difference between sample means" (Gall et al., 2003, p. 137), and to test the null hypothesis.

H_0: There is no significant difference of the Cornell Critical Thinking Test scores of non-transfer, third-year undergraduate students who complete different general education requirements at two different MnSCU institutions.

A *p* value of less than .05 was considered statistically significant.

Human Subject Approval

The researcher completed the required human subject and privacy training required by St. Cloud State University. An approved IRB was filed at SCSU and WSU (see Appendix E for the approved IRB decision letter and Appendix F for the stamped consent of the informed consent form).

Procedures and Timeline

In December 2013, a request was placed with the office of institutional research at St. Cloud State University and Winona State University to provide the names and email addresses of non-transfer, third-year students. Students may restrict the release of directory information, including student name and e-mail addresses. This restriction is indicated with an electronic

privacy flag and students who elect to restrict directory information were not included in the electronic lists provided from each respective college.

Based on the academic schedules of students attending St. Cloud State University and Winona State University during spring 2014, a reasonable timeline to contact students and provide information regarding the study, and travel distance between the campuses the researcher scheduled ten testing sessions to be conducted in March 2014. The testing schedule for each institution is outlined in Table 3.

Table 3.

Testing Schedule at SCSU and WSU

St. Cloud State University Testing Dates	March 4, 2014 March 18, 2014 March 26, 2014 March 27, 2014 (2 sessions)
Winona State University Testing Dates	March 3, 2014 March 19, 2014 March 24, 2014 March 25, 2014 (2 sessions)

One week prior to the first testing session, participants were invited to participate in this study via email (see Appendix G). Participants were asked to respond to the email indicating their preferred testing date and time. A confirmation email was sent to each participant indicating their testing date and time. Another email reminder was sent to each participant 1 day before the testing session. Participants who confirmed a testing date and time were removed from the overall email list as recruiting continued. Potential participants received weekly requests during March 2014, via email, to participate in this study. The researcher compiled a list of names and email addresses for each testing session based on the participant's responses. A total of 105

participants volunteered; 40 participants from WSU, and 65 participants from SCSU. This list of email addresses was used at each testing session as verification of participants.

Five testing sessions were held on campus at St. Cloud State University in the Education Building, Room B113 and five testing sessions were held on campus at Winona State University in Gildmeister Hall, Room 225. During the first week of the testing sessions, an information table was provided to recruit potential participants and provide additional information for those already willing to participate. The informational table was displayed in Atwood Memorial Center on the St. Cloud State University campus and in Kryzsko Commons Lower Hyphen on the Winona State University campus. Six students visited the informational table at St. Cloud State University and three students visited the informational table at Winona State University. No students volunteered to participate in this study through the informational tables recruiting efforts. Participants could also access a Facebook page for additional information. Again, the Facebook page did not solicit any volunteers for this study.

All testing sessions were facilitated by the researcher. At the testing session, each participant's email address was verified against the participation list created from email responses. Each testing session was conducted by the same procedures. Each participant was given the informed consent form; the researcher read this form before the testing session began. Prior to beginning the test, participants were instructed to complete the Course Completion form indicating if they completed a critical thinking course. If no critical thinking course was completed, the participant left the Course Completion form blank. The researcher distributed the CCTT Level Z test booklet, scantron form and pencil, and then read aloud the testing instructions provided by the testing instrument. Participants were given 50 minutes to complete the test. The

Course Completion form, test booklet, and scantron were collected at the end of the testing session. If participants finished before the 50 minute session they could hand-in their testing materials and leave the testing session. Participants were asked to complete an entry form to be eligible for the prizes given in this study. Prizes were awarded to the winners and sent USPS to the address submitted on the entry form. All prizes were sent on or before April 4, 2014.

Summary

This study investigated if alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in different MnSCU institutions, impact the development of critical thinking skills among undergraduates. This study followed a causal-comparative research design comparing the scores of the Cornell Critical Thinking Test, Level Z of non-transfer, third-year students at SCSU and WSU. The Cornell Critical Thinking Test, Level Z was administered to students in a paper pencil format. Data was analyzed using a t-test. The findings of this study are presented in the next section, the Results section, and include a brief outline of the organization of the section, results as it relates to the null hypothesis, and a synthesis of findings with an overall conclusion of the study.

CHAPTER IV

RESULTS

This study investigated whether alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in two different MnSCU institutions, impacted the development of critical thinking skills among undergraduate students. The null hypothesis is that there is no significant difference between the Cornell Critical Thinking Test scores of non-transfer, third-year undergraduate students who completed different general education requirements at two different MnSCU institutions. Outcome variables are scores obtained as an overall score on the Cornell Critical Thinking Test Level Z and in the seven sections of the instrument defined as deduction, meaning and fallacies, observation and credibility of sources, induction (hypothesis testing), induction (planning experiments), definition and assumption identification, and assumption identification.

This chapter reports the results of the study as the comparison of scores obtained on the Cornell Critical Thinking Test Level Z between students who completed a critical thinking course and students who did not complete a critical thinking course. The analysis uses a t-test for independent samples. A description of the sample is provided, followed by an overview of the findings, and the results from each of the seven sections are presented in turn. This chapter concludes with a summary of results.

Description of Sample

The sample population of this study was third-year, non-transfer students attending St. Cloud State University or Winona State University. A total of 54 participants completed the Cornell Critical Thinking Test Level Z. The total number of participants who completed a

critical thinking course and the total number of participants who did not complete a critical thinking course are presented in Table 4.

Table 4

Cross-Tabulation of Participants

Participants	*N*	Percentage of Participation	Number of Participants that did completed a critical thinking course	Number of Participants that did not complete a critical thinking course
St. Cloud State	32	2.12	29	3
Winona State	22	1.82	0	22
Total	54	1.98	29	25

The total number of participants from St. Cloud State University was 32 or 2.12% of the sample population. Of the 32 SCSU participants, 29 participants completed a critical thinking course and three participants did not complete a critical thinking course. The total number of participants from Winona State University was 22 or 1.8% of the sample population. Of the 22 WSU participants, zero participants completed a critical thinking course and 22 participants did not complete a critical thinking course. Overall, of the 54 total participants, 29 participants did complete a critical thinking course; 29 participants from St. Cloud State University and zero participants from Winona State University. Of the 54 total participants, 25 participants did not complete a critical thinking; three participants from St. Cloud State University and 22 participants from Winona State University.

Research Findings

This study investigated the following research question: How do alternative instructional approaches to developing critical thinking, exemplified by different general education requirements in two different MnSCU institutions, impact the development of critical thinking skills among undergraduate students?

H_0: There is no significant difference between the Cornell Critical Thinking Test scores of non-transfer, third-year undergraduate student who complete different general education requirements at two different MnSCU institutions.

The data analysis included a group statistics t-test that compared the scores of the Cornell Critical Thinking Test Level Z between participants who did not complete a critical thinking course with participants who did complete a critical thinking course. The aggregated data for this study showed that the scores of participants who did not complete a critical thinking course were slightly higher than the scores of participants who did complete a critical thinking course; however the data analysis indicates that the effect was not statistically significant. Scores for students who completed a critical thinking course (M= 26.28, SD 5.61) was not significantly higher than the scores of students who did not complete a critical thinking course (M=28.10, SD 4.84), t (52) = 1.28, p = .205. Therefore, the null hypothesis was accepted that there was no significant difference between the Cornell Critical Thinking Test scores of non-transfer, third-year undergraduate students who complete different general education requirements at two different MnSCU institutions.

Section Results

The Cornell Critical Thinking Test includes seven subsections for different components of critical thinking. While, there was no significant difference in the overall scores of the two study groups it may be informative to analyze the differences between the two study groups on these subsections. The mean score of the participants who did not complete a critical thinking course was slightly higher than the mean score of participants who did complete a critical thinking course; however, the total mean scores of participants who did not complete a critical thinking course and participants who did complete a critical thinking course on each section did not differ significantly. The results of the independent samples test are presented for each section in Table 5.

Table 5

Independent Samples Test of Sections

Section		*N*	Mean	Std. Deviation	*t*	p
Deduction	Did not complete critical thinking course	29	6.76	1.38	1.62	.11
	Completed critical thinking course	25	6.00	1.96		
Meaning and Fallacies	Did not complete critical thinking course	29	4.24	1.53	0.26	.80
	Completed critical thinking course	25	4.12	1.92		
Observation and Credibility of Sources	Did not complete critical thinking course	29	2.28	0.99	0.43	.67
	Completed critical thinking course	25	2.16	0.99		
Induction (Hypothesis Testing)	Did not complete critical thinking course	29	7.89	1.70	0.42	.68
	Completed critical thinking course	25	7.68	2.07		
Induction (Planning Experiments)	Did not complete critical thinking course	29	1.66	1.00	-0.24	.81
	Completed critical thinking course	25	1.72	0.94		
Definition and Assumption Identification	Did not complete critical thinking course	29	2.41	0.78	1.60	.12
	Completed critical thinking course	25	2.04	0.93		
Assumption Identification	Did not complete critical thinking course	29	2.86	1.40	0.69	.49
	Completed critical thinking course	25	2.56	1.80		

The Cornell Critical Thinking Test Level Z is designed to measure critical thinking skills in the areas of deduction, meaning and fallacies, observation and credibility of sources, induction (hypothesis testing), induction (planning experiments), definition and assumption identification, and assumption identification. The results of the independent samples test are presented for each section of the Cornell Critical Thinking Test Level Z.

Deduction

The Deduction Section, Items 1-10 of the Cornell Critical Thinking Test Level Z is defined as "reasoning in which the conclusion is supposed to follow necessarily from the reasons" (Ennis, 1996, p. 396). The basic concept in deductive inference is deductive validity "to say that an argument is deductively valid is to say that its conclusion follows necessarily from its reasons. If you accept the reasons in a deductively valid argument, you are thereby automatically committed to accepting the conclusion" (Ennis, 1996, p. 90). In each of the deduction items, "the proposed conclusion either follows necessarily from the statements given, contradicts them, or neither" (Ennis et al., 2005, p. 45).

The scores of the deduction section for students who did not complete a critical thinking course (M= 6.76, SD 1.38) were not significantly higher than the scores of students who did complete a critical thinking course (M=6.00, SD 1.96), t (52) = 1.62, p = .11. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the deduction section. For this subsection, the assumption of equal variances was not obtained, so the t value reported here was the one for unequal variance. For the remaining subsections of the Cornell Critical Thinking Test reported below, the assumption of equal variance held.

Meaning and Fallacies

The Meaning and Fallacies Section, Items 11-21 of the Cornell Critical Thinking Test Level Z is "concerned with the more verbal and linguistic aspects of argument. Other fallacious types of reasoning are represented here with only the foils being linguistic" (Ennis et al., 2005, p.

46). “An argument is an attempt to prove or establish a conclusion. It has two major parts: a conclusion and the reason or reasons offered in support of the conclusion” (Ennis, 1996, p. 2).

The scores of the meaning and fallacies section for students who did not complete a critical thinking course (M= 4.24, SD 1.53) were not significantly higher than the scores of students who did complete a critical thinking course (M=4.12, SD 1.92), t (52) = 0.26, p = 0.80. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the meaning and fallacies section.

Observation and Credibility of Sources

The Observation and Credibility Section, Items 22-25 of the Cornell Critical Thinking Test Level Z requires reasons to be “justified to the extent that they satisfy the criteria of the observation” (Ennis, 1996, p. 73). Observations will be “justified as observations roughly to the extent that they come from a credible source” (Ennis, 1996, p.73), and are really observations rather than a conclusion (Ennis, 1996). Observation requires judging the acceptability of reasons based on the situation presented (Ennis, 1996).

The scores of the observation and credibility of sources section for students who did not complete a critical thinking course (M= 2.28, SD 0.99) were not significantly higher than the scores of students who did complete a critical thinking course (M= 2.16, SD 0.99), t (52) = 0.43, p = 0.67. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the observation and credibility of sources section.

Induction Hypothesis Testing

The Induction Hypothesis Testing Section, Items 26-38 of the Cornell Critical Thinking Test Level Z require, "best-explanation criteria apply to judging these induction items" (Ennis et al., 2005, p. 46). Ennis (1996) defined the criteria for accepting a hypothesis as:

1. The hypothesis should explain some facts, given reasonable assumptions.
2. Other possible explanations should be inconsistent with some other facts, given reasonable assumptions.
3. The hypothesis should not be inconsistent with any facts, given reasonable assumptions.
4. The hypothesis should be plausible. (p. 200)

Induction is defined as "reasoning that is either generalizing or best-explanation reasoning or both" (Ennis, 1996, p. 397).

The scores of the induction hypothesis testing section for students who did not complete a critical thinking course (M= 7.89, SD 1.70) were not significantly higher than the scores of students who did complete a critical thinking course (M=7.68, SD 2.07), t (52) = 0.42, p = 0.68. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the induction hypothesis testing section.

Induction Planning Experiments

The Induction Planning Experiments Section, Items 39-42 of the Cornell Critical Thinking Test Level Z identifies in a planning experiment that:

> It is desirable to have a control group (especially with random assignment to experimental and control groups) to generate results that could be in conflict with the hypothesis (by virtue of the hypothesis' implying the opposite, given acceptable assumptions), and to be fairly specific. (Ennis et al., 2005, p. 47)

The scores of the induction planning experiments section for students who did not complete a critical thinking course (M= 1.66, SD 1.00) were not significantly higher than the scores of students who did complete a critical thinking course (M=1.72, SD 0.94), t (52) = -0.24, p = 0.81. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the induction planning experiments section.

Definition and Assumption Identification

The Definition and Assumption Identification Section, Items 43-46 and Assumption Identification, Items 47-52 of the Cornell Critical Thinking Test Level Z determine what a person is thinking by identifying assumptions. Assumptions include "explicit undefended premises, conclusion that are possibly questionable, presuppositions, unstated beliefs upon which a person based a conclusion or explanation, and propositions deemed to be needed for the maximum justification of conclusion" (Ennis, 1982, p. 369). Assumption identification is, "interpreted as the identification of implicit propositions taken for granted as a basis of argument or action" (Ennis, 1982, p. 84). Ennis (2005) identified "one basic criterion for an assumption is that it fills a gap in the reasoning" (p. 47). Gap fillers are those assumptions that "join with one or more other premises in giving support to the conclusion" (Ennis, 1982, p. 63). The definition and assumption identification section requires definition of the implied intentions of reasoning

before it can be determined if the assumption fills a gap in the reasoning. The assumption identification section focuses on determining if the assumption fills the gap of reasoning, without first identifying the implied intentions.

The scores of the definition and assumption identification section for students who did not complete a critical thinking course (M= 2.41, SD 0.78) were not significantly higher than the scores of students who did complete a critical thinking course (M=2.04, SD 0.93), t (52) = 1.60, p = 0.12. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the definition and assumption identification section.

The scores of the assumption identification section for students who did not complete a critical thinking course (M= 2.86, SD 1.40) were not significantly higher than the scores of students who did complete a critical thinking course (M=2.56, SD 1.80) t (52) = 0.69, p = 0.149. Therefore, the null hypothesis was accepted that there is no significant difference between the Cornell Critical Thinking Test scores of the two study groups on the assumption identification section.

Summary

This study investigated whether alternative instructional approaches to developing critical thinking impact the development of critical thinking skills among undergraduate students. The data from this study indicated students who did not complete a critical thinking course obtained a slightly higher mean score on the Cornell Critical Thinking Test Level Z than students who did complete a critical thinking course; however, the data analysis for this study indicate the difference was not statistically significant. The results of the data analysis for each of the seven

subsections of the Cornell Critical Thinking Test Level Z also showed the differences were not statistically significant.

Discussion of whether institutions incorporate immersion or the general approaches to their curriculum can improve critical thinking outcomes are outlined in the Discussion chapter. The Discussion chapter includes the limitations of the study, the implications for research and theory, and a synthesis of conclusions of the study.

CHAPTER V

DISCUSSION

Higher education plays a crucial role in preparing students to be successful leaders, including the development of critical thinking skills. Today many colleges and universities highlight critical thinking as an institutional goal or outcome. The purpose of this study is to determine how different instructional approaches develop critical thinking skills in undergraduate students and is based on the theoretical framework of Ennis's (1989) classification of general, infusion, immersion, and mixed instructional approaches. The intent of this study is to determine if different instructional approaches to teaching critical thinking produces higher gains in critical thinking scores. St. Cloud State University applies the general, immersed, and mixed instructional approaches, but explicitly requires students to complete courses with specific critical thinking learning outcomes. Since immersion is an assumed practice at St. Cloud State University, then, the University automatically incorporates the mixed approach combining the general approach with the immersion approach.

Winona State University instructional approach most closely matches the immersion approach. No specific course in critical thinking is required, as in the general approach, and no critical thinking learning outcomes are required in content specific courses, as is a characteristic of the infusion approach. Winona State University does offer a critical thinking course, PHIL 110 Critical Thinking and, if students elect to take this course, they would be exposed to the general approach, but this applies only for those students making this election. No Winona State University participants in this study made that election.

Overall, the findings of this study did not reveal a significant difference in student scores resulting from the use of different instructional approaches, which limits the ability to make firm recommendations about which instructional approaches are most effective at developing critical thinking skills in undergraduate students. However, the current trend within higher education is to define critical thinking as a measurable student learning outcome, increasing the need to identify the most effective instructional approaches to improve critical thinking skills in undergraduate students. This chapter is organized to include a discussion of the findings of this study, the limitations, the recommendations, future research and a summary of the overall study.

Discussion and Conclusion

The conceptual framework of this critical thinking study is grounded in the work of Ennis (1989). The working definition on which this study is based is that "critical thinking is reasonable and reflective thinking focused on what to believe or do" (Ennis et al., 2005, p. 1). This definition is the foundation of Ennis' et al. (2005) "continuing research work in the area of critical thinking, which is concerned not only with critical thinking testing, but also with conceptualizing critical thinking and with critical thinking instruction and curriculum development" (p. 1). Ennis (1989) offered a classification of instructional approaches, which include the general, infusion, immersion, and mixed approaches, to teaching critical thinking. This study aimed to determine whether alternative instructional approaches to develop critical thinking, exemplified by different general education requirements in two different Minnesota State Colleges and Universities (MnSCU) institutions, impact the development of critical thinking skills among undergraduate students. The findings of this study do not reveal a

significant difference in student scores resulting from the use of different instructional approaches to develop critical thinking skills.

It is important to note that several concerns should have been addressed during the course of this study. The timing of completion of a critical thinking course was not captured as part of the initial study, but has the potential to impact the development of critical thinking skills. St. Cloud State University requires a critical thinking course as part of the requirements of the Liberal Education Program; however, this study did not capture when the participants (non-transfer, third-year students) completed the required critical thinking course. If a critical thinking course was completed at the freshman level students would have the opportunity to improve critical thinking skills throughout their sophomore and junior year. If the critical thinking course was completed at the junior level there would be less time to further develop critical thinking abilities attributing to the notion that, "cognitive growth is a gradual and cumulative process" (Halpern, 2001, p. 273).

The low participation rate of this study could have been overcome with changes to the recruiting efforts and delivery of the testing instrument. This study recruited participants from two Minnesota Universities, St. Cloud State University and Winona State University to determine if different instructional approaches impact the development of critical thinking skills. Other universities in Minnesota follow the same instructional approaches to fulfill the critical thinking requirement of the general education requirement. In addition to St. Cloud State University, Minnesota State University, Moorhead; and Southwest Minnesota State University each require a specific course in critical thinking. While, as at Winona State University, Bemidji State University; Minnesota State University, Mankato; and Metropolitan State University

maintain critical thinking develops as a result of the completion of general education requirements. Expanding the recruiting of participants to other universities that share the same instructional approach to developing critical thinking could have increased the participation rate.

The Cornell Critical Thinking Test was administered to participants in face-to-face testing session using a paper and pencil based format on each campus during the spring semester. Expanding recruiting to additional Minnesota Universities would add complexities to the study that involve logistics and time constraints. This study focused on non-transfer, third-year students because students typically complete most of the general education requirements in the first two years of college at four-year universities and begin course work in their specific disciplines in the third, fourth, and subsequent years of college. It may not be feasible to complete all testing, of students at multiple locations, in the same semester due to the location and travel time to and from the institutions. An alternative would be to offer the test in an electronic format at each respective institution. The Cornell Critical Thinking Test is available to be installed on a server with access to a limited number of tests, but requires a substantial increase in expense. This allows the test to be delivered in a computer lab setting with features such as: password protection, self-timing, self-grading, and printable reports. This option, however, still requires participants to travel to a testing location.

There may be several factors that contributed to the findings of this study that there was no significant difference in student scores resulting from the use of different instructional approaches to develop critical thinking skills. The general approach utilized at St. Cloud State University relies on a specifically designed course to teach critical thinking. McPeck (1981) is critical of the general approach and stated:

> In isolation from a particular subject, the phrase 'critical thinking' neither refers to nor denotes any particular skills. It follows from this that it makes no sense to talk about critical thinking as a distinct subject and that it therefore cannot be taught as such. (p. 5)

Perhaps it is unrealistic to expect one critical thinking course to significantly impact the development of critical thinking skills in undergraduate students. Halpern (2001) concluded "it would be unrealistic to expect a huge gain in the thinking abilities of college students that can be attributable to one course that is a quarter or semester in length" (p. 273).

One final consideration of the general approach is the possible limitations of teaching critical thinking skills without the context of a discipline. It is debatable if critical thinking skills are general skills that can be taught in a specific course aimed at teaching critical thinking or if the development of critical thinking skills is dependent on concepts in specific content disciplines. "Isolated instruction in thinking skills, no matter how elegant the training provided, is unlikely to produce broadly used thinking ability . . . [but] embedding instruction in thinking skills within the academic disciplines of the school curriculum has several advantages" (Resnick, 1987, p. 48). One of the advantages of embedding critical thinking in the instruction is that it "supplies criteria from within the disciplinary traditions for what constitutes good reasoning and thinking" (Resnick, 1987, p.48). Using the general approach to teach critical thinking may limit a student's ability to apply critical thinking skills to different contexts. Based on the literature, it cannot be assumed that critical thinking skills developed in a critical thinking course can be transferred to discipline specific contexts or contexts outside the realm of education.

The inconsistency of content and delivery of critical thinking course materials may further complicate the effectiveness of a single critical thinking course. Tsui (1999) stated that

"courses and programs designed to foster critical thinking might differ widely in content as well as delivery" (p. 186). Several studies (Bailey, 1979; Eason, 1986; Gibson, 1985; Smith, 1977) found instructional strategies such as: student participation, problem solving and out-of-class assignments, among others, all lead to greater gains in critical thinking. It is questionable whether an institution can consistently apply critical thinking instruction across the curriculum in a way that improves upon the delivery of the content of critical thinking in the infusion or the immersion approach. Nonetheless, inconsistent instructional techniques between institutions and courses may have influenced the results of this study to find no significant gains in critical thinking.

With an understanding of the cognitive growth process of college students and the results of this study, I tend to favor the use of the mixed approach to developing critical thinking. Ideally, the goal of education is for students to develop critical thinking skills and be able to apply these skills to a wide variety of contexts. This may require a progressive approach to teaching critical thinking by devising a curriculum that incorporates a stand-alone critical thinking course with critical thinking infused or imbedded in the content of discipline subject-matter. Perkins and Salomon (1989) stated: "The fact remains, however, that most efforts to cultivate general cognitive skills have not focussed [*sic*] on bringing together context-specific knowledge with general strategic knowledge" (p. 23). The results of this study do not offer a definitive conclusion if alternative instructional approaches develop critical thinking skills in undergraduate students, but does offer further conversation on the bigger picture on how college develops critical thinking.

Perhaps it is not enough to study the difference in critical thinking scores based solely on Ennis' (1989) classification of instructional approaches, but to include the dispositions necessary to use critical thinking skills. By definition, the general, infused, imbedded, and mixed instructional approaches each reference the development of critical thinking skills and dispositions. A few of the dispositions defined by Ennis (1987) include seek a clear statement of the thesis or question; seek reasons; try to be well informed; be open-minded; and be sensitive to the feelings, level of knowledge, and degree of sophistication of others, among others. This study utilized the Cornell Critical Thinking Test, Level Z to measure the development of critical thinking skills. This testing instrument is a "general critical thinking ability test . . . and does not cover attitudes or dispositions of a critical thinker . . . [which are] very difficult to test" (Ennis et al., 2005, p. 2). Facione et al. (2000) indicated that "skill and dispositions are two separate things in people" (p. 32). They further explained "to teach for thinking one must nurture truth-seeking, open-mindedness, analyticity, systematicity, intellectual curiosity, confidence in the proper use of reasons and evidence, and maturity of judgment" (p. 34). This study focused on the approach taken by higher education institutions rather than seeking to further define the specific skills and dispositions related to each respective approach. Understanding to what extent critical thinking skills are covered in course work and the role of how dispositions are included in the instructional process could impact whether students are able and willing to engage in critical thinking.

This study focused on how critical thinking skills develop using Ennis' (1989) classification of instructional approaches. The findings of this study did not reveal a significant difference of gains in critical thinking scores between students that have completed a critical

thinking course and students that have not completed a critical thinking course, but an important conclusion of this study highlights the need to seek how dispositions may have impacted the development of critical thinking abilities. Critical thinking skills can be mastered through the instructional setting, but it is the refinement of dispositions that insure critical thinking skills can be applied appropriately in multiple contexts.

Limitations

The Cornell Critical Thinking Test (CCTT) measures critical thinking ability in the areas of induction, deduction, observation, credibility, assumptions, and meaning. The CCTT is a well-established testing instrument, "designed for evaluation and have been used in curriculum and teaching experiments for appraisal of the critical thinking ability of a group" (Ennis et al., 2005, p. 1). This study may be limited by using the CCTT to measure the differences in critical thinking development between students at institutions that use two different instructional approaches. The CCTT measures critical thinking ability, but does not measure if alternative approaches impact the development of critical thinking skills in undergraduate students.

This study relied on non-transfer, third-year students at St. Cloud State University (SCSU) and Winona State University (WSU) to volunteer to participate in this study. It was assumed that the similarity of average ACT scores, average high school GPA, class rank, and high school preparation curriculum between SCSU and WSU participants would produce very similar study groups. That, in turn, would focus the interpretation on the primary dependent variable, the form of critical thinking instruction, rather than student's academic abilities. This may not have been a valid assumption and, therefore, represents the second limitation of this study. The average ACT scores differed by 2 points between SCSU (21) and WSU (23). Ennis et

al. (2005) reported a significant correlation (.62) between the Cornell Critical Thinking Test Level Z and the ACT (p. 33). The average high school Grade Point Average (GPA) differed by 0.18 points between SCSU (3.12) and WSU (3.3). Ennis et al. (2005) reported a significant, but smaller, correlation (.26) between the Level Z Test and high school GPA (p. 35). This relationship between average ACT scores and average high school GPA could suggest WSU participants may have developed critical thinking skills prior to enrolling in college or were better equipped academically to further develop critical thinking skills during college instruction, whether through the general or immersion approach. In effect, the slightly higher scores of WSU students on the Cornell Critical Thinking Test Level Z may have occurred independent of the different methods for fulfilling the critical thinking goal area within the universities' general education curricula.

A third limitation of this study is that it does not account for variables that could potentially contribute to the development of critical thinking skills such as: employment, leadership roles, and sports participation, among others. The development of critical thinking is not isolated to the general, infused, immersed or mixed approaches used in college curricula. Critical thinking skills can be developed through personal and professional experiences outside the classroom. This study is limited in that it did not account for other experiences related to developing critical thinking outside the college curriculum; however, the literature suggests little impact on critical thinking development when employed or participating in fraternity or sorority membership. Pascarella and Terenzini (2005) concluded: "There is little compelling empirical evidence to suggest that on- or off-campus work in general has anything more than a trivial impact on cognitive or intellectual development during college" (p. 197). Similar results are

found for fraternity and sorority membership. The impact of Greek-affiliation on critical thinking of men and women is small and non-significant (Pascarella & Terenzini, 2005). Participation in intercollegiate sports does impact critical thinking skills and dispositions. A small body of research exists on the impact of intercollegiate participation on critical thinking development. McBride and Reed (1998) concluded that "irrespective of gender, intercollegiate athletes had significantly lower critical thinking skills, but also demonstrated significantly lower disposition to use those skills than non-athletes" (para. 1). The design of this study assumed participation in other activities and accounted for this through the random distribution of participants.

Recommendations

The evidence in this study suggests no significant overall differences of gains in critical thinking scores between students who have completed a critical thinking course and students who have not completed a critical thinking course; however, the literature supports that gains in critical thinking abilities are experienced by college students (Dressel & Mayhew, 1954; Shim & Walczak, 2012; Tsui, 1999). This study utilized the Cornell Critical Thinking Test to measure the critical thinking skills of non-transfer, third-year undergraduate student. The Cornell Critical Thinking Test is a well-recognized testing instrument, but is classified as a general critical thinking ability test that does not test for attitudes or dispositions. Dispositions play an important role in a student's ability to thinking critically and can include,"one's internal motivation to engage problems, seek answers to questions, and make decisions using critical thinking skills" (Pascarella & Terenzini, 2005, p. 159). Ennis (1989) defined the general, infusion, and immersion approach to include teaching critical thinking abilities and dispositions. This study only focused on the development of critical thinking abilities leaving questions regarding how

dispositions may have impacted a student's desire to participate in the study or the effort put forward when completing the test. Additionally, dispositions may also influence the learning process in a critical thinking course, the delivery of content by the instructor, and the overall learning process; factors that could potentially impact the development of critical thinking skills. It is the recommendation of this researcher to include measuring the critical thinking dispositions of participants. Objective, standardized testing instruments are available to measure the growth in dispositions to think critically during college.

Another consideration of this study is the impact of instructional techniques used in the classroom to teach critical thinking abilities and dispositions. The literature revealed mixed results; however, Pascarella & Terenzini, (2005) stated there was "no single instructional or curricular approach that consistently and significant facilitated the growth of critical thinking when critical thinking was measured by general instruments" (p. 173). This study focused on the type of instructional approach (general, infusion, immersion, and mixed) and did not consider the impact of instructional techniques used in classroom to teach critical thinking abilities and dispositions. Some of the literature reveals certain instructional strategies used in the classroom have impacted the development of critical thinking abilities. For example, Tsui (1999) found writing assignments with instructor feedback, independent research projects, group projects, and essay exams seem to enhance critical thinking skills. It is the recommendation of this researcher to consider the instructional strategies, at the very least, utilized in critical thinking courses or content-specific courses that identify critical thinking outcomes. It cannot be ignored that pedagogy approaches to teaching and learning critical thinking may impact the development of critical thinking skills and dispositions in college students.

Finally, it is the recommendation of the researcher to consider alternative methods of recruiting participants. Email was the primary method of contact for recruitment purposes and may not have been the most effective method. Email used in conjunction with a more personal, visible format such as, establishing contacts with faculty to visit classrooms and provide information on the study would likely increase the participation rate.

Considerable research has been conducted using Ennis' (1989) classification of general, infused, immersed, and mixed instructional approaches. Critical thinking continues to be an important, measurable outcome of higher education institutions and these classifications provide a vital framework for defining the instructional approaches used to develop critical thinking. The curriculum structure of many undergraduate programs requires critical thinking as a stand-alone course or in disciplined-based, content courses. Faculty may choose to incorporate critical thinking into various courses either as infused or immersed; therefore, it cannot be assumed that these instructional approaches can exist in any one pure form within an institution, so a true comparison between approaches is unattainable. If it is assumed all higher education institutions practice the immersed approach, it may be possible to isolate and compare a general versus infused approach.

As with many colleges and universities, St. Cloud State University and Winona State University recognize critical thinking as a primary goal. To reach this goal, critical thinking skills in higher education institutions must become part of an overall curriculum plan. Institutions must make a commitment to research and implement best practices for teaching critical thinking. In addition, regular institutional assessment of the development of critical thinking in all students needs to occur.

The infusion approach provides an opportunity for faculty to restructure content to include critical thinking. Faculty members need to be knowledgeable of formal and informal instructional practices that facilitate the development of critical thinking abilities. Shim and Walczak (2012) examined the impact of faculty teaching practices on the development of critical thinking skills and suggest "instructors and teaching assistants need to learn how to organize the class presentations, formulate and ask challenging questions in class, give clear explanations about abstract concepts, and encourage students to apply course concepts for effectively teaching critical thinking abilities" (p. 25). This suggests that higher education faculty may need specialized training in order to teach critical thinking skills. This may require institutions to provide purposeful training of faculty to effectively teach and assess critical thinking skills in their classrooms.

Future Research

While this study did not find a significant difference in student scores resulting from the use of different instructional approaches; some of the literature did suggest certain instructional strategies can impact the development of critical thinking abilities. This raises questions regarding the connection between the approaches of developing critical thinking skills with classroom instructional strategies. What is the current state of assessing critical thinking development in higher education institutions? What is the relationship between faculty teaching practices and the development of critical thinking abilities and dispositions? What is the relationship between the development of critical thinking skills in higher education and generalizability to applying these skills in different contexts?

One possible area for future research is a more in depth study on both the instructional approach and the instructional strategies used in college classrooms to teach critical thinking abilities and dispositions. If the development of critical thinking is a gradual and cumulative process, then it is necessary to have multiple courses in which critical thinking skills and dispositions can be developed. It is Ennis' (1989) mixed approach that combines a stand-alone critical thinking course with courses that infuse or immerse critical thinking skills and disposition into the content of the subject-matter. Some of the literature suggests certain instructional strategies that are used in the classroom can impact the development of critical thinking abilities. Further research on how instructional strategies develop dispositions is also needed to determine if students can apply critical thinking abilities to different contexts outside a critical thinking course.

Building on this research and extending beyond the college student, further studies are needed to determine if critical thinking skills can be generalized to everyday life. If the outcome of higher education is to develop the critical thinking skills of students, future studies should attempt to determine whether students are able to effectively apply critical thinking skills to situations in their professional and personal lives.

Conclusion

This study investigated whether alternative instructional approaches to develop critical thinking, exemplified by different general education requirements in different Minnesota State Colleges and Universities (MnSCU) institutions, impacted the development of critical thinking skills among undergraduate students. Overall, the findings of this study did not reveal a significant difference in student scores resulting from the use of different instructional

approaches to the development of critical thinking skills in undergraduate students. An important conclusion of this study brings to the forefront the fact that higher education institutions have made critical thinking an institutional priority and that a college education can improve critical thinking abilities, but equally important are the development of critical thinking skills are dispositions. Developing both critical thinking abilities and dispositions insures students will apply critical thinking skills in different contexts. It is necessary for higher education institutions to be purposeful in including critical thinking learning outcomes in the overall curriculum plan and measuring the development of critical thinking skills and dispositions with consistent institutional assessments. This, in turn, will further the investigation of how critical thinking is gained by college students and if they can apply critical thinking to post college professional and personal lives.

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Appendix A

Entry Form

Name	
Address	
City	
State	
Zip Code	
Phone	

Appendix B

Sample Questions of the Cornell Critical Thinking Test Level Z

The following are test questions of Ennis, Millman, and Tomko (2005) Cornell Critical Thinking Test, Level Z:

> Section III: The experiment attracted a great deal of attention. Many statements were made about the experiment and about the protection of ducklings.
>
> Items 22 through 25 each contain a pair of statements (A&B), which are underlined. Read both, then decide which, if either, is more believable. (p. 8)
>
> Section IV: From the original experiment, the doctors drew this conclusion: CABBAGE WORMS ARE POISONOUS TO DUCKLINGS. Mark items 26 through 38 according to the following system: A. If true, this information supports the conclusion. B. If true, this information goes against the conclusion. C. This information does neither. (p. 9)

Appendix C

SCSU Course Completion Form

Please indicate if you have *completed* the following SCSU courses by checking the appropriate course.

_____ PHIL 194 Critical Reasoning
_____ CMST 306 Rhetoric in Popular Culture
_____ CMST 318 Argumentation and Advocacy
_____ ENGL 306 Rhetoric in Popular Culture
_____ POL 191 Introduction to Political and Legal Reasoning
_____ POL 192 Critical Reasoning: Issues and Events in American Politics

Appendix D

WSU Course Completion Form

Please indicate if you have *completed* the following WSU courses by checking the appropriate course.

_____ PHIL 110 Critical Reasoning

Appendix E

Approved IRB Decision

OFFICE OF RESEARCH AND SPONSORED PROGRAMS
ST. CLOUD STATE UNIVERSITY.

Institutional Review Board (IRB)

Administrative Services 210
Website: stcloudstate.edu/osp *Email: osp@stcloudstate.edu*
Phone: 320-308-4932

Name: Karla Saeger

Adc

I

IRB APPLICATION DETERMINATION: EXEMPT

Co-Investigator:

Project Title: Development of critical thinking skills in undergraduate students at SCSU and WSU

Advisor: Michael Mills

The Institutional Review Board has reviewed your application to conduct research involving human subjects. Your project has been: **EXEMPT**

We are pleased to advise you that your project has been deemed as exempt in accordance with federal regulations. The IRB has found that your research project meets the criteria for exempt status and the criteria for protection of human subjects in exempt research. Please note the following items concerning our exempt policy:

-- Principal Investigator assumes the responsibilities for the protection of human subjects in this project

--Exempt protocols DO NOT need to be renewed.

--Exempt protocols DO NOT require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

--Adverse events (research related injuries or other harmful outcomes) must be reported to the IRB as soon as possible.

--The IRB reserves the right to review the research while it is in progress or when it is completed.

Good luck on your research. If we can be of further assistance, please contact the Office of Sponsored Programs at 320-308-4932 or email lidonnay@stcloudstate.edu. Please use the SCSU IRB number listed on any of the forms submitted which relate to this project, or on any correspondence with the IRB.

For the Institutional Review Board:

Linda Donnay
IRB Administrator
Office of Sponsored Programs

For St. Cloud State University:

Patrica Hughes,
Interim Associate Provost for
Research Dean of Graduate Studies

OFFICE USE ONLY

SCSUIRB# 1244 - 1492
Type of Review:

Today's Date: 12/2/2013
EXEMPT: 12/2/2013
Expiration Date:

Appendix F

Approved Informed Consent Form

Development of Critical Thinking Skills in Undergraduate Students

Informed Consent

You are invited to participate in a research study of the development of critical thinking skills in undergraduate students. You were selected as a possible participant because you are a non-transferred, junior level student attending at St Cloud State University or Winona State University. This research project is being conducted by Karla Saeger to satisfy the requirements of an Ed. D. Degree in Higher Education Administration at St Cloud State University.

Background Information and Purpose
The purpose of this study is to investigate if different instructional approaches to developing critical thinking impact the development of critical thinking in undergraduate students.

Procedures
If you decide to participate, you will be asked to complete the Cornell Critical Thinking Test Level Z. A test booklet will be provided and a scantron sheet will be used for the student to record their answers. The test takes approximately 50 minutes to complete and will be offered on campus at St Cloud State University and Winona State University, respectively.

Risks
There are no appreciable risks from participating in this study.

Benefits
There are no appreciable benefits from participating in this study.

Confidentiality
Information obtained in connection with this study is confidential and will be reported as aggregated results. No identifying information will be associated with the results.

Research Results
Upon completion, my dissertation will be placed on file at St Cloud State University's Learning Resources Center.

Contact Information
If you have questions right now, please ask. If you have additional questions later, you may contact me at 920.698.0166 or saka1103@stcloudstate.edu or my adviser, Dr. Michael Mills at 320.308.3730 or mrmills@stcloudstate.edu. You will be given a copy of this form for your records.

St Cloud State University
Institutional Review Board
Approval date: 12-2-13
Expiration date: N/A

Appendix G

Invitation to Participate

My name is Karla Saeger and I am a doctoral student at St Cloud State University. I am conducting a study in which I am measuring the development of critical thinking skills in junior level students at WSU and SCSU.

I am requesting your participation in my study. If you choose to participate, you would be required to complete a short critical thinking exam (about 50 minutes). That's it! Once you complete the exam you would be eligible to win:

- **Samsung Galaxy Tab 3** (2 available)
  or
- **Visa Gift Cards** (totaling $500.00)

The testing dates will be as follows in the Education Building; Room B113:
Tuesday, March 4, 2014, 4:00 p.m.
Tuesday, March 18, 2014, 4:00 p.m.
Wednesday, March 26, 2014, 6:00 p.m.
Thursday, March 27, 2014, 10:00 a.m. or 3:00 p.m.

Please respond to this email with your intent to participate in my study. Include your name, testing date and time preference.

For more information please feel free to contact me via email, cell phone at 920-698-0166, visit or like my Facebook page searching by SCSU critical thinking study, or stop by my informational table on March 4, 2014 from 10:00 a.m. to 3:00 p.m. in Atwood Memorial Center.