ABSTRACT

TOLIN, ANTHONY DELL. An Investigation of Community College Student's Understanding and Use of Critical Thinking During Summative Assessments. (Under the direction of Drs. Jessica DeCuir-Gunby and Margaret Blanchard.)

Current gaps in the literature highlight the need to investigate community college students and if they share a common understanding of what critical thinking is, what codable levels of critical thinking they utilize, and their capability of accurate self-assessment of their ability to think critically. This research addresses that gap in the literature.

Using semi-structured cognitive interviews, participants from a local community college provided the qualitative data for codable levels of critical thinking. During the interviews, each participant defined critical thinking and answered questions from a course assessment they were familiar with. Each question was presented with a series of cognitive probing questions to capture their individual codable critical thinking strategies in answering each question. Once completed, each interview was transcribed and coded for analysis. In addition, each participant provided a confidence score for each answer and the perceived difficulty of each question.

Results showed that higher performing students (based on course grade and GPA) exhibited more instances on codable critical thinking than the lower performing students. On average, higher performing students had 11 instances of codable critical thinking while the lower performing students had on average, 6 instances. Further examination of the levels of codable critical thinking strategies showed that while lower performing students only had 2 codable instances combined of higher levels of critical thinking, the higher performing students utilized the higher levels of codable critical thinking strategies almost half the time, with an average of 5 of the 11 instances. Results also indicated the lower performing students would exhibit confidence in their answers not commensurate with their accuracy at a much higher rate than the

higher performing students. When the lower performing students missed a question, their average level of confidence was a 6 out of 10. When looking at their reported perception of difficulty of the question, they reported an average difficulty of only 3 out of 10. In contrast, the higher performing students, having answered all but 1 question between them correctly still reported an average difficulty rating of 3 out of 10.

As the current research has answered the call to address the gap in the literature, more research is needed to better understand critical thinking abilities of community college students. While the results from the current research will help guide future curriculum development, there needs to be attention placed on the most effective way to incorporate critical thinking into course instruction.

An Investigation of Community College Student's Understanding and Use of Critical Thinking During Summative Assessments

by
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A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Curriculum and Instruction

Raleigh, North Carolina

2024

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DEDICATION

This is dedicated to the memory of my baby brother. Not a day goes by I don't think about him. His strength of character is what drives me every day to pursue my dreams and the strength to push through the hard times. I love you, Jason. This is for you.

BIOGRAPHY

Anthony (Dell) Tolin grew up in Texas and attended The University of Texas at San Antonio earning both a B.A in Psychology and a M.S. in Experimental Psychology. The son of a school teacher, he knew his love for education would be the passion he pursued in life. During that time in his master's degree, given the opportunity to teach undergraduate courses, he found his love for teaching. Since then, he has spent over 20 years in higher education teaching courses in statistics, psychology, and educational psychology. Having spent time teaching at both 4-year institutions and community college, it is in the community college environment and student population that he found his calling.

Recognizing his passion for not only teaching, but researching various aspects of the community college classroom, he realized he needed to pursue further graduate studies to gain the experience to develop his own program of research under the guidance of veteran faculty researchers. He applied and was accepted to the Educational Psychology Ph.D. program at North Carolina State University. During his time in the program, he has been able to pursue and shape his research to learn more about the role critical thinking plays in the community college classroom. That passion is what drives each semester of teaching to be one that advances the student's recognition and ability to utilize a critical thinking skillset for improved course material comprehension.

For the last 20 years, he and his family have called Raleigh, North Carolina, home.

ACKNOWLEDGMENTS

Completing a dissertation is not a solo venture. This could not have been done without the contributions of so many people. These contributions are spread across my committee members, my faculty mentors, my colleagues, my family, and so many others.

Many thanks to Dr. Jessica DeCuir-Gunby for taking on the role of committee chair when I was searching for the right fit. She was instrumental in getting me to this point. When you can’t seem to get in the groove, she knows just what is needed. From tough love to timely guidance, her leadership is immeasurable. Getting to the finish line would not have been possible without her.

There are some mentors you have along the way, and then there are mentors like Dr. Margaret Blanchard. From the very beginning of my time in the program, we had a connection that many search for but never find. From presenting together at conferences, to working as a part of many research teams, to just giving the right advice when it’s needed, are memories I will cherish deeply. To be valued, respected, and treated as a colleague in the right mix is to create the confidence needed to bring a colleague into the field. For all that, I am so appreciative and proud to call you a mentor and more aptly, a friend.

When my journey began, my path was that as a quantitative researcher and one searching for a faculty member I knew I could grow from. I found that in Dr. Jason Allaire. From class to conversations, I learned so much and advanced my quantitative capabilities. For that I am truly thankful. With that said, I am grateful for your mentorship and your input when my focus took a shift into qualitative inquiry. When many would have suggested a committee replacement, you still supported me and my research. I have no doubt, when I build my research focus further, we will work together again in a quantitative capacity.

When your committee suffers an unexpected departure of a committee member late in the game, panic sets in as you try to regroup and fill the spot. To find a committee member who is willing to come on board so late and be able to contribute is a hard thing to find. For me, that was accomplished with the addition of Dr. Susan Barcinas. I am truly indebted to her for her contributions to my committee. It could have been easy to pass on the offer to join the committee when it is late in the game, but that was not the way she approached it. Instead, she was able to contribute her experience and become a valuable member of the committee. While it would have been great to be able to spend many years together leading to this end, I am truly grateful to have a committee member who perfectly rounded out the team.

To all the faculty mentors along the way who have shaped me and my focus, I say thank you. There are so many along the way and I am sure you all know who you are. Thank you for being a part of who I have become.

To my amazing family for their encouragement and unwavering support of my endeavors, this is just as much your accomplishment as it is mine.

And lastly, a special thanks to my wife, Kellie, who kept encouraging me and pushing me as we navigated life’s obstacles on this journey. I love you.

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CHAPTER 1

INTRODUCTION

The intellectual origin and overarching concept of critical thinking is one that dates back 2,500 years to a time when Socrates led the cadre of early Greek philosophers to seek out rational justification for their knowledge outcomes. While the concept of critical thinking has evolved over the centuries, it remains congruent with its origins. This is as evident today as when put forth by Socrates, whereby the process is one arrived at through questioning perceived authority as the absolute on knowledge, searching out evidence, examining basic assumptions, and in-depth analysis, to arrive at an independent conclusion. Since those early days of Socrates, the need for critical thinking has never been needed more from our society than today (Alexander, 2014; Halpern, 2002; Ku, 2009). Halpern (2002) notes this need for critical thinking stems from the modern-day surge of information we have experienced as a technologically based society, resulting in a plethora of information at our fingertips. This overwhelming nature of information creates a society that suffers from "paralysis of analysis" (Halpern, 2002). The author continues this theme, noting that as we are overwhelmed by the sheer content of information, it becomes commonplace to accept as fact what is presented without critically thinking about the outcome itself. As Ku et al. (2013) noted, while we, as early as adolescence, have a healthy degree of skepticism about information presented in social media, we still underperform greatly in the evaluation of the evidence to support the claims. However, all is not lost, as they illustrate that our critical thinking skillset continues to strengthen as we move through late adolescence in our early college years. The maturation of critical thinking through the years is further influenced by the sheer quantity of social media we are exposed to. Ophir, Nass, and Wagner (2009) demonstrated that social media consumption would introduce interference into our ability to critically think and as our volume of consumption increased, so did the amount of interference present. This, in turn, hinders our ability to filter out the noise affecting our ability to process the information.

So where do we go from here? It's evident, as Halpern (2002) notes, that over the last several decades, multiple national reports highlight the growing need of instruction that facilitates critical thinking. This demand for creating critical thinkers, cited by one of the earliest national reports (National Commission of Excellence in Education, 1983), is bolstered by the identification that we are a nation at risk of failing to provide our students with the basic foundations of thinking.

Preparing critical thinkers has consistently been a central goal in education. This goal has given rise to the increased focus on critical thinking research in education (Heijltjes et al., 2014; Kuhn, 1999; Lunenburg, 2011; Marin & Halpern, 2011). This research is further needed as employers are demanding that graduates possess those skills that enable them to think smarter than in generations past, or more specifically, the ability to engage critically (Halx, 2010; Pithers & Soden, 2000). While there is agreement on critical thinking as a central goal of education, there are differences in how critical thinking is defined.

Fong et al. (2017) note that critical thinking is integral and important for those students in the community college systems, whether in vocation training, or preparing for transfer to a four-year institution. The ability to teach our community college student population the skills needed to think critically comes at such a crucial time, when there are low degree completion rates (Fike, 2008) and a dropout rate of community college students as high as 50% in the first year (Causey et al., 2022). Therefore, the community college is an environment that could benefit from an increased focus on critical thinking skills.

Critical Thinking Defined

In the early 20th century, researchers began the push to create a more cogent statement of what critical thinking entails. John Dewey (1933) began that modern day push by stating that "critical thinking is the active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and further conclusions to which it tends constitutes reflective thought." (Dewey, 1933, p. 9). Since then, numerous researchers (Case, 2005; Ennis, 1991; Facione, 1990; Halpern, 1998; Lipman, 1995; Paul, 1992; Tindal & Nolet, 1995; Willingham, 2007) have explored the meaning of critical thinking and navigated the range of how critical thinking is defined for the modern-day research paradigm. The central theme of these research investigations highlights that critical thinking is defined by the theoretical discipline in which the researcher is rooted. The overwhelming majority of critical thinking research is published under the social science disciplines of education and psychology. As a result, these social science disciplines drive the bulk of research citations defining critical thinking, with common components. Although it is important to understand that, while researchers agree there are common components of critical thinking across the varied definitions, there is no universally agreed upon definition of critical thinking on which researchers can anchor their research. Mulnix (2012) notes that if we are, as educators, tasked with teaching today's students to think critically, we must elucidate a definition that prevents us from "shooting arrows at a target we cannot see." To put forth a single definition of critical thinking, while appearing simplistic in nature, is not practical. Therefore, as researchers, understanding the commonalities of what defines critical thinking across disciplines, definitions that capture the very tenets of our disciplines and the constructs investigated, must be put forth.

Within the social sciences, several researchers have attempted to define critical thinking through incorporation of the common components seen across the research. While the following section of defining critical thinking is grounded in those definitions that are most citied and utilized in research across fields, it is in no way exhaustive. This section merely addresses those most often seen in the research while including a list of lesser used, but still relevant, definitions of critical thinking which can be found at the end of this section.

One of the most oft-cited definitions of critical thinking is that of Diane Halpern. Halpern (2006) puts forth a simple definition of critical thinking whose purpose is to capture the main components of the construct and states:

> Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed—the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions, when the thinker is using skills that are thoughtful and effective for the particular context and the type of thinking task. (Halpern, 2006, p. 6)

The underlying result of Halpern's definition captures most importantly that critical thinking is not merely thinking about how to solve a problem, but rather it is using skills and strategies that allow the individual to reach the desired outcome.

While Halpern’s (2006) definition is one of simplicity and application across research, it is important to understand those characteristics of competing definitions put forth by various researchers across disciplines past and present. Further, while there are consistent themes across definitions, it is important to note those characteristics that anchor the researcher’s intent of what should be the focus of the critical thinking researcher. The common characteristics of the varied definitions most seen are those that characterize critical thinking as those processes that are learned and automatic, virtues of the thinker, utilize systematic and algorithmic processes, and those that incorporate the metacognitive component.

Scriven and Paul (2008) put forth a detailed definition of critical thinking that focuses on the process as one that is learned and utilized consistently. They state:

> Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness. (Scriven & Paul, 2008, para. 3)

After in-depth examination of the Scriven and Paul (2008) definition, one is left with the understanding that critical thinking is a skill that must be learned as an active process that the individual utilizes to navigate through the known and unknown evidence to arrive at an outcome. Further, they list those values that represent the critical thinker. Those values represent an individual who strives to arrive at an outcome regardless of personal preference or desire, using active cognitive engagement rather than an algorithmic step process. It is clear that Scriven and Paul focus on those qualities (values) of the individual that are present in their everyday approach to information presented, and the way it is to be interpreted. That is, the individual (critical) thinker almost does so in a manner that is automatic to their thought process without any preconceived outcomes or prejudices.

Consistent with the theme that critical thinking encompasses those components of intellectual skills and values as well as intellectual virtues, Paul and Elder (2008) state:

> Critical thinking is that mode of thinking – about any subject, content, or problem — in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them. Critical thinking is self- directed, self-disciplined, self-monitored, and self-corrective thinking. It presupposes assent to rigorous standards of excellence and mindful command of their use. It entails effective communication and problem-solving abilities, as well as a commitment to overcome our native egocentrism and sociocentrism. (Paul & Elder, 2008, p. 2)

While there are many similarities between the definitions of Scriven and Paul (2008) and Paul and Elder (2008), the noteworthy difference is the way the critical thinker arrives at the outcome. While Scriven and Paul (2008) put forth a definition that highlights the almost automatic nature of the process, Paul and Elder (2008) caveat the process as one that requires the critical thinker to be mindful of our native egocentrism and sociocentrism. To be mindful of the native traits individuals all possess, Scriven and Paul (2008) are highlighting those intellectual virtues that keep them on guard against those traits that can affect the outcome in an adverse way.

Alternatively, Vaughan (2005) puts forth a definition of critical thinking that speaks to critical thinking as a (systematic) process rather than an internal virtue or set of values possessed by the individual. He states:

> Critical Thinking is the systematic evaluation or formulation of beliefs, or statements, by rational standards. Critical thinking is systematic because it involves distinct procedures and methods. It operates according to rational standards in that beliefs are judged by how well they are supported by reasons. (Vaughan, 2005, p. 4)

To acknowledge the process is purely systematic, as put forth by Vaughan, the researcher must accept that the individual can accomplish that highest level of reasoning by following those rules of rationality as defined. Further, this systematic process is one that does not require the individual to be intrinsically bound by the results or outcome of the critical thinking process. That is, the conclusion the individual arrives at is not one based on some habitual process inherent to them but rather that they have successfully utilized the systematic process with no influence from internal values or virtues.

Taking a departure from traditional definitions, Willingham (2007) believes the common understanding of critical thinking to be:

> In layperson's terms, critical thinking consists of seeing both sides of an issue, being open to new evidence that disconfirms your ideas, reasoning dispassionately, demanding that claims be backed by evidence, deducing and inferring conclusions from available facts, solving problems, and so forth. (Willingham, 2007, p. 8)

Willingham (2007) cautions this with the prerequisite that domain-specific knowledge is required for critical thinking to be effective. He states that if we focus merely on sharpening the critical thinking skills of the student, we are doomed to fail as educators. This failure is the direct result of only acquiring the skills of critical thinking while ignoring the domain-specific knowledge to formulate the critical thinking outcome. Critical thinking, as Willingham (2007) states, is so connected with the domain knowledge that it creates that situation where critical thinking is discipline-specific and thus, not transferable across disciplines. While this stance by Willingham has merit and should be considered when formulating an understanding of critical thinking, one must take caution to not qualify a critical thinker merely based on possessing domain-specific knowledge. In the end, the process comes down to the critical thinker being able to utilize their critical thinking skill set to formulate an informed outcome based on reasoned thought to the problem faced. The outcome relies on the individual to be a well-versed critical thinker and not held on the prerequisite of possessing domain-specific knowledge.

Incorporation of the metacognitive component is one that can be found both specifically within the definition of critical thinking itself (Dwyer et al., 2014; Moore & Parker, 2012; Nosich, 2005) as well as within the expanded explanation of the meaning. Nosich (2012, p.5) states "critical thinking is different from just thinking, it is metacognitive—it involves thinking about your thinking." Moore and Parker (2012) ground their approach as a metacognitive one in that they put forth that critical thinking, on a very basic level, is thinking about how we think. While these definitions of critical thinking capture the metacognitive process, Robert Ennis (1991) put forth a definition of critical thinking that not only utilizes the metacognitive component but many other dispositions and abilities of the critical thinker. Ennis (1991) provided a brief summation of the definition of critical thinking by stating "critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do" (Ennis, 1991, p. 6). As ever evolving as critical thinking is, Robert Ennis has continually re-examined his definition of critical thinking (Ennis, 1991, 2013, 2015). While the definition has remained static and brief, he has put forth an exhaustive list of the dispositions and abilities of the critical thinker as they continue to evolve.

Dispositions:

1. Seek and offer clear statements of the conclusion or question.
2. Seek and offer clear reasons, and be clear about their relationships with each other and the conclusion.
3. Try to be well informed.
4. Use credible sources and observations, and usually mention them.
5. Take into account the total situation
6. Keep in mind the basic concern in the context
7. Be alert for alternatives
8. Be open-minded
9. Take a position and change a position when the evidence and reasons are sufficient
10. Seek as much precision as the nature of the subject admits
11. Seek the truth when it makes sense to do so, and more broadly, try to "get it right" to the extent possible or feasible
12. Employ their critical thinking abilities and dispositions

Abilities:

1. Focus on a question
2. Analyze arguments
3. Ask and answer clarification questions

4. Understand and use elementary graphs and maths
5. Judge the credibility of a source
6. Observe, and judge observation reports
7. Use existing knowledge
8. Deduce, and judge deductions
9. Make, and judge inductive inferences and arguments
10. Make, and judge value judgments
11. Define terms, and judge definitions
12. Handle equivocation appropriately
13. Attribute and judge unstated assumptions
14. Think suppositionally
15. Deal with fallacy labels
16. Be aware of, and check the quality of, their own thinking (metacognition)
17. Deal with things in an orderly manner
18. Employ rhetorical strategies

While the dispositions and abilities lists are lengthy, the summation of the critical thinker is one that is disposed to grasp a position, to get it right, to find the truth if it is to be found, and to present a position honestly and clearly (Ennis, 2013).

While there are many definitions of critical thinking put forth by researchers, there is one that has been put forth as an amalgamation from researchers all over the world. In his essay on critical thinking, Facione (2006) cites this combined definition developed under the Delphi Method (Facione, 1990) as one which understands critical thinking to be purposeful, self-regulatory judgment. Facione, serving as the lead investigator on the committee tasked to coordinate the international consensus of what experts agreed upon as a definition of critical thinking, put forth one that incorporates those traits that encompass college level teaching and assessment. The result, known as the Delphi Report (Facione, 1990), defines and expands on critical thinking as:

> 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. Critical thinking is essential as a tool of inquiry. As such, 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, critical thinking is a pervasive and self-rectifying human phenomenon. 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 on inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating strong critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights, which are the basis of a rational and democratic society. (Facione, 1990, p. 3)

The statement put forth by the Delphi Report (Facione, 1990) is one that makes clear that not only does the critical thinker need to utilize the toolbox of skills (e.g., interpretation, analysis, evaluation, inference) available to them, but also be able to fully explain their conclusion.

As previous stated, the field of critical thinking research does not have a universally accepted definition utilized across most research inquires. Instead, research inquiries typically will embrace the researcher's personal definition or one of the many available most oft used definitions that align most closely with their interests. With that said, while this is the common practice, included here is a list of lesser used, but still relevant, definitions of critical thinking. It is important to note, that while not fully exhaustive, the following definitions (see Table 1.1) of critical thinking, found in many branches of research, consistently share the usual themes found across most of the predominant definitions used in current research.

Table 1.1 Less *Frequently Used Definitions of Critical Thinking.*

Bailin (2002)	Critical thinking is a particular quality where good thinking meets specified criteria or standards of adequacy and accuracy.
Burden and Byrd (1994)	Critical thinking is a higher order thinking activity requiring a set of cognitive skills.
McPeck (1981)	Critical thinking is the skill or propensity to engage in an activity with reflective skepticism.
Moore and Parker (2012)	Critical thinking is purposeful determination of whether to accept, reject, or suspend judgement.
Pascarella and Terezini (1991)	Critical thinking involves the individual's ability to do some or all the following: identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted based on the data given, and evaluate evidence or authority.
Simon and Kaplan (1989)	Critical thinking is the formation of logical inferences.
Stahl and Stahl (1991)	Critical thinking is developing careful and logical reasoning.
Sternberg (1986)	Critical thinking comprises the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts.
Warnick and Inch (1994)	Critical thinking involves the ability to explore a problem, question, or situation; integrate all the available information about it; arrive a solution or hypothesis; and justify one's position.

Personal Definition of Critical Thinking

Building on the foundation established in critical thinking and how it is defined, the critical thinking definition selected for this study is influenced by my experience in education and the current research on critical thinking. Most notably, the definition is influenced by the interpretations of Halpern (2006) and Scriven and Paul (2008). These influences highlight the use of critical thinking to increase the probability of a desired outcome and is accomplished through an active process to navigate the unknown. Therefore, the definition of critical thinking guiding this study is as an active process the individual engages in to arrive at a conclusion through thoughtful internal discourse independent of the common sources of misinformation pervasive in society. This is achieved through self-reflection, filtering of information, elimination of interference, and searching out supporting evidence, if needed, to allow for confident confirmation of an unbiased outcome. Moving forward, this definition is the guiding principle for this dissertation study to create a better tool set for community college students as they successfully navigate their academic journey

CHAPTER 2

REVIEW OF THE LITERATURE

A plethora of resources have attempted to define and refine the topic of critical thinking. However, as Kennedy et al. (1991) pointed out several decades ago, the abundance of books, studies, and research articles in the field make a comprehensive review of critical thinking virtually impossible. With that said, it is essential to understand the current and fundamental structure of critical thinking and its practical application in education. Therefore, the effort must be made to cover critical thinking in a manner that supports the direction of the research and compliments the current body of literature. This literature review will examine the prevailing theoretical frameworks (models) that guide educational research and the widely accepted options available to measure critical thinking, with a focus on its relevance for community college education.

Critical Thinking Frameworks (Models)

To understand the basic structure of critical thinking, frameworks (models) guide us through the skills necessary to reach a rational outcome free from our inherent biases. These models illustrate how an individual can dissect an argument and arrive at a quality outcome through skillful analysis. The result, if applied properly, is an individual with the tools necessary to think at the highest levels, critically. While there are many models of critical thinking, those repeatedly seen in the literature with the greatest application to education and crossover to environments outside the classroom model are examined: the Halpern 4-part Critical Thinking Model (1998), Bloom's Model of Critical Thinking: A Taxonomy of Educational Objectives (1956) and the subsequent revision as proposed by Anderson et al. (2001), the Paul-Elder Model of Critical Thinking (2008), the Kuhn Development Model of Critical Thinking (1999), and the Pearson RED Model of Critical Thinking (Pearson Talent Lens, n.d.).

Halpern 4-part Critical Thinking Model. Halpern (1998) has proposed a four-part model that is grounded in the theories of cognitive psychology that illustrate how we learn. The thinking behind this model is that if we understand how we learn from a cognitive perspective, the process of critical thinking becomes enhanced. Further, it is proposed that this model is one that will transfer across various domains of knowledge. The four parts of the model are (1) a dispositional or attitudinal component, (2) instruction in and practice with critical thinking skills, (3) structure-training activities designed to facilitate transfer across contexts, and (4) a metacognitive component used to direct and access thinking.

The dispositional or attitudinal component is one that is central to critical thinking. The very undertaking and use of critical thinking by the student is the ability to recognize when that skill set is needed as well as their desire to engage critically with that skill set when presented with the new information. It is important to differentiate when the skill set is used. Critical thinking is not something to be used during a routine (or habitual) task where the student is operating in a purely unconscious manner to solve. Rather, the process of critical thinking requires the student's disposition to be one that actively and consciously engages the problem to ultimately reach the desired outcome. As Halpern (1998) points out, students need to comprehend the nature of critical thinking as effortful and not to abandon the process of critical thinking prematurely based on the false belief that the result should have come sooner or easier. Further, we must ensure that the students understand that their disposition toward critical thinking is not the same as their ability to think critically. For example, they might have advanced critical thinking skills yet choose not to put forth the effort required to reach the desired outcome. Pointing students in the right direction that enables them to become excited about the opportunity to engage the problem and put forth their critical thinking skills is central to the effective educator. In the end, if we teach them the skill set necessary for critical thinking yet fail to show them when and how to apply them in an engaging and appealing manner, again we have failed the student. Halpern (1998) sums up the critical thinker as having the following five dispositions: (1) willingness to engage in and persist at a complex task, (2) habitual use of plans and the suppression of impulsive activity, (3) flexibility or open-mindedness, (4) willingness to abandon nonproductive strategies in an attempt to self-correct, and (5) an awareness of the social realities that need to be overcome so that thoughts can become actions (Halpern, 1998, p. 452).

Instruction in and practice with critical thinking skills, or as Halpern (1998) outlines, a skills approach to critical thinking is established on two assumptions. First, there must be clearly identifiable thinking skills that students can be taught to recognize and apply appropriately. Secondly, if the skills are recognized and applied, the students will in turn be better thinkers. For example, the students must have the skills of verbal reasoning, argument analysis, understanding of hypothesis testing (i.e., explain, control, and predict events), understand likelihood and uncertainty, and most important, have decision making skills. After all, all skills that fall under the umbrella of critical thinking involve some aspect of decision-making.

Structure-training activities designed to facilitate transfer across contexts enables the student to recognize when the skill learned is applicable in a novel situation. It is important that students not only have the skill set to think critically, but even more importantly recognizing when a situation requires a specific strategy from that skill set. The most difficult aspect of this, according to Halpern (1998), is when faced with a novel situation, the lack of retrieval cues to trigger the memory recall process allowing the student to put forth the skill required in that situation. We know this from the basic memory model where the most impactful retrieval cue is the one that is learned at the time of encoding. However, when we are teaching these skills to students, it is not feasible to teach them every possible scenario with specifics that they would use when presented with a novel task in the future. Therefore, we need to teach them to identify the structural aspects of problems, so in turn, when presented with a novel problem that has similar structural components, they can excite that portion of their memory systems that house the skills and problem-solving techniques they used in a parallel situation. We can enhance this aspect of critical thinking and its use in novel situations with similar structure(s) if we teach our students to elaborate and connect the structural components of a problem rather than the specific information needed for the unique problem. Thus, ensuing problems of similar structure will be possible as their skill set has transferability across situations. One of the most effective techniques, according to Halpern (1998), is the use of thoughtful questions, which in turn requires the student to create the connections to the problem. If educators use and guide the student through not only thoughtful questions, but also ones that elaborate and draw from the real world, those connections can be more easily identified. For example, Halpern (1998) would have the student explain why they selected a particular multiple-choice question alternative and then followed up with what would be the second best and why. The rationale for this strategy is that the student is required to think about what led to the creation of that answer and not the question itself. Another example would be to ask them to break down the question and identify what information is important and what is not important to answering the question. This will encourage them to identify the key components of a problem across situations. A final example would be to have the student create two possible answers for the question. This process requires them to use a more creative approach instead of just identifying the sole correct answer.

Finally, the last part of the Halpern (1998) model involves a metacognitive component that enables the student to create metacognitive monitoring skills. As we know, metacognition is "knowing about knowing" or "thinking about thinking" and more importantly how we use that knowing or thinking to improve the process. Teaching the students metacognitive monitoring strategies will allow that process to work to its fullest potential. We need to make sure as educators to emphasize that the monitoring aspect of the process is what makes it work. If the student is continually monitoring the situation and determining what level of time, effort, and knowledge is needed to solve the problem in a critical manner, then they can reach the resolution in the most effective and efficient manner possible. Halpern (1998) suggests that students be questioned after the monitoring activity to judge their performance. This will in turn require them to look back on the process and determine what was done right and what can be done to improve the process in future iterations.

While the Halpern 4-part Critical Thinking Model is widely accepted as the gold standard for application in most levels of education to enhance the critical thinking process in our students, the fourth part of the model (metacognition) is one that is not completely understood by students. While it is very straightforward to educators, the concept requires students to typically have a level of critical thinking ability which allows them to dissect their thought process and comprehend their performance on any assessment or task. This criticism is not an indictment of the model, but rather one that highlights the strength of the other 3 parts of the model and their sufficient commentary on critical thinking as cogent summation not needing the fourth part to complete the model itself. This criticism is addressed by Anderson et al. (2001), noting that metacognitive skills are a skill that the student must possess to perform even the most basic critical thinking level.

Bloom's Model of Critical Thinking: A Taxonomy of Educational Objectives. One of the most influential models developed for educators to date, Bloom (1956) and his colleagues created the taxonomy to address those hierarchical levels of cognitive thinking characteristics of a student's critical thinking skills and abilities. These skills, most notably the high-order skills in the taxonomy, are those essential to the critical thinking process. The taxonomy is a multi-leveled hierarchy arranged from less to more complex levels. As a student masters one level in the taxonomy, they possess those skills necessary for mastery of the next level of the taxonomy. The six increasing levels of the taxonomy and their brief descriptions as presented by Bloom (1956) are:

1. Knowledge: involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.
2. Comprehension: refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.
3. Application: refers to the use of abstractions in particular and concrete situations.
4. Analysis: represents the breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between ideas expressed are made explicit.
5. Synthesis: involves the putting together of elements and parts so as to form a whole.

6. Evaluation: engenders judgments about the value of material and methods for given purposes.

Using these six levels, educators can develop course objectives and assessments targeting specific, measurable goals. These measurable goals in turn permit the educator to not only validate a level of critical thinking of the student, but also provide feedback on their level of assessment. The taxonomy provides a framework for educators requiring no additional skill set. As the taxonomy is not teaching a new skill, but rather providing a primer for the levels of cognitive thinking in a student utilizing those characteristics specific to each level. It is important for the educator to understand, that while the Bloom's (1956) taxonomy follows a hierarchical structure, to truly impact the critical thinking component in the student, the educator should focus on the top half of the hierarchy utilizing analysis, synthesis, and evaluation as a larger gauge of critical thinking. It is this focus that will fill the deficient gap in education that reflects these basic reasoning skills (Paul, 1992).

While Bloom's Taxonomy (1956) had been the gold standard for educators to line up objectives with assessments, it has some basic flaws in the labelling of the taxonomy. Most notably, basic recall (first level of the hierarchy) does not equate to knowledge. Knowledge, while a complex construct, is agreed across education to be the understanding of a given topic and to think critically about that topic rather than just be able to recall information about the topic. This is evident during a basic question and answer session with students after an assessment. Many times, a student will report they were correct with their answer, however they do not know why they were correct. To better understand the levels, it would be best to relabel the hierarchy and simplify each level for educators to accurately measure a student's true level of mastery and use of critical thinking across the hierarchy. This basic flaw was addressed during a revision of the hierarchy by Anderson et al. (2001).

Anderson's Revision of Bloom's Taxonomy of Educational Objectives. While Bloom's (1956) taxonomy has stood the test of time, Anderson et al. (2001) proposed a revision to Bloom's Taxonomy of Educational Objectives (1956). Anderson, a former student of Bloom, assembled an expert group of researchers to update an almost 50-year-old taxonomy. Led by a group of cognitive psychologists, curriculum theorists, instructional researchers, and assessment specialists, the goal was to address the concerns and criticisms Bloom (1956) outlined in his original work as well as put forth a revised taxonomy that lines up with modern cognitive theories while providing relevance for modern day students and teachers. The new taxonomy defines the goals, curriculum standards, and objectives the educator should expect a student to learn. Anderson et al. (2001) proposed several revisions to the taxonomy and the way it is defined. The first revision made was to change the levels of the original taxonomy from nouns to verbs to reflect the cognitive process rather than the subject matter more accurately. The next revision involved the switching of the two highest level of the taxonomy: synthesis and evaluation. Anderson concluded that the student must be able to evaluate before they can synthesize. Lastly, to incorporate modern theory, Anderson added the metacognitive component to the first level of the hierarchy. It was important to demonstrate that the student must have some metacognitive ability to demonstrate knowledge recall. Anderson et al. (2001) put forth the following revised six levels of the taxonomy:

1. Remembering: ability to recall knowledge from memory.
2. Understanding: ability to construct meaning from different types of information.
3. Applying: ability to use information in a new way by executing or implementing a

procedure.

4. Analyzing: ability to break down information into its essential parts, determine how they relate to one another or an over structure or purpose.
5. Evaluating: ability to judge or criticize information based on criteria and standards.
6. Creating: ability to create something new from different elements of information into a new pattern or structure.

While the revision is not meant to entirely replace the original taxonomy, it provides the tool for a larger audience to adopt and implement as well as provide a more powerful tool for modern day educators. Anderson et al. (2001) makes the case for change by pointing out that the original taxonomy was not developed as a final product, but rather a work in progress for future researchers to build upon.

Paul-Elder Model of Critical Thinking. The Paul-Elder model of critical thinking (Paul & Elder, 2008) was developed as a framework to outline those facets necessary for the highest level of critical thinking. Paul and Elder (2008) state that critical thinkers are those individuals that consistently apply intellectual standards to their reasoning to cultivate intellectual traits. Their 3-part model states that (1) intellectual standards of critical thinking must be applied to (2) the elements of reasoning as we learn (3) to develop intellectual traits.

The intellectual standards are built around the concept of reasoning. As such, critical thinkers will possess the various aspects of the intellectual standards. The intellectual standards include: clarity, accuracy, relevance, logicalness, breadth, precision, significance, completeness, fairness, and depth. According to Paul and Elder (2008), the goal is for the standards to become part of the individuals thinking and to be the guide for their reasoning. These standards must be applied to the elements of critical thinking. The elements of reasoning that the intellectual standards are applied to are: purposes, questions, points of view, information, inferences, concepts, implications, and assumptions. Finally, once the individual has applied (consistently) the intellectual standards to the elements of reasoning, they will learn to develop those intellectual traits that define a critical thinker. According to Paul and Elder (2008), those intellectual traits consistent with the critical thinker are: humility, autonomy, integrity, courage, perseverance, confidence in reason, empathy, and fair-mindedness. The result, Paul and Elder (2008) state, that the well cultivated critical thinker:

- Raises vital questions and problems, formulating them clearly and precisely.
- Gathers and assesses relevant information, using abstract ideas to interpret it effectively.
- Comes to well-reasoned conclusions and solutions, testing them against relevant criteria and standards.
- Thinks open-mindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences.
- Communicates effectively with others in figuring out solutions to complex problems.

While the end goal is to identify those traits found in critical thinkers, it is important to understand those traits outlined by Paul and Elder (2008) are generalities that seek to identify that which typically results in a process the critical thinking has already built cognitively over time without having to mentally create steps in the process when facing current problems. The critical thinking that is identified possessing those traits is one that will consistently, when presented with a problem, be able to identify the problem, provide meaning about the problem, and create reasonable outcomes against those assertions. As eloquent as the framework presents itself and the compactness of the general traits possessed by the critical thinking, the framework itself does little to outline the method to think critically. While identification of traits of the critical thinking is crucial to understand the makeup of a successful critical thinking, the detailed explanations of how to obtain those traits are lacking. The model has its place in the literature, but in terms of ease of application, the model is one that serves as a benchmark to identify the end result of the critical thinker's journey to success.

Kuhn Development Model of Critical Thinking. The Kuhn (1999) Developmental Model of Critical Thinking was put forth to fill a gap in critical thinking that highlights the developmental nature of the process and addresses the practical nature of critical thinking outside the instructional environment. The model is the result of integrating the vast library of cognitive development research to build a model based on cognitive development progression in the individual that bridges the gap to meta-knowing competencies. Kuhn (1999) believes that while the individual gains cognitive competencies over time, the increasing control over our management of our own cognition is what leads to those meta-knowing tools necessary for the highest levels of critical thinking. The Kuhn (1999) model consists of three aspects of meta-knowing that in turn build on the previous in a successive manner: metacognitive, metastrategic, and epistemological.

According to the model, the first level of meta-knowing, metacognition is developed in children as early as 3-5 years old. This first level serves as the foundation of critical thinking as the child learns to grow that metacognitive capacity enabling them to reflect on their own thinking. For example, the child will ask itself questions like "what do I know?" and "how do I know it?” to reflect on the thinking just presented before them. The progression through this stage of the model is one that begins in these preschool years whereby the child understands that other’s beliefs may depart from reality. Thus, the child can differentiate between a true and false statement when the belief is incongruent with held beliefs and calls for evaluation. However, it is crucial to note that while the child can evaluate a claim and state its validity, that validity assertion is strictly their interpretation of the comparison between the claim and their reality. This ability lays the groundwork for progression in critical thinking where the child begins to take in more evidence leading to a more informed outcome. As the child reaches age 6, they begin to distinguish evidence from claims presented before them. The developmental progression put forth in the model illustrates the growing metacognitive capacity of the child to examine their thinking about the thought process and in turn to differentiate between a claim put forth and the available evidence as two distinct aspects of knowledge. In short, the child can move past intuition and search for empirical support.

The second level of meta-knowing in the Kuhn (1999) model, metastrategic, involves that aspect of critical thinking development whereby the child understands that memory strategies aid recall and their knowledge of strategies has a direct influence on their use. It is important to note though that this level of meta-knowing is one that lines up with Piaget’s (1926) level of cognitive development referred to as formal operational. Like the formal operational stage, the metastrategic thinking of the child may never truly be mastered as they reach adulthood. During this period of development, the child begins to utilize strategies such as categorization to aid in recall during problem solving tasks. Such strategies during these developmental years begin to mature and replace more rudimentary strategies that formed the initial building blocks of their critical thinking. As the child passes through adolescence en route to adulthood, Kuhn (1999) states that the individual begins to not only understand their strategies available to think critically, but more importantly, have the consistency to select the best strategies required to arrive at the intended outcome. This skill set is the result of experience understanding what strategies they possess, the appropriate strategies for a given problem, and the belief that absolute truth is potentially attainable using their strategies.

The third, and final level of meta-knowing in the model, Kuhn (1999) states is epistemological understanding. This understanding is one that Kuhn (1999) posits as the most profound transition in the individual whereby they move from an unawareness of belief states to the beginning characteristics of epistemology signified by absolutism. This characteristic enables the critical thinker to evaluate all claims presented against external standards while employing their cognitive strategies. This process repeats itself in a manner that continues to strengthen those strategies. It is important to understand that this epistemological understanding will highlight those other outcomes, while different, can be equally right. This is referred to as a multiplist epistemological stance. Most individuals do not progress past this level of epistemological understanding. Those that do progress, according to Kuhn (1999), achieve what is referred to as complete epistemological meta-knowing. This level is referred to as evaluative epistemological. This characteristic of the critical thinker is one that understands that not all opinions are equal, and that meta-knowing is that process that relies on the individual to employ judgment, evaluation, and argument. This leads the critical thinker to ultimately understand that while all people have a right to their opinion and outcome, some are righter than others. As Kuhn (1999, p.22) states "only the evaluativist is successful in integrating and coordinating the two (absolutism and multiplism), by acknowledging uncertainty without forsaking evaluation."

Kuhn (1999) developed this model to address the concerns of educators looking for a way to maximize their student's potential as critical thinkers. Kuhn (1999) goes on to state that educators can utilize this developmental framework by understanding the way meta-knowing strategies and skills develop as a guide for the development of their instructional curriculum.

Arguments made by Kuhn (1999) highlight the basic understanding of cognitive evolution in the child as they gain understanding in the process of formulating the groundwork for solid critical thinking skills. To parallel the understood development of cognitive growth over time is one that will truly allow educators the necessary corollary to model their classroom curriculum for growth. The flaw in this model, while very minor, is one that supposes educators already possess the knowledge depth in meta-knowing literature and practice.

Pearson RED Model of Critical Thinking. Based on the Watson-Glaser Critical Thinking Appraisal (1925), the Pearson RED Model of Critical Thinking, or RED model, was developed to illustrate not only how critical thinking works, but to also develop the necessary skill set for critical thinking. The model is based on what Pearson Talent Lens (n.d.) identified reviewing almost 100 years of critical thinking assessment as the three keys to critical thinking. The three keys are to (R)ecognize assumptions, (E)valuate arguments, and (D)raw conclusions.

The first skill, recognize assumptions, is based on skepticism. It is important to be able to separate fact from fiction in the face of lack of information. By recognizing assumptions, the individual can identify gaps in the information presented. The model directs the individual to listen to what others have said and think about what impact that has on the assumptions. Lastly, when the assumption is identified, it should be examined from the perspective of others. This skill of recognizing assumptions puts forth a level of critical thinking that enhances the individual's view of the information presented. Key RED model questions to ask to recognize assumptions (Pearson Talent Lens, n.d.) are:

1. What is the key issue/problem that you are trying to solve?
2. What information and facts do you have about the issue?
3. What are your ideas and assumptions that support your strategy or plan?
4. Is there solid evidence to support those assumptions, and what might be some gaps in your reasoning?
5. Who are the key stakeholders and what are their viewpoints?
6. What other ideas should be explored?
7. What else do you need to know?

The second skill, evaluate arguments, is key to critical thinking in that it provides the framework to evaluate those assertions presented in an objective and accurate manner. This skill of the RED model is integral to be able to avoid confirmation bias in the face of only wanting to hear what we want to hear. To do this, the individual must be able to separate emotion as it has a clouding effect on judgment and objectivity. Key RED model questions to ask to evaluate arguments (Pearson Talent Lens, n.d.) are:

1. What are the pros and cons of the solution you are proposing?
2. What are your biases?
3. Is there someone who has a different opinion that you could run your ideas by?

4. What impact will your decision have on others and how will you handle this?
5. What will be the financial impact of your decision?
6. Who would disagree with your proposed solution and what is the rationale that supports their viewpoint?
7. What key points or perspectives do you need to keep in mind as you evaluate the options?

The last skill, draw conclusions, concerns the manner with which the individual arrives at a conclusion that logically follows the evidence presented. The individual that possesses this skill has the ability to not generalize a conclusion outside the available evidence presented. In addition, the conclusion is malleable in that when new evidence is presented to justify a change, the individual will incorporate that to arrive at the most salient outcome. Key RED model questions to ask to draw conclusions (Pearson Talent Lens, n.d.) are:

1. After evaluating all the facts, what is the best possible conclusion?
2. What specific evidence is driving your conclusion?
3. Is there new evidence that would impact your decision?
4. What does your common sense and experience tell you to do?
5. What is the timeline for making a decision (e.g., would your decision be different in a month)?
6. What opportunities does your conclusion provide?

7. What risks are associated with your conclusion?

The RED model (year) is designed to facilitate learning and critical thinking in not only an educational setting, but also those settings where critical thinking is key both in public and private sector organizations. Due to the nature of the simplicity of the model, business environments are those with the higher adoption rates of a critical thinking model for teaching critical thinking skills to employees across all abilities. While the RED model is one that is simplistic in nature, and thus easy for most to adopt, the simplistic nature of the model is best used in those environments where the highest levels of critical thinking are not required to be inherent to the individual. As a foundational model, the RED model is elegant in its clarity to understand the basics of critical thinking and evaluation of a presented problem. However, the model is best utilized as the building block for developing better critical thinkers with very little to no background or understanding of the critical thinking process. So, is there a place for the Red model in educational environments like the community college system? Absolutely. However, with the high level of stratification present in abilities in the community college system, a more encompassing model would be better suited in a varied population found in the community college system.

Measuring Critical Thinking

As ubiquitous as the definitions of critical thinking are, there are also a large number of critical thinking assessments available. A quick Google search for critical thinking tests will yield over 400 million hits with countless websites offering to administer a "critical thinking" test. To navigate the tangled web of results, one need look no further than the most oft used and cited tests available. Those critical thinking assessments that have gained the most traction over the years are the Watson-Glaser Critical Thinking Appraisal (Watson & Glaser, 1925) with the most recent update in 2009, the Cornell Critical Thinking Test (Ennis & Millman, 1985), the International Critical Thinking Basic Concepts and Understanding Test (Elder et al., 2007), the Ennis-Weir Critical Thinking Test (Ennis & Weir, 1985), the Halpern Critical Thinking Assessment (Halpern, 2010), the Psychological Critical Thinking Exam (Lawson, 1999), domain specific test.

Watson-Glaser Critical Thinking Appraisal. The Watson-Glaser Critical Thinking Appraisal (WGCTA) was developed in 1925 with the goal to measure those skills and abilities necessary for critical thinking. The WGCTA is comprised of passages that the test taker would see in everyday life (work, classroom, media) based on problems, statements, arguments, and interpretations that they would encounter. Each passage is accompanied by a number of items relating to the scenario. Each scenario is presented as either neutral or controversial. The neutral scenarios are intended to not produce strong feelings or prejudices while the controversial scenarios will invoke those feeling many have to political, economic, and social issues. Over the last century, the WGCTA has been revised several times in 1941, 1994, and 2009. The revisions allow the test to evolve with the current definition of critical thinking as well to create parallel forms. Those revisions over the years also aimed to improve the test by reducing the number of items, thus making the test administration time drop significantly. The most recent revision came in 2009 as a forty-item multiple-choice test. This newest version should take between 20-40 minutes to complete and is untimed. While the test is untimed, it is suggested that if the administrator of the test desires to make it a timed test, then a 40-minute limit is recommended.

The current version of the WGCTA is based on the 3-factor structure of the Pearson RED model. The RED model factors are (1) recognize assumptions, (2) evaluate arguments, and (3) draw conclusions. Factor 1 (recognize assumptions) presents statements to the reader that are assumed to be true. The key to the presentation is that the statement is presented in the absence of proof. The WGCTA is directly examining if the reader can recognize the assumptions in presentations, strategies, plans, and ideas, which are all key elements of critical thinking. This in turn allows the reader to evaluate the actual merit of what is presented. Factor 2 (evaluate arguments) are those assertions presented to the reader that intend to persuade the reader into believing or acting in a certain way. The reader needs to demonstrate whether to believe the assertion or to act accordingly. Further, the reader needs to overcome his or her own confirmation bias. Lastly, the reader needs to be able to recognize when emotion attempts to cloud the objectivity of their ability to accurately evaluate the assertions. Factor 3 (draw conclusions) requires the reader to arrive at a conclusion that is the result of logically following the available evidence. The reader must evaluate all the evidence prior to arriving at a conclusion, consider the possible alternate conclusions, and avoid overgeneralizing to arrive at a conclusion beyond the evidence presented.

Extensive testing of items through exploratory factor analysis allowed test developers to refine the test structure into one that contains the strongest items that best represent the 3 factor RED model. Confirmatory factor analysis supported the 3-factor structure (GFI = .97; AGFI =

.96; RMSEA = .03) with each factor containing 12-16 items. Reliability of the WGCTA has been examined many times over the years. Most recently, in 2006, test-retest reliability was measured at *r* = .89. Cronbach's alpha was examined as a measure of internal consistency and 2 parallel forms and calculated at α = .83 and α = .81.

The WGCTA, with its ease of administration, revised structure to fewer items, and the time required to administer and grade, should be highly considered for educators looking to measure general dimensions of critical thinking in their students. As previously discussed, the Pearson Red Model of Critical Thinking captures those general dimensions of critical thinking in an eloquent and simplistic format. The educator looking to identify the most basic abilities of their students should highly consider the WGCTA as a tool to capture those dimensions of critical thinking present in their students.

Cornell Critical Thinking Test (Level Z). The Cornell Critical Thinking Test (CCTT) is designed for educators to directly test their student's critical thinking abilities. The CCTT was developed in 1985 by Robert Ennis and Jason Millman and is aimed at advanced and gifted high school students, college students, and adults. The test is frequently used as a measure amongst educators to predict and place students in advanced courses. The CCTT consists of 52 multiple-choice items within 6 subscales that assess induction, credibility, prediction and experimental planning, fallacies, deduction, and assumption identification. Items are presented to the test taker as a passage in which certain conditions are underlined. The test taker is then required to determine if the conclusion is logical, contradictory, or neither. The CCTT is administered as an untimed test. However, if a timed administration is desired, it is recommended to allow 50 minutes.

Reliability of the CCTT is reported between $r = .49$ to $r = .80$ utilizing split-half and between $r = .50$ and $r = .76$ utilizing Kuder-Richardson. Cronbach's alpha was examined as a measure of internal consistency and 2 parallel forms were calculated at $\alpha = .58$ and $\alpha = .72$.

The major advantage of the CCTT at the disposal of the educator is the ability to use the results of the test to teach those critical thinking skills their students need. By providing a clear outline of the critical thinking abilities of the student, the educator has the added capacity to utilize those results to specifically target their intended outcomes such as placement in courses, career aptitude, and employment considerations. While there are several capable tests of general critical thinking skills, the CCTT has the advantage of a wider number of subscales to be able to target as well as the ease of use to administer. The use of pencil and paper, while appearing archaic in current times, is the most simplistic to administer, grade, and distribute outcomes with speed and accuracy, without the reliance on technology and the ecosystem surrounding it. It is one of the reasons why the CCTT is one of the most widely used assessments of critical thinking available to educators.

Halpern Critical Thinking Assessment. The Halpern Critical Thinking Assessment (HCTA) was developed in response to the call from employers that found 93% stated "a demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than a candidate's major." (Hart Research Associates, 2013). The HCTA is designed to capture those constructs most often found in the various definitions of critical thinking. The five dimensions the HCTA focused on are verbal reasoning, argument analysis, thinking as hypothesis testing, likelihood and uncertainty, and decision-making and problem solving. As Halpern (2010) concludes, it is those 5 dimensions that comprise the skills of critical thinking. The HCTA consists of 20 everyday scenarios and available in 2 versions each with parallel forms. Version 1 requires responses to each scenario to be both a constructed response and a forced-choice alternative (recognition). The second version consists of exclusively forced-choice items. Values for both inter-rater reliability and Cronbach's alpha are reported. Inter-rater reliability for constructed response was calculated at $r = .79$ and forced choice (recognition) was calculated at $r = .84$. Cronbach's alpha was examined as a measure of internal consistency and calculated at $\alpha = .88$. The HCTA is administered as a computer-based test. The grading of the tests is done automatically for the force-choice response questions while a test administrator using a computer-guided grading system grades the constructed responses in real-time. The HCTA is recommended for ages 15 and up. The HCTA is the only critical thinking assessment available that offers multiple format responses allowing the test taker the ability to demonstrate critical thinking proficiency through both recognition and constructed responses.

While the HCTA is the most well rounded and generally accepted gold standard in critical thinking tests, the required use of costly licenses and digital only administration requirements, many educators will typically default to one of the more cost efficient and/or easier to administer options available.

International Critical Thinking Basic Concepts and Understanding Test. Developed by Elder et al. (2007), the International Critical Thinking Basic Concepts and Understanding Test is a 3-part, 100 item test that can be administered to students at the high school level through graduate school. The test is untimed and takes approximately 30-45 minutes to complete. The test focuses on 5 dimensions of critical thinking: analysis of thought, assessment of thought, dispositions of thought, skills and abilities of thought, and obstacles or barriers to critical thought. The test is administered and scored in an online environment providing an in-depth grading report and feedback to both the test taker and administrator at the conclusion of the test.

Test takers can retake the test up to 8 times over a 4-year period to compile detailed pre/post test results. The test is suggested to be taken 2 to 4 times per year to measure progress. The test is also marketed as a tool to enable educators to determine the extent their students are developing the understanding that will enable them to be critical thinkers. Unfortunately, test development statistics are not publicly available.

Ennis-Weir Critical Thinking Essay Test. The Ennis-Weir Critical Thinking Essay Test (1985) is designed to measure critical thinking in the context of argumentation. The test taker is presented with a complex argument and then asked to formulate another complex argument in response to what was presented. This critical thinking skill set measures the ability of an individual to evaluate an argument presented and in turn draft an argument in response. As the test is not designed to be a measure of formal or deductive argument, it does not capture those constructs. In short, it is a real-world test designed to give educators a tool to not only teach their students critical thinking skills in a formative manner, but also measure their progress in a summative evaluation. Those areas of critical thinking the test focuses on are: getting the point, identifying the reasons and assumptions, stating one's point, offering good reasons, seeing other possibilities and explanations, and responding to and avoiding equivocation, irrelevance, circularity, reversal of a conditional ("if-then") relationship, overgeneralization, credibility problems, and the use of emotive language to persuade. The test is most appropriate for administration to high school and college students but may also be used with high performing middle school students. As the test is an open-ended essay, grading criteria is applied flexibly and should only focus on the argument and not the writing. While suggestions for grading are present in the manual, graders are free to use their best judgment when analyzing the argument. Inter-rater reliability was examined over two different samples and 2 different sets of graders.

Inter-rater reliability values of $r = .86$ and $r = .82$ were obtained, which are considered very strong for an essay-based test. Inter-rater reliability was again revisited (Ennis, 2005) recently with 24 groups of raters. Inter-rater reliability ranged from $r = .72$ to $r = .99$. It is recommended that prior to administering the test, the educator take the test, grade it, then revisit the grading recommendations to determine their level of confidence in addressing any questions the students may have during the course of introducing the test.

The learning curve on the Ennis-Weir Critical Thinking Essay Test could be steep depending on the confidence of the test administrator. With that said, the test creators offer the administrators the ability to use the suggestions for grading in the manual as well as use their "best judgement" when interpreting the test taker's responses. For optimal outcomes, it is recommended that the test administrators take the test themselves and follow-up with multiple graders in order examine the inter-rater reliability results.

Psychological Critical Thinking Exam. While there is an abundance of assessments available to measure the critical thinking ability of students, there is a scarcity of subject-centric assessments. Many researchers in the social sciences (Halpern et al., 1993) stated that the evaluation of the psychology major is paramount as an overall outcome assessment. Understanding that measuring the critical thinking success of psychology students is as important as showing proficiency in the discipline, Lawson (1999) developed an assessment, the Psychological Critical Thinking Exam (PCTE), to measure the critical thinking ability of psychology majors. Further, the assessment was developed as a primer for the psychology faculty at other institutions to assess the critical thinking skills of their majors.

The central requirement Lawson (1999) states that is asked of psychology majors is not only to think critically, but also to utilize the basic principles of psychological science. He refers to this as *psychological critical thinking*. He elaborates that this type of thinking is one that requires the psychology major to evaluate claims without the requisite empirical support. To assess the skill set of the psychology major he developed a series of 9 questions that the psychology major can use while evaluating those claims presented to them. These 9 questions (see appendix A) form the basis to answer the various claims presented to the psychology major as the Psychological Critical Thinking Exam. The various claims presented were created by selecting 14 claims generated by the psychology faculty that met the requirement of relating to all the questions presented on the assessment. Lawson (1999) gave the following two examples of claims presented to students as well as the assessment question number that the claim will primarily relate to at the end of each claim:

> A researcher located 100 pairs of identical twins who had been reared apart and reunited them. The twins discovered that they had an extraordinary number of things in common. For example, one set discovered that, among other things, both have a daughter named Cindy, a workshop where they restore old cars, cocker spaniels, and they both crush their beer cans with their left hands. The other pairs of twins also had numerous similarities. The researcher concluded that these stories are evidence that our personalities are influenced by genetics (Lawson, 1999, p. 207).

> A researcher tested a new drug designed to decrease depression. She gave it to 100 clinically depressed patients and discovered that their average level of depression, as

measured by a standardized depression inventory, declined after 4 months of taking the drug. She concluded that the drug reduces depression (Lawson, 1999, p. 207).

Lawson (1999) states there are many advantages to his PCTE. The advantages include the fact that the test is consistent with the call for assessing critical thinking using written assignments, short-answer, or essay questions (Smith, 1995; Wade, 1995; Ennis, 1993). The assessment can be administered in approximately 20 minutes with a faculty member grading the test quickly. Furthermore, the faculty can utilize the results to identify those weaknesses that will need to be addressed in subsequent curriculums.

To verify the PCTE was not only measuring the level of *psychological critical thinking* in graduating psychology majors, the assessment was also given to first year introduction to psychology students as well as natural science (biology/chemistry) majors. Lawson (1999) hypothesized that graduating psychology majors would perform better than the introductory students and natural science majors. He further hypothesized that the natural science majors would outperform the introductory students as they (natural science) often take introduction to psychology and at least one other psychology course. The results confirmed his hypotheses. Graduating psychology majors performed significantly better than the natural science majors and the natural science majors performed significantly better than the introduction to psychology students. The results were not only useful in supporting the new exam, but it gave the faculty great insight into those areas that required further attention when developing future curriculum.

In response to the success of the PCTE, Lawson (2015) released a revised version for wider use and to assess the reliability of the PCTE. The updated PCTE reduced the original list of 9 questions to a total of 7 with slight modifications (see appendix B). The 7-question format allows alignment of each question with 2 items on the 14-item PCTE. While the exam itself stayed consistent with 14 items, modifications included 7 newly developed items to replace 7 original items (see appendix C). To assess reliability, both split-half and test-retest was examined. Split-half reliability was strong at $r = .88$, as was the test-retest reliability at $r = .90$. Further, the previous hypotheses results were replicated.

The response to the PCTE has been consistent with previous findings regarding what a measure of critical thinking is assessing. While the general measures of critical thinking discussed have shown to be proven measures of critical thinking, what they do not address is the subject-centered critical thinking important for students within a specific major. Further, they do not capture the unique subject-centered critical thinking skills acquired from majoring in a discipline like psychology (Burke et al., 2014; Johnson, 2011; Stark, 2012; Yanchar & Slife, 2004). This outcome is the reason for the introduction of the PCTE into the literature by Lawson (1999).

As with any assessment, to examine the level of critical thinking ability in the individual, one must first determine if they are intending to measure general critical thinking skills applicable to a broad range of problems or if they are measuring a subject-specific level of critical thinking. Further, it is important to understand where the individual is in their educational progression. It is, to this end, what must drive our research within a specific area of critical thinking and ultimately, the measure we utilize for our research.

Each of the previous measures discussed have their own unique direction to measure critical thinking and all would be a tremendous benefit to various iterations of my current research interests. With that said, there are 3 most closely aligned with my needs of a measure of general critical thinking ability: The Watson-Glaser Critical Thinking Assessment, The Halpern Critical Thinking Assessment, and the Cornell Thinking Test Level Z.

The current research study would benefit specifically from a general measure of critical thinking with a short administration time requirement and applicable to more general every-day situations, the Watson-Glaser Critical Thinking Appraisal (1925, 1941, 1994, 2009) would be most appropriate except for one key aspect. While it can be used across a broad selection of the population, educational environments would not be the most applicable location for a measure such as this. As previously discussed, the WGCTA utilizes scenarios that illustrate problems they would encounter in everyday life. While the assessment has evolved over the years to parallel the evolving definitions of critical thinking, the scenarios presented deal mostly with political, social, and economic issues more relevant to the everyday problems faced outside the classroom.

If this research study focused more on a measure that captures the most common dimensions of critical thinking as shown across the plethora of available definitions in the literature, then the Halpern Critical Thinking Assessment (HCTA) would be most appropriate. As previously discussed, the HCTA is an ideal tool for employers to examine the critical thinking capabilities of graduating students to gain a better understanding of their abilities outside their chosen major of study. While this is a great tool, validated across multiple populations, and generally considered the gold standard in critical thinking tests, it is more aimed at the end of the matriculation of the student, rather than at the beginning. To use HCTA at the beginning of the student's higher education journey, it would more often appear that the student lacks the skills necessary, obfuscating the fact that many of those skills are learned during the higher education process. While the HCTA is one of the most widely used assessments in the measurement of critical thinking, it is primarily a benefit to the researcher testing students critical thinking skills toward the end of their education. Thus, the assessment would identity those skills acquired during their education and the subsequent application of those skills needed post-graduation.

Lastly, the Cornell Critical Thinking Test Level Z covers a large range of students and abilities. While it can be administered to students as young as 5th grade, it is most appropriate for gifted high school students, college students, and most adults. The test is designed to test the critical thinking abilities of the individual across this large population through the identification of a conclusion's validity. Each item presented to the test taker would be in the form of a passage with a conclusion presented. The test taker would answer via multiple choice options if the passage conclusion logical, contradictory, or neither. The test results can be graded quickly by the administrator without the need to rely on a testing agency which provides for the ability to quickly analyze the results without delay.

While the current selection of the most oft used critical thinking tests have demonstrated their ability to measure the construct of critical thinking in a reliable and valid manner, they are all different in the intended use and target population. It is crucial, as the researcher, that the test selected most aligns with the intended outcome that is being measured and appropriate population. It is why, for the purpose of this research study, the most applicable test to use would be the Cornell Critical Thinking Test (Level Z).

Role of Critical Thinking in Education

Critical thinking in education has been identified for almost a century as the primary purpose of education (Halpern, 2002). The early American educator, John Dewey, presented this to us in his 1933 book, *How We Think*. If the current generation of students (and beyond) is to advance this goal of education as Dewey identified, then the call to action that has been at the forefront needs to be taken seriously. As previously addressed, according to Halpern (2002), The National Commission of Excellence in Education in 1983 described the United States as a "nation at risk" based on their findings that illustrate the U.S. educational system's failure to provide an education that advances critical thinking in its students. Therefore, educators need to cultivate critical thinking in their students at the beginning of the learning process. To do so, educators are priming and addressing the most important process in the memory model, encoding. Rather than have students as passive learners of the information, which encourages them to rely on memorization techniques (Gray, 1993; Connor-Greene, 2000) to perform well on assessments, their critical thinking skills can be fostered to maximize their understanding of *why* they know the information. This focus on critical thinking now shifts the design of classroom curriculum from one that has for the most part left out critical thinking to one that made it incumbent on educators to embrace (Cohen, 2010; Tittle, 2011; Vaughn, 2005). The result of educators focusing on bringing critical thinking instruction into the curriculum is one that shifts how students perceive the subject matter. Critical thinking will, in turn, transform students' experience from one that has largely been about learning the subject to one that has them thinking about the subject (Lunenburg, 2011). Most importantly, critical thinking is not something that is limited to a specific age group or subject, but rather one that has virtually unlimited ways to be incorporated at any age or grade level (Dunn, 2010; Hooks, 2009; Leicester, 2010; Swartz, 2003).

The skills and strategies of critical thinking are not merely those that are learned through education, but rather a concept that needs to be taught as such that builds on those skills already learned and incorporates those skills that complete the conceptual strategy of critical thinking. To think critically, educators need to be able to teach the learner to understand the steps of scientific investigation, apply rules of logic, understand probabilities, identify the quality of information presented, and be able to formulate a salient argument that supports the conclusion. This is a difficult task to accomplish, as competition from outside forces is greater today than ever before. Students today are inundated with a plethora of information in a round-the-clock manner without any filter. Halpern (2002), taking from a report published by The University of California at Berkeley, reports that that the world's total yearly production of information (print, film, digital, etc.) would require 1.5 billion gigabytes of storage. That number will obviously grow as the years continue. This access to information has created a culture that relies less on critical thinking and more on proximity, expediency to access, and ease to the information. In turn, that information is then passed along without any critical thinking employed, perpetuating the information or in many cases, misinformation. To be able to prepare students with the skill set to excel both inside and out of the classroom in a way that allows them to sort through the mountain of information and misinformation, will produce a more informed individual and society. The more informed individual is one that thinks critically when presented with this abundance of information. The result is an individual that is prepared to interact with the current culture of information that now demands critical thinking, yet it is rarely seen employed. The next logical step is one that teaches students not only to think critically, but more importantly, to form the solid foundation by teaching the *how* of critical thinking.

Teaching Critical Thinking. Teaching critical thinking is no different than teaching any other subject (Halpern, 2006). Halpern states that while the typical classroom instruction deals with content area knowledge, it is the background information needed to think critically. Teaching the critical thinking skills to the individual will allow them to take the information learned and apply the new critical thinking skills to make desirable outcomes more likely. This can only happen through the development (cognitively) of the individual. This is no more evident than reviewing the early works of Jean Piaget. Piaget (1926) has illustrated from a cognitive development perspective that conceptual change through schema formation, accommodation, and assimilation, is the hallmark of cognitive development. An understanding of basic cognitive development enables educators to employ those pedagogical lessons and assessments that can create the very critical thinking skills our students need. However, as Halpern (1998) has pointed out, the sad but true reality in our current education system, is that most educators do not apply the understanding of cognitive psychology in the classroom. With that said, those skills are becoming more of a priority as each academic year concludes with the call for teaching from a cognitive foundation infused with both learning of new information as well as those skills necessary to build their critical thinking base.

The teaching of critical thinking skills to students is something that needs to be done in a deliberate and conscious manner standing on their own to be effective (Nisbett, 1993; Tsui, 1999, 2001, 2006). The reasoning for teaching critical thinking skills to students in a deliberate and conscious manner is that, currently, it is far easier for the students to describe critical thinking than actually engaging in critical thinking through their own experiences. Therefore, the instruction needs to be focused on engagement of critical thinking rather than the typically employed method of merely demonstrating or defining critical thinking skills to the students (Lyutykh, 2009). Lyutykh expands on this, explaining that while it may appear simplistic in practice, getting buy-in from the students is difficult. This is in part attributable to the fact that years of educational experiences may have hard-wired the way students think about the educational endeavor, in general. The hard-wired thinking over years of instruction has taught the student that the learning process consists of listening to a lecture, memorizing information, and most importantly, demonstrating the ability to be proficient in the memorized information. The proficiency is demonstrated typically in some form of assessment (test, paper, etc.). If educators merely lecture about critical thinking to the student, the mere demonstration of proficiency will be a high level of memorization, rather than application of those skills consistent with critical thinking.

Educational professionals continue to show enthusiasm for incorporating critical thinking skills in the classroom (Angeli & Valanides, 2009; Barnett & Francis, 2012; Bentley, 2014; Lunenburg, 2011). However, that incorporation of critical thinking in the classroom requires not only the skills of the educator to teach those skills, but also the participation (Fung and Howe, 2012) of the learner in that environment to want to learn (and use) critical thinking skills. Halpern (2006) postulated that critical thinking is much like intelligence in that there is both a nature and nurture component. To teach critical thinking, there must be change to the nurture (environmental) component in the individual. She puts forth the idea that there is no reason to believe critical thinking cannot be taught (or improved) through proper instruction. The very nature of education is delivered in this manner. For example, a math teacher will teach strategies for solving math problems to maximize the outcomes for the student. Understanding that while there are components of each learner that are inherent to them based on nature, educators' goal is to maximize the variance in their nurture component, through instruction of the subject taught. Thinking of critical thinking as just another component of their educational subject matter will enable the educator to implement critical thinking more successfully in the classroom and in turn, transference of these skills across domains.

Teaching the critical thinking skills in the classroom is vital to bring greater congruence to what the students perceives as their level of knowledge in a course, and what is actually learned. Students themselves often overvalue their level of ability in the subject area. For example, Kruger and Dunning (1999) examined students self-reported level of knowledge in a content area. They found that students with low ability tested at the 12th percentile in the subject area while they rated themselves, on average, at the 62nd percentile. If we can teach our students proper critical thinking skills, we can bridge the gap from perception to performance.

Research has shown that learning critical thinking skills in the classroom can lead to daily application by the student outside the academic environment (Fong et al., 1986; Hashemi & Ghanizadeh, 2012; Helsdingen et al., 2011). Fong et al., (1986) investigated whether students taught critical thinking skills in the classroom would transfer them to applications outside the classroom. To investigate this, they called students months after the course completed under the guise of a phone survey to identify the use of critical thinking skills outside the classroom. While the skills required to answer the phone survey were similar to those from their class, months prior, they were able to demonstrate that students were able to use the critical thinking skills outside the classroom. Similar studies outside education have found similar results (Burson, 2004; Ferraro, 2010) whereby transfer of critical thinking skills was demonstrated outside the environment in which the individual learned.

Solon (2007) examined the available empirical research that investigated critical thinking as part of a subject course. What was discovered was that while there is an abundant amount of research focused on critical thinking in higher education, there is very little research from a quantitative inquiry perspective in the subject. Further, the research that is available examining critical thinking in a course, is mixed. While finding mixed results is discouraging, that is not a recipe for lack of continual growth of the inquiry. Fong and his colleagues (1986) report that many studies suggest that even limited amounts of critical thinking instruction in higher education led to higher levels of critical thinking application on post-tests compared to control groups. The conclusion of their extensive literature review was that even moderate amounts of critical thinking instruction could be very effective. So, the question remains, what is the time investment required to gain the critical thinking skill set that will make a difference? While previous research (Allegretti, 2005; Allegretti & Frederick, 1995; Solon, 2001, 2003) reported that significant change of critical thinking ability in students required at least one year or more of critical thinking instruction, Solon (2007) illustrated that only moderate amounts of critical thinking instruction over a single semester can produce significant growth in student's critical thinking abilities. However, his research, and the other research studies with similar results (Riniolo & Schmidt, 1999; Wesp & Montgomery, 1998; Allegretti & Frederick, 1995; Solon, 2001, 2003 Blessing & Blessing, 2010) used dependent measures that captured critical thinking skills rather than the application of those skills in the subject matter. It is important to note that in the Solon (2007) study, learning of subject material was measured between the control and experimental courses, and showed no significant difference in level of subject learning. Students were able to significantly increase their critical thinking skills over the semester, yet not have significant learning outcomes over the control group. These results could be interpreted as not a failure but rather a situation where the critical thinking skills were taught as an independent skill rather than as an application of subject matter problem solving. The next logical step would be to incorporate the teaching of critical thinking and the specific application of it to the subject material. Solon (2007) makes the call for not only further research in this area but better quality of studies as well that address any limitations that his (or other) studies have highlighted.

To teach critical thinking skills in the classroom is one that rests on two assumptions (Halpern, 2006). First, there must be clearly identifiable and definable thinking skills that students can be taught to recognize and apply appropriately. Second, if the skills are recognized and applied, the students will be more effective thinkers. However, the later assumptions rest on the recognition of those skills by the student. It is important to understand that critical thinking is a skill that requires intentional effort on the part of the student. To create that environment, the educator needs to foster a classroom culture that excites the students and has them engage in ways they wouldn't normally view class. To maximize their engagement, the use of role-playing, group discussions, and student-instructor interactions, are most effective in gaining buy-in of the students and developing those critical thinking skills (Staib, 2003).

The implementation of the critical thinking skill set for the students is one that can be delivered in many ways. Most commonly, the critical thinking instruction is either imbedded or explicit. A meta-analysis (Abrami et al., 2008) of existing studies of instructional interventions that affect critical thinking highlighted that critical thinking skills are increased significantly more if taught explicitly. Bensley et al. (2010) compared several groups of psychology students taking a research methods course that should in theory be developing critical thinking skills implicitly. The groups were separated into those that would receive further explicit instruction and those that would not. As supported by the Abrami et al. (2008) research, Bensely et al. (2008) hypothesized that those students receiving the explicit instruction would have higher gains of critical thinking skills than those with implicit (imbedded) instruction. As hypothesized, the groups that received the explicit critical thinking instruction showed significant gains. This research is important for two reasons. First, it continues to build on previous findings that highlight the significant gains in critical thinking skills of explicit instruction over implicit instruction. Second, it contributes to the small amount of research that specifically examines critical thinking skills in a subject specific course (Bensley et al., 2010; Nieto & Saiz, 2008; Solon, 2007). Most notably, Solon (2007) examined the connection between critical thinking skill improvement and explicit instruction. Solon (2007) compared two introductory psychology courses in which one received explicit instruction in critical thinking skills and the other receiving none. Both groups completed the Cornell Critical Thinking Test (Ennis & Millman, 1985) and those in the explicit instruction group increased significantly from pretest to posttest while those in the non-explicit group performed no different between the pretest add posttest. These results highlight the need for introduction of those explicit skillset teaching needed in the classroom to further develop the critical thinking ability of the student.

Like Solon (2007), Marin & Halpern (2011) investigated the relationship between explicit instruction and critical thinking skill increase. Obtaining results that differed only slightly, they were able to further support the conclusion that explicit based instruction leads to significantly greater gains. The major difference in their research was that the non-explicit group also showed significant gains, however nowhere near the level of the explicit group. Through their research, Marin and Halpern (2011) put forth a framework in a manner that relies on explicit, rather than imbedded instruction. They implemented the explicit model in a secondary educational setting. Their method of delivery was the result of the gap in the literature that seems to be dominated by post-secondary education settings. Further, it is their hypothesis that post-secondary students will not only be able to learn the critical thinking skills required to succeed in their courses, but also have transferability to novel situations. This hypothesis though is predicated on the idea that maximum success is based on the students receiving explicit instruction. Imbedded critical thinking was also examined in the study, however, the gains seen in the explicit groups were significantly higher. While imbedded instruction has its place, and is useful in specific course success, the transferability of those critical thinking skills learned has nowhere near the rate of transference across to novel situations. These results are further supported by research examining explicit instruction application transference to other domains when skills inherent to critical thinking (i.e., metacognition), are also examined (Kuhn, 2000; Moseley et al., 2005). Marin and Halpern (2011) highlight the three key principles of critical thinking instruction as put forth by Swartz (2003): (1) the more explicit the teaching of critical thinking is, the greater the impact it will have on students, (2) the more classroom instruction incorporates an atmosphere of thoughtfulness the more open students will be to valuing good thinking, and (3) the more the teaching is integrated into content instruction, the more students will think about what they are learning. While research has demonstrated that students from all levels of achievement can benefit from this (Dweck, 2002; Halpern, 2002; Kuhn, 2000), we typically only see this form of instruction at the upper division undergraduate courses or more prevalently, in graduate level courses. By incorporating them earlier on (i.e., as early as first year introductory courses in both the university and community college system) we can foster a level of critical thinking that allows the students to excel in later coursework. With the recent surge of community college enrollment, it is important to also understand that teaching these skills will benefit all students at all levels, including those older students and 2nd career students enrolling in the community college systems.

Critical Thinking in the Community College

Community college students represent almost half the total number of undergraduate students attending college at approximately 46% and continually growing (American Association of Community Colleges, 2015). Sadly, over half of all newly enrolled community college students will dropout within the first year. As Pascaralla and Terenzini (2005) have shown over their 30-year review, there is a distinct disadvantage for community college students in transferring to a 4-year institution than those students who start at the 4-year institutions. These finding suggest that we need to focus our efforts on research that will identify those aspects of the community college experience that will lead to higher transfer rates to the 4-year institutions. The American Association of Community College (2015) looks for ways to implement programs in the community college system through procurement of federal and private funding. This funding will afford the colleges the ability to expand the educational programs offered. Without these programs, we will continue to see the achievement gap widen and degree completion rates continue to decline. To highlight the achievement gap, degree completion rates remain low, hovering around one-third of students completing a degree or credential within six years. At the end of the day, degree completion is the goal and this call to research must be taken seriously.

Educators have continued to express over time a sustained interest in teaching critical thinking skills in the classroom (Huber, 2016). To accomplish this, educators as a collective must place critical thinking as a priority of the curriculum in the classroom. Deangelo (2009) reported that educators endorsed critical thinking as the most important goal of an undergraduate education with over 99% of respondents in their study stating that it is essential and very important. If this is the case, then why do we continue to see a decline in overall levels of critical thinking in undergraduates (Arum & Roska, 2011). Their study examined undergraduates over the last several decades which lead them to conclude that while students gain critical thinking skills over their time in college, the overall levels of critical thinking in students is a direct result of colleges becoming less effective at teaching critical thinking over time. What could be contributing to this decline? Educators are reporting that curriculum requirements continue to increase leaving very little time to focus on teaching non subject specific skills like critical thinking. Therefore, it is important to understand the present state of critical thinking in the community college population. And what can be done to address any measurable inadequacies. Regardless of each student's measurable level of critical thinking when they enter the community college system, fostering the skills across the board will benefit all students. In the end, we need to balance the educational gains in critical thinking against the reduction in subject related instruction. Once that balance is understood, curriculum can be designed to foster an environment rich in critical thinking while also advancing the knowledge of the subject matter.

As there is very little published research on the community college population (Townsend, 2009), it comes at the detriment of understanding the needs of the community college student required for a successful academic journey. Townsend (2009) identified that much of this gap in the literature is the result of most research funding being focused on 4-year students. Inevitably, this results in the community college student population being disadvantaged when it comes to programs that contribute to academic success. That success can happen when educators are able to implement those programs and instruction that will foster the critical thinking skills of the students. Fong (2017) states that in particular, critical thinking is that vital component students need at the community college level to better prepare them for either their vocational training outcomes or for preparation to transfer to the four-year college systems. With that said, the little research that is done in community college populations has focused on those elements more evident such a socioeconomic status, achievement in prior educational environment, and generational status typically identified as the first to attend higher educational settings. To focus on those aspects merely identifies those characteristics seen in the typical student but ignores the much-needed tool for academic success in critical thinking. Of the research that is done examining gender and ethnic background, the results show very little differences, if at all, between the groups.

Research in the community college system investigating critical thinking differences between majors has produced interesting results. Students in physical sciences, life sciences, engineering, and mathematics had significantly higher critical thinking scores than students in the humanities and social sciences. It is important to note that these differences are mostly prevalent in the early college years with little difference between seniors across disciplines. This would lead the researchers to conclude that students are reaching equivalent and increased levels of critical thinking as the degree progresses. Understanding the role that enrollment consistency over time can yield higher levels of critical thinking, one aspect of the community college experience we need to be focused on is retention. Students that see progress in that first year are likely to stay enrolled and it is incumbent upon the educators to provide that environment that fosters those gains. By understanding what students understand critical thinking to be as well as provide them with a curriculum that fosters those skills, we can contribute to increased retention rates.

As more research into critical thinking in the community college classroom is done, this can only bolster the critical thinking outcomes we see in the community college student (Pergiovanni, 2014). What is not clear, as current research has not addressed, is whether students share a common understanding of what critical thinking is and further, are they capable of accurate self-assessment of their ability to think critically (Huber, 2016). This will take the collective effort of researchers not only investigating critical thinking in the community college student population but highlight and implement the strategies in the classroom that students will understand their relevance for academic achievement. My research attempts to address these deficiencies through the examination of how students define critical thinking and how they apply their critical thinking skillset during assessment activities.

CHAPTER 3

METHODS

The purpose of this research will be to examine the level of critical thinking present in community college students. As previously stated, almost half of the undergraduate population is comprised of students in the community college system. In answering the call put forth by Crisp et al. (2016), it is my hope that adding to the research on community college students will not only address those levels of critical thinking present in the student population but enable researchers and educators to tailor instruction to prepare students in a way that promotes critical thinking inside and out of the classroom. To accomplish this, the use of qualitative methods is used to best illustrate a complete picture. This research will provide the foundation for future research to create measurement tools for educators to identify aspects of the construct that need to be addressed to strengthen course delivery and content.

Research Questions

As outlined by the research purpose, the following research questions addressed those aspects of critical thinking in community college students necessary to identify their understanding of critical thinking as well as the strategies used. Therefore, the research will be guided by the following questions:

Research Question #1: How do community college students define critical thinking?

Research Question #2: What levels of critical thinking do community college students utilize during a typical end-of-semester assessment (i.e., summative test that covers all semester topics in the introductory to psychology course)?

Context

Participants were from a local community college system in the Southeastern U.S. The community college system is in a large metropolitan area and has been in operation since 1963. As the largest community college system in the state, it is part of the larger statewide community college system accredited by the Southern Association of Colleges and Schools. Current demographic data of the student population (2022 census data) is comprised of approximately 57% female, 43% male. Identified race of the students is 50% White, 22% Black/African American, 13% Hispanic, 6% Asian, and 9% other. With approximately two-thirds of the students aged 24 or younger, the student population breakdown is 10% Under 18, 56% 18-24, and 34% 25-64. With an annual enrollment of over 70,000 students, the community college is one of the fastest growing in the country, doubling its student population in the last 10 years and offering degrees and certificates in 57 different fields of study. Currently, 25% of enrolled students already hold a bachelor's degree or higher and half of all degree program students transfer to a 4-year university or college. The role of the researcher within the college is to teach the introduction to psychology course, which is part of the general education core requirement in social and behavioral science. The course gives the student a broad overview of psychology covering core concepts in the discipline. Upon completion of the course, students take a comprehensive exam to demonstrate their level of mastery of the science of psychology.

Participants

A prospective participant pool of approximately 30 students was solicited for volunteer participation through contact via email with an explanation of the study and a date to reply to be a part of the research. Emails were sent to all students previously enrolled in a section of introduction to psychology during the last two academic terms. All prospective students were familiar with the researcher's lectures, classes, and assessments as well as met the minimum attendance requirement for the course (no more than 3 missed classes during the semester). All students had an equal chance of participation. There was no restriction on gender, race, or age of the participants, thus ensuring the potential for a random cross-section of students. Students agreeing to participate were compensated for their time through the issuance of a $10 gift card. In addition, all participants were entered into a random drawing for a $50 gift card. All participants were presented a demographics inventory (see Appendix E) and an informed consent form with detailed research information as well as contact information for review and signature consenting to participate. In addition, all participants were asked to define critical thinking before their scheduled interview and to present that definition during the scheduled interview. To allow for creativity and latitude, there were no specifics given to the participants as to what they needed to include in their definition of critical thinking. The goal of this strategy was to obtain original interpretations of how they think critical thinking is defined.

A total of 7 participants agreed to participate in the study. Willis (2005) has stated that while 7-10 participants is acceptable, it also depends on the complexity of what is presented to the participants. Because the participants were presented with questions they had already been exposed to, there is confidence in the sample size. Responses from students allowed for a sampling of 7 students across different academic levels of achievement. No students enrolled in a current section of the researcher were utilized for the study to remove the need to award extra credit as well as remove any perceived favoritism toward the student(s) by other classmates who choose not to participate. Pseudonyms are used to protect student identities.

Design and Procedure

One of the most oft used methods for probative questioning is the use of cognitive interviews. Based on cognitive theory, cognitive interviewing is the practice of administering a survey questionnaire while collecting verbal information about the survey responses to evaluate the quality of the response or to generate the information intended (Beatty, 2004). A form of cognitive interviewing, the semi-structured interview format, was utilized to obtain the data necessary to answer Research Question 2. The purpose for this type of interview is based on the idea that the goal of the research is to gather descriptive data during the interview in the participant's own words without having to follow a strict format (Bogdan & Biklen, 2003). This format allows for the researcher to collect data off script to facilitate richer data collection while allowing the interview to take a more organic flow. To better understand and accurately capture the participants' use of and interpretation of critical thinking during the interview, data collection took place during the session in the form of audio recording. All audio recordings were coded with a match to the participant as well as stored both on a password-locked recording device as well as backed up to a password-accessed cloud storage system to ensure confidentiality and redundancy. Once participants were identified and confirmed for participation, they were offered the choice of an in-person interview to be completed on an agreed-upon date in a private area on campus (or acceptable substitute) or a Zoom video conference (or similar platform). All 7 participants selected the virtual option. Once confirmed, a date and time was established for each participant's virtual interview session. Each session took approximately 30-45 minutes to complete.

Instruments

Semi-structured interviews conducted with the students were comprised of the student, defining what critical thinking is to them, followed by a selection of cognitive probe questions (see Table 3.1) from the works of Hofmeyer et al. (2015).

Table 3.1 Cognitive *Probe Questions*

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Probe Category	Probe Question
Think Aloud/General Probe	-How did you go about answering that question? -How easy or difficult did you find this question to answer? Why do you say that?
Comprehension/Interpretation	-What does the term X mean to you? -What do you understand about X?
Retrieval/Recall	-How did you remember that?
Confidence Judgement	-How well do you remember that? -How sure of your answer are you?

The cognitive probing questions asked of each participant were used to answer 7 assessment questions (see Table 3.2) they have seen on their final exam during their enrollment in a section of introduction to psychology.

All participants were presented the same 7 assessment questions and the questions ranged from basic knowledge recall of concepts to higher level analysis of concepts and main ideas. The cognitive probes were designed to more fully understand the process, thoughts, and methods participants use to assign meaning and comprehension to each assessment question posed (Hofmeyer et al., 2015). The time requirement to complete the interview lasted approximately

30-45 minutes depending on level of detail the student provided for each question. Further, depending on the organic flow of the semi-structured interviews, some participants received the cognitive probe questions in a slightly different order or potentially not being presented a specific probe question.

Table 3.2 Assessment *Questions.*

Question	Multiple-Choice Response Options
Q1: Four psychologists, each from a different psychological perspective, are eating dinner. They notice their waitress is crying. When the waitress leaves, they each provide an explanation for why she is crying. What did the humanistic psychologist most likely say?	a. She is struggling with psychological blockages from unconscious conflicts. **b. She thinks her job is harming her personal growth and preventing her from realizing her full potential.** c. She was probably punished by her boss or denied some reward. d. She is concerned about her biological clock and that she will not be able to pass on here genes.
Q2: Edmund was walking down a dark street when he heard a car backfire. His heart started to race, and he began to perspire in response to this student, startling noise. These physical reactions were triggered by Edmund's:	a. parasympathetic nervous system b. somatic nervous system **c. sympathetic nervous system** d. cerebellum
Q3: Sally developed a fear of balconies after almost falling from a balcony on a couple of occasions. What was the conditioned response?	a. the balcony b. almost falling **c. fear of the balcony** d. fear resulting from almost falling
Q4: Regarding operant conditioning, what do both negative reinforcement and negative punishment have in common?	**a. They both remove a stimulus** b. They both decrease behavior c. They both add a stimulus d. They both increase behavior
Q5: The string of 16-digits 1776149217872014 is difficult to remember. If a person breaks them up into four groups of four digits (1776, 1492, 1787, and 2014), these numbers are easier to remember, due to the effect of:	a. elaborative rehearsal **b. chunking** c. dual coding d. maintenance rehearsal

*Correct multiple-choice option is bolded

Table 3.2 (continued).

Question	Multiple-Choice Response Options
Q6: You are buying a cup of coffee which costs $2.82. To use exact change, you must hold the number 2.82 in your head while sorting through your wallet and calculating what coins you have. To be successful in actively processing this information, you must keep the information maintained in storage by using your:	**a. working memory** b. sensory storage c. semantic memory d. long-term storage
Q7: Which of the following is the main conclusion from Milgram's shock experiments?	**a. Ordinary people will do terrible things if ordered by an authority** b. Ordinary people are naturally violent and easily provoked c. Ordinary people will follow immoral orders, but only in hypothetical situations d. Ordinary people will follow immoral orders, but only in stressful situations

*Correct multiple-choice option is bolded

Data Analysis

Interview data was analyzed using a prepared codebook. Rather than use an inductive, open coding strategy, the use of deductive coding was utilized. The deductive coding strategy was chosen as the current research was not exploratory in nature and thus relied on existing theory to use predefined codes. Using a deductive approach based on Anderson's Revision of Bloom's Model of Critical Thinking: Taxonomy of Educational Objectives (2001), codes were established using the first 4 of the 6 defined levels of critical thinking. See Table 3.3 for codebook. As the summative test questions were written to apply to the first 4 of the 6 levels of coding, it was not anticipated that any student would respond at levels 5 or 6, therefore, only the first four levels are coded. To capture the top 2 levels of codable critical thinking, evaluate (level 5) and create (level 6), would require probative essay questions on the summative assessment allowing the students to address topics at those levels. Further analysis for the qualitative interviews followed the methods outlined by Miles and Huberman (1994) whereby the interview responses are reduced, organized, and conclusions drawn. This process is achieved post-interview through the synthesizing of the responses into summaries that allow the researcher to examine not only the individual responses, but comparisons across participants to identify themes and conclusions. In this research study, the conclusions to be made are about the veracity of the student's ability to utilize critical thinking methods represented in their outcomes.

Table 3.3 Codebook *for student interview responses.*

Category	Description	Examples
1. Remembering	Ability to recall knowledge from memory	-provide definition -basic information
2. Understanding	Ability to construct meaning from different types of information	-highlighting multiple aspects of a problem and the interpretation of those aspects
3. Applying	Ability to use information in a new way by executing or implementing a procedure	-taking the current problem and applying a novel or abstract idea to solve to problem
4. Analyzing	Ability to break down information into its essential parts, determine how they relate to one another or over structure or purpose	-demonstrate the deconstructing of the problem into individual parts and discuss the relationship of those parts

Credibility and Trustworthiness

Credibility ensures the participants views and interpretation of those views and responses is truthfully captured by the researcher (Polit & Beck, 2012). To provide a level of trustworthiness and credibility, several actions were put in place. First, a sampling of recorded interviews and the accompanying transcripts were presented to a colleague to make sure transcripts captured the dialogue and intent presented in the recordings. As speech varies from individual to individual, subtle nuances and cadence can be interpreted incorrectly. Once there was agreement that the transcripts captured the interview consistently and any anomalies addressed, coding could begin. Second, once coding was explained to a colleague, coding of a sampling of interviews by both coders was captured. Coding was compared across the sample of interviews to verify there was congruence and reliability in the coding of interview responses. This step ensures that the interpretation of the codebook and the proper application of codable levels to interview responses is reliable. Lastly, all interview transcripts were reviewed and interrater coding across 2 separate transcripts was performed. This was done to ensure that not only codable responses were captured reliably across coders, but from the original coder himself. Coding between the 2 researchers was completed for 2 interview transcripts. Both coders had similar identifiable instances of codable levels of critical thinking with an intercoder percent agreement of 86.4% with only 3 of 22 instances not coded the same by both coders.

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CHAPTER 4

RESULTS

In this chapter, the findings are presented, starting with the demographic data of the participants and their characteristics. Participant profiles are presented to better understand each participant interviewed, how they defined critical thinking, and the themes that presented themselves during each interview. Lastly, codable examples by level are presented to highlight the observed differences between ability levels (course grade) of the participants.

Participant Characteristics

Table 4.1 presents the demographic data of the seven participants. Initially, participants were asked for the total number of hours completed in college. During the initial portion of the interviews, it became apparent that students typically don't recall their total hours, but rather how many years they have been attending. Because of this, the collection of cumulative hours was not completed and will potentially be examined in future research.

Table 4.1. *Participant Demographics.*

Participant	Gender	Age	Ethnicity	GPA	Course Grade
Brooke	Female	22	White	2.1	D
Clay	Male	28	White	2.9	C
Destiny	Female	26	African American	1.9	D
Ethan	Male	22	White	3.9	A
Jeff	Male	24	White	2.6	D
Ruth	Female	19	White	3.1	B
Sally	Female	27	White	3.7	A

To better understand the characteristics of the sample, a short narrative of each participant, based on the interview demographic inventory, is provided. The 7 participants varied in gender, age, and academic GPA. While gender and age aligned nicely with the census data, a racially diverse group that lines up closer to the community college system was not achieved. The student makeup in the courses sampled was mostly skewed white which created the less racially diverse group. With a larger pool of sections to choose from, a sample more closely aligned might have been achievable, but not guaranteed.

The sample characteristics described are presented with pseudonyms to protect anonymity. To answer Research Question #1, the following descriptions of each participant also include their interpretation/definition of what critical thinking is. Each participant was given the opportunity to complete their demographics questionnaire and definition of critical thinking once a date to interview was confirmed to allow ample time to complete.

Brooke

Brooke is a 22-year-old white female with a cumulative 2.1 GPA. She earned a D in the course. Brooke defined critical thinking as follows:

> Critical thinking involves clear, independent, logical thinking, that involves independent thinking without letting other's opinions come into play while still making sure you do your part with supporting evidence by observation and necessary research.

The clear takeaway for Brooke was the high degree of incongruence between her confidence in her answers and the numbered answered correctly with an average confidence rating of 6.0 out of 10 and only answering 2 of 7 questions correctly. Routinely, she would fail to provide the correct answer while stating a high degree of confidence in her answer. Further, when her confidence was high, her perceived difficulty of the question was very low. When her confidence was a 5 out of 10 or greater, her perceived difficulty of the question would be a 1 (not difficult at all). In all those instances, except for 1, her answer was incorrect. When pressed further with the probing questions, it became apparent that the more she attempted to explain her answer, the more confident she became.

Clay

Clay is a 28-year-old white male with a cumulative 2.9 GPA. He earned a C in the course. Clay defined critical thinking as follows:

> Critical thinking is the process of observing information, analyzing information, and reflections on information. This includes using previous information, breaking apart other arguments and answers and avoiding bias.

Clay had a unique style to answering questions. It was clear that he was a solid student who struggled with self-confidence in his recall and understanding. With that said, he answered 6 of the 7 questions correctly and his confidence in his final answer was relatively strong, routinely stating a confidence 6 out of 10 or better. It was clear he doubted his ability, yet at the same time was employing various recall strategies while attempting to state an answer to each question. For example, during one of his responses, he stated what stood out to him in the question but then followed it up with "I guess that it was stuck with me" and "I just struggle" which was indicative of his own self-doubt.

Destiny

Destiny is a 26-year-old black/African American female with a cumulative 1.9 GPA. She earned a D in the course. Destiny defined critical thinking as follows:

> Critical thinking deals with logic. Logic is imperative for critical thinking because if we did not consider logic, then nothing would make sense.

During most of her responses, Destiny would reference personal anecdotes that she had experienced; tangents that were clearly meaningful to her but not really related to the question.

With that said, it was clear that these prior anecdotes had personal meaning to her, and some connection was trying to be made in order to help her to answer the question in any way possible. Ultimately, these attempted connections failed to provide the needed help to arrive at the correct answer as she attempted to fit a narrative from the personal perspective or story she told. For example, during the first question relating to what a humanistic psychologist would say about the crying waitress, she went on shared a very personal story about how she was crying once at work when her dad died, and then she talked about other circumstances that could make a waitress cry. After this story, the researcher steered her back to the situation that was described in the critical thinking question (#1) to allow her an opportunity to recall anything from class that might help her to answer the question. In this case, her response was:

> So, if I was a psychologist, I would be like, I wonder why she's crying. But I'm eating too, so I would care enough to think it has to be job related. It would depend on how hard she's crying. If she's crying hard or she's just a few tears dropping. Or it could be she's crying and it's that time of the month. You never know."

Once again, the student was steered back on track with a follow up asking specifically, how she thought a humanistic psychologist would answer it, based on the 4 available multiple-choice options. She finally gave one more attempt to explain her answer and just said she took away the psychology part and thought more like a regular person. While her answer was incorrect and had no substantive support to justify her selection, she was still very confident in her answer at 8 out of 10 and stated the question was quite simple at 1 out of 10. This method was the theme throughout the interview.

Ethan

Ethan is a 22-year-old white male with a cumulative 3.9 GPA. He earned an A in the course. Ethan defined critical thinking as follows:

> Critical thinking is an alternative form of thinking where an individual uses unbiased thought and logical processes to better understand scenarios as well as make informed decisions to solve problems effectively and efficiently.

From the outset, Ethan was very straightforward and analytical in his answers. Depending on the difficulty of the question, his level of critical thinking utilized was commensurate. Further, his explanations were consistently full of confidence. What was most impressive during the interview, was his approach when presented with a question he didn't know the answer to immediately. Those answers would typically start with an explanation of how he arrived at his answer by breaking it down. For example, during one back and forth he started with "and I went about this question differently, because I totally blanked." He started by explaining he knew the definition and application of 3 of the 4 multiple choice answers. Starting there he was able to toss out 2 answers immediately, thus leaving him with 2 options. Knowing 1 of the 2 remaining was clearly not the answer, he selected the remaining option. Even though that remaining option was one he had no understanding about, he still answered the question correctly and stated he was 100% confident in his answer. Lastly, there was one question he explained that he constructed the problem in his head and visualized himself writing out the various parts of the problem and arriving at the answer. In that case, there was no need for pen and paper, rather just a mental image of problem solving.

Jeff

Jeff is a 24-year-old white male with a cumulative 2.6 GPA. He earned a D in the course. Jeff defined critical thinking as follows:

> Critical thinking helps people think more logically about a problem.

Jeff had an interesting methodology for how he would answer a question. Each question that was presented to him, he would begin by presenting his own interpretation or definition of the various terms presented rather than what was written or what was taught. And instead of the interpretation being a precursor to how it tied back into the question, it became his own story that guided him to his rationale for any option selected. This strategy continued through the entire interview and resulted in giving incorrect answers to most of the questions. It was apparent to him that this was a somewhat flawed strategy, as his confidence in his answers was typically between 4 to 6 out of 10. Routine answers from Jeff started out with responses like "I wasn't really sure about this one either" or "I'm not really remembering that one."

Ruth

Ruth is a 19-year-old white female with a cumulative 3.1 GPA. She earned a B in the course. Ruth defined critical thinking as follows:

> Critical thinking is using your knowledge, expanding your knowledge, and using the knowledge of others to problem solve, create solutions, and to work with others.

Ruth would approach answering each question by identifying the answer she believed to be correct, immediately. Then, once that selection was identified, she would start the process of breaking down the question into its parts to define terms and rule out selections that could not be correct. This strategy typically left her with 2, as she would say, possible answers. Once she had the process narrowed down, it became very apparent that this strategy really worked for her, as she would be able to identify why 1 of the remaining 2 selections would not be correct. At this point, her confidence in her selection was solid and she would move on. In addition to this strategy, she would also rely on visual imagery to create an outline of the problem in her head and then solve it. This higher-level thinking was typically utilized when the questions were of higher difficulty. The way she approached solving a question gave her such a high degree of confidence that all but 1 question resulting in a confidence score between 7 to 10 out of 10 regardless of her perceived difficulty of the question.

Sally

Sally is a 27-year-old white female with a cumulative 3.7 GPA. She earned an A in the course. Sally defined critical thinking as follows:

> Critical thinking is to flow thoughtlessly through the critical thinking process based on knowledge acquired and sculpted into your thinking style.

Sally had a very thorough response style. Her interview was one of the longest interviews conducted, as every response appeared to be well thought out and methodical in her approach to problem solving. She stated that she typically takes the longest to finish and routinely was the last person to turn in her test. She stated this was probably attributed to her style whereas she will complete test and then go back through every question to make sure her selected answer aligned completely with her level of confidence in the answer and no doubt that she selected the best possible answer of the available multiple-choice options. One recurring theme I noticed during her responses was that almost every response explanation began with some version of what she likes to focus on. For example, she started several replies with “I focused on” or “I definitely remember.”

Understanding the Levels of Critical Thinking

During the coding process, a couple of dominant themes presented themselves. As noted previously, of the 6 levels of critical thinking coded, it was not anticipated that any student would be above level 4, as none of the questions were written at that level. All codable instances ranged from level 1 to 4. From a quantity standpoint, students with higher course grades would employ significantly more instances of critical thinking strategies. For example, the 3 students with A/B course grades (Ethan, Ruth, and Sally), had on average, 11 codable instances of critical thinking strategies utilized compared to 6 codable instances for the 4 students with a C/D course grade (Brooke, Clay, Destiny, and Jeff). Further, breaking down the 4 levels of critical thinking observed into 2 halves (lower/higher), those codable instances across the group were significantly higher as the course grade increased. Those A/B students had, on average, 5 of the 11 codable instances at the higher levels compared to only 2 total instances for those 4 C/D students.

Codable Examples of Critical Thinking by Level

To address Research Question #2, examples of the 7 student interviews are presented with responses identified by the 4 codable levels of critical thinking utilized. First, the items that were responded to with remembering (Level 1) are discussed, with examples from each of the students. The subsequent sections are presented with examples from Level 2 through Level 4.

Level 1 (Remembering)

The first codable level of critical thinking is remembering. Remembering is the ability to recall, retrieve, or recognize knowledge from memory. This can be in the form of definition recall, facts listed, or reciting course material. Examples from the interviews are presented.

During the interview with Brooke, there was 1 codable instance of the first level of codable critical thinking, remembering. When answering question 6 (You are buying a cup of coffee which costs $2.82. To use exact change, you must hold the number 2.82 in your head while sorting through your wallet and calculating what coins you have. To be successful in actively processing this information, you must keep the information maintained in storage by using your ________.), she was very matter of fact in her response. As the question was written at the first level, this was the anticipated reply for a student using a basic level of remembering.

> Answer: I just knew it was short-term memory. I know that is where we hold memory for a short period of time after sensory memory.

Clay was able to produce a single instance of the first level of codable critical thinking during his interview. In this instance, he was able to show basic recall. When answering question 4 (Regarding operant conditioning, what do both negative reinforcement and negative punishment have in common?), he identified the answer quickly, showing quick recall from memory.

> Answer: The keyword is negative which means they both remove a stimulus. Negative means to subtract or remove a stimulus.

Ethan, one of the highest achieving students in the class, displayed many instances of codable levels of critical thinking. For question 1 (Four psychologists, each from a different psychological perspective, are eating dinner. They notice their waitress is crying. When the waitress leaves, they each provide an explanation for why she is crying. What did the humanistic psychologist most likely say?), he gave a textbook example of remembering, the ability to recall knowledge from memory.

Answer: I went by the definition of what humanistic psychology is. It's becoming the best person you can be. It was personal growth and realizing your full potential.

Jeff, as discussed prior, had an interesting methodology for how he would answer a question. Each question that was presented to him, he would begin by presenting his own interpretation or definition of the various terms presented rather than what is written or what was taught. Because of this, there was very little evidence of codable critical thinking in his responses. In one of the few questions, which he got correct, answering question 2 (Edmund was walking down a dark street when he heard a car backfire. His heart started to race and he began to perspire in response to this sudden, startling noise. These physical reactions were triggered by Edmund's _________.) there was just a basic level of critical thinking at the remembering level.

Answer: I know it's part of the nervous system. It's the sudden reaction, the sympathetic, it comes straight from there. It comes off emotion, the startling emotion, and the noise he heard is what triggered it.

Ruth would approach answering each question by identifying the answer she believed to be correct, immediately. Then, once that selection was identified, she would start the process of breaking down the question into its parts to define terms and rule out selections that could not be correct. She had several instances of various codable levels of critical thinking. In question 1 (Four psychologists, each from a different psychological perspective, are eating dinner. They notice their waitress is crying. When the waitress leaves, they each provide an explanation for why she is crying. What did the humanistic psychologist most likely say?), she exhibited basic ability to recall knowledge from memory, remembering.

Answer: I remember humanistic psychology being about reaching specific levels and personal growth and stuff like that.

In another instance, for question 5 (The string of 16-digits 1776149217872014 is difficult to remember. If a person breaks them up into four groups of four digits (1776, 1492, 1787, and 2014), these numbers are easier to remember, due to the effect of _________.), Ruth was able to demonstrate once again the first level of critical thinking.

Answer: Chunking I just automatically associate it with breaking it down and chunking. It was just straight definition. I just knew it was chunking, breaking it into pieces.

And lastly, for Ruth, for question 5 (You are buying a cup of coffee which costs $2.82. To use exact change, you must hold the number 2.82 in your head while sorting through your wallet and calculating what coins you have. To be successful in actively processing this information, you must keep the information maintained in storage by using your ________.), she was able to answer correctly demonstrating the first level of critical thinking, remembering.

Answer: I just remember working memory is associate as short-term memory. It’s just another name for it.

Sally was also able to demonstrate basic recall of knowledge form memory when the question was written at that lower level. For example, for the fifth question (The string of 16-digits 1776149217872014 is difficult to remember. If a person breaks them up into four groups of four digits (1776, 1492, 1787, and 2014), these numbers are easier to remember, due to the effect of _________.), written at the first level of critical thinking, she was able to exhibit that basic recall of information.

Answer: I chose B as my answer. I dint’ really have to put much thought into this question. You can just look at the string of numbers in itself and look at how they are divided into smaller group and instantly know that was chunking.

Level 2 (Understanding)

The second codable level of critical thinking is understanding. Understanding is the ability to construct meaning from different types of information. This can be accomplished through highlighting multiple aspects of a problem and the interpretation of those aspects. Examples from the interviews are presented.

During the interview with Brooke, when trying to answer question 5 (The string of 16-digits 1776149217872014 is difficult to remember. If a person breaks them up into four groups of four digits (1776, 1492, 1787, and 2014), these numbers are easier to remember, due to the effect of _________.), she was able to break apart the question into different pieces of information from the question as well as classroom discussion. This response illustrated understanding, the second level of codable critical thinking.

> Answer: I remember going over this in class, and I took the string of numbers and broke them unto four groups of four digits, which then made it easy to remember that was the chunking effect.

During the first question (Four psychologists, each from a different psychological perspective, are eating dinner. They notice their waitress is crying. When the waitress leaves, they each provide an explanation for why she is crying. What did the humanistic psychologist most likely say?), Clay was able to show a level of understanding in his answer.

> Answer: I said it would be humanistic, which is how a person sees their self and what their potential is. The humanistic side of it, the full potential, is what sticks out to me. In addition, I was able to eliminate the other answer options as I was able to define them and rule them out.

Destiny, when presented with question 5 (The string of 16-digits 1776149217872014 is difficult to remember. If a person breaks them up into four groups of four digits (1776, 1492, 1787, and 2014), these numbers are easier to remember, due to the effect of _________.), she was able to immediately answer it correctly with the second level of critical thinking. She also added a personal story showing the ability to construct meaning from different situations.

> Answer: Chunking. I just know it's chunking because I do it all the time. Like when I am working, I don't write any orders down. It just makes sense to chunk orders together.

Ethan, when presented with a question he didn't quite know the answer to immediately, question 2 (Edmund was walking down a dark street when he heard a car backfire. His heart started to race and he began to perspire in response to this sudden, startling noise. These physical reactions were triggered by Edmund's _________.), his approach was to start to work through all the available multiple-choice options. Utilizing the second level of critical thinking, understanding, he was able to create meaning from different types of information. He worked on defining 3 of the 4 options which he was certain of. This allowed him to determine that if he was certain of 3 of the 4 possibilities and they didn't fit the answer needed for the question, then by default, the correct option was the one he didn't know.

> Answer: So, I went about this question differently, because I totally blanked on the definition of the sympathetic nervous system. But I do know the other 3. And right off the bat, I knew it wasn't B or D options. So, I tossed them out and then it was between parasympathetic and sympathetic. I couldn't remember sympathetic but because I knew what the parasympathetic was, I knew what the correct answer had to be.

Jeff was able to demonstrate a codable level of critical thinking at the understanding level when presented with question 3 (Sally developed a fear of balconies after almost falling from a balcony on a couple of occasions. What was the conditioned response?). He was able to identify the different meanings between stimuli.

> Answer: It's the fear of the balcony because she wasn't afraid before. Now, since she felt like she was going to fall, she is now shared of balconies. So now she fears the balcony, but before she didn't. She is now conditioned to be scared of the object.

Demonstrating the second level, understanding, Ruth was able identify the meaning of two different types of conditions when answering question 4 (Regarding operant conditioning, what do both negative reinforcement and negative punishment have in common?).

> Answer: Okay, I saw that they were both negative, so I knew that they had to be taking something away and that they were, one was reinforcement, and one was punishment. So, they couldn't be the same, one had to increase behavior and one had to decrease behavior. So, the only thing in common was they were both negative, removing something. That made it obvious to select A because they are both removing a stimulus.

Sally had an example of the second level of critical thinking during her response to the sixth question (You are buying a cup of coffee which costs $2.82. To use exact change, you must hold the number 2.82 in your head while sorting through your wallet and calculating what coins you have. To be successful in actively processing this information, you must keep the information maintained in storage by using your ________.). She was able to take the question and construct meaning from different types of information using an example comparing short-term memory to a conveyor belt.

> Answer: So, for this question, the second sentence really stood out for me a lot. To use exact change, you must hold the number in your head while sorting. I thought of the conveyor of how in short-term memory or the working memory, information lasts for

about 20 seconds and if you don't tend that in the 20 seconds it'll go away. So, my mind instantly went to that example and how you can repeat the number in your head to start the conveyor belt over. This in turn made me think of the connection to sensory, short-term, and long-term memory and I knew immediately, that it was working memory, or short-term which came back to my memory using the example in my head.

Level 3 (Applying)

The third codable level of critical thinking is applying. Applying is the ability to use information in a new way by executing or implementing a procedure. This is often done when the individual takes the current problem and applies an existing or novel procedure to solve the problem. Examples from the interviews are presented.

In the third question (Sally developed a fear of balconies after almost falling from a balcony on a couple of occasions. What was the conditioned response?), Ethan was able to display a higher level of critical thinking in his approach. His answer illustrated the third codable level of critical thinking. He was able to implement the procedure of diagraming the problem into its essential parts.

> Answer: So, I chose C, and I went about answering this question in my head. I did the diagram, per se, that we learned how to break down the problem from class. Well, every person an innate fear of heights. That's just something we all have. So that would be the unconditioned. And then because she almost fell off a balcony, the balcony became the new stimulus, the conditioned stimulus, which had the same effect as the unconditioned fear of heights.

For the same question, Sally spent a considerable amount of time breaking down the question into its components and how to execute the procedure to solve the question. She described what she was focusing on and why. This approach really highlighted her use of the third level of critical thinking, applying.

> Answer: For this question, I actually did what you told us to do in class, which was to write out the unconditioned stimulus, unconditioned response, conditioned stimulus, and then conditioned response. And so, what I did was pull from the question each thing. So, like the fear, like it was the fear of almost falling and, so fear was the unconditioned response and the conditioned response. But like for the conditioned response, the balcony was the conditioned stimulus that caused her to fear which caused her to now fear balconies. So, I chose answer C, which was the fear of falling from the fear of the balcony.

Level 4 (Analyzing)

The fourth codable level of critical thinking is analyzing. This is the ability to break down information into its essential parts, determine how they relate to one another on an overall structure. This is often demonstrated through discussing the relationship of those parts as they deconstruct the problem. Examples from the interviews are presented.

For question 7 (Which of the following is the main conclusion from Milgram's shock experiments?), Ethan gave a very detailed explanation about how he determined the conclusion of the experiment. His explanation shows the fourth codable level of critical thinking, analyzing. He was able to break down the information into its essential parts and determine how they relate to one another to arrive at the conclusion.

Answer: I chose A and I easily crossed out C and D. So, in the shock experiment, while part of it ended up being a stressful situation, white it was a stressful situation, people were more reluctant to follow the orders than they were to just do it. And there were no hypothetical situations. Then I was able to personally understand that ordinary people aren't naturally violent and easily provoked and I don't believe that was a focus at all of the experiment. I do remember that even when people were reluctant, when someone of authority told them to do it, they kept doing it.

For question 3 (Sally developed a fear of balconies after almost falling from a balcony on a couple of occasions. What was the conditioned response?), Ruth was able to use exhibit the fourth level of codable critical thinking. When explaining how she broke down the question, she described the process she went through to relate the various aspects of the problem together and reach the correct answer.

> Answer: So, I built a little chart in my head of the various aspects of the problem. I had unconditioned stimulus, unconditioned response, conditioned stimulus, and conditioned response, filled them in and compared to the story and how they all relate. Then I was like, the general response was fear. I went through the various scenarios of what made her scared and then she went from being scared of failing to now being scared of the balcony, the conditioned response.

As mentioned previously, Sally had a very thorough response style. Her interview was one of the longest interviews conducted as every response appeared to be well thought out and methodical in her approach to problem solving. She would typically begin a response with "I focused on" or "I definitely remember." For question 1 (Four psychologists, each from a different psychological perspective, are eating dinner. They notice their waitress is crying. When the waitress leaves, they each provide an explanation for why she is crying. What did the humanistic psychologist most likely say?), Sally spent a considerable amount of time breaking down the question. She described what she was focusing on and why. This approach really highlighted her use of the fourth level of critical thinking, analyzing.

> Answer: I focused on two main things. So, like, the first was that the waitress was crying and the I focused on the humanistic psychologist. During this process, I kind of, in my mind, I was like, well, what is humanistic psychology? And the I defined that, what it was and then looking at the whole person from what I remember was reaching their potential. So, then I thought is this what the humanistic psychologist would say in this situation and does it relate to the waitress crying. So, then I would go through all the multiple-choice answers and make sure I read them all. From there I was able to define them and then match what was best for the question as to what a humanistic psychologist would say. I was able to mark out those that would not be the response. I was able to really think about personal growth, free will, and what not. Then I saw personal growth and full potential and knew it was answer B.

For the second question (Edmund was walking down a dark street when he heard a car backfire. His heart started to race and he began to perspire in response to this sudden, startling noise. These physical reactions were triggered by Edmund's _________.), she was once again able to demonstrate a higher level of critical thinking in her approach to solving the question. In this instance, it was clear she was able to break the question down into its essential parts and determine how they relate to one another.

> Answer: I'm taking a physiology course right now and I recall the discussions we had about the sympathetic and parasympathetic nervous system. So, when answering this question, I remember that the parasympathetic was more like the rest and digest part of the nervous system. And then the sympathetic is the like the person sympathizing with

the world around. So, I looked at the question and I see there was a loud backfire from the car which made his heart start to race and began to perspire. These were physical reactions, and they were enhanced. So instantly in my mind I was able to relate that back to the sympathetic nervous system. Also, I was able to recall the video about the woman who fell and her sympathetic nervous system kicking like the fight or flight. So, once I remembered that, like that specific example, I was kind of like everything made sense and I was able to identify sympathetic and parasympathetic. So, when I'm answering a question, I try to remember example and relate them all back to the question and topic. That really helps.

For the fourth question (Regarding operant conditioning, what do both negative reinforcement and negative punishment have in common?), again, she was able to take the question and break it down into its essential parts and then determine how they all relate to one another.

Answer: I do remember when I went through this question, that I had to remember that reinforcement and punishment were different, and reinforcement was to increase behavior and punishment was to decrease behavior. Also, I knew that to break down negative and negative punishment in that it wouldn't add a stimulus or an increase in behavior because reinforcement is the increase in behavior. So, then it left me with both options A and B. And so, I went through the process of looking at B first and knew that reinforcement was meant to increase behavior, not decrease behavior. So, then that left me with A because both negative reinforcement removes something to increase a behavior and negative punishment remove something to decrease that behavior. So instantly I was able to compare all of those and how they relate to each other and was able to go with A because the common was removing the stimulus which is what is attributed to both increase the beaches and decrease the behavior. I just wanted to make sure I fully understood the question before I decided on my final answer. I wanted to make sure I was looking at all the facts. Even though my gut said A, I still wanted to confirm everything begore I made a final decision. To do this I also went over related examples I learned from class.

Reasoning Between Ability Types

When looking across the seven students, there were some patterns. The higher performing students (Ethan, Ruth, and Sally) would employ all levels of codable critical thinking across all the questions. Typically, the level of question would dictate the level of critical thinking utilized. With that said, there were several instances of higher level of critical thinking displayed on the lower difficulty questions. In contrast, the lower performing students (Brooke, Clay, Destiny, and Jeff) had few codable instances of critical thinking and when they did, they were predominantly amongst the first 2 levels of critical thinking.

Question Confidence and Accuracy

During the interviews, students were asked to rate each question on a scale of 1 to 10, as well as their confidence in the answer. The lower performing students (Brooke, Clay, Destiny, and Jeff) generally reported high confidence in their answers, despite many of the answers being incorrect. For example, when the lower performing students missed a question, their average level of confidence was a 6 out of 10. What is more concerning, when looking at their reported perception of difficulty of the question, they reported an average difficulty of only 3 out of 10. In contrast, the higher performing students (Ethan, Ruth, and Sally), answered all but 1 question correctly, yet still rated many of the questions as difficult questions concurrent with reported a high level of confidence in their answers, For example, there were many instances where they would rate their confidence lower than 10 (ranging from 5-9) even when reporting that the question was in fact easy (rated a 1 out of 10 in difficulty).

CHAPTER 5

DISCUSSION

The current research was designed to investigate how community college students define critical thinking and what levels of codable critical thinking they utilize during a typical end-of-semester assessment in an introductory psychology course. As Fong et al. (2017) have stated, there is an importance to have critical thinking as an integral part of the student's success at the community college level. Gaining a better understanding of their thought process and use of critical thinking is key to help researchers and educators shape future class curricula. This responsibility should be at the forefront of all educators in the community college system to combat the high dropout rate of first year students (Xu, 2011).

Key Takeaways

Students' Definitions of Critical Thinking

During data collection, I was initially enthusiastic to read the personal definitions of critical thinking each participant provided. After reading the individual definitions, it became clear that, I was given definitions that were clearly an amalgamation of definitions researched (i.e., procured through Google searches) with very little understanding of what they were truly writing and incongruent to the critical thinking represented during the interview. For example, one definition from a low performing participant (Brooke) was stated as:

> Critical thinking involves clear, independent, logical thinking, that involves independent thinking without letting other's opinions come into play while still making sure you do your part with supporting evidence by observation and necessary research.

During the interview with Brooke, she frequently gave incorrect answers (she missed 5 of the 7 questions) while consistently having a high level of confidence in her answers. Her answers were frequently supported by personal anecdotes that were not clearly related to the scenario, rather than using supporting evidence, in contrast with her stated definition of critical thinking.

The other type of definition students provided was indicative of one that little effort was put forth or just rushed before the interview. For example, Jeff defined critical thinking as:

Critical thinking helps people think more logically about a problem.

During the interview with Jeff, there was little evidence of his thinking logically during his responses. He consistently provided his own interpretation of the terms presented in a question, rather than what had been taught in class. To present his responses logically, as he defined critical thinking, would require his responses to be tied back to the terminology and concepts learned in a manner that would illustrate the process that brought him to the answer.

The takeaway from these definitions is, to truly understand what the participants perceive critical thinking to be, it should be asked during the interview to provide a more organic response. Those responses would be more representative of their current thinking and likely to reflect their understanding and interpretation of critical thinking in the moment. In retrospect, to ask them to define critical thinking prior to their scheduled interview with no clear direction allowed for the path of least resistance which contributed to the provided definitions.

Level of Critical Thinking

The most evident takeaway from this research was the difference in level of critical thinking during each answer between the lower and higher performing groups (based on their grade in the course). With the exception of just 2 answers above the second level of codable critical thinking, the lower performing group was only able to illustrate critical thinking at the first 2 levels, regardless of the difficulty level of the question. In contrast, the high performing students were able to not only show a range of codable critical thinking, but they were also fairly consistent with answering at a level commensurate with the intended level of a question. In only a few instances did the higher performing students exhibit a higher level of critical thinking to a lower-level question. This is attributable to their personal approach to answering questions.

Confidence Ratings

During the analysis of the average confidence ratings for the participants, it was found that confidence levels were high for most of the questions missed. While it was not feasible to compare confidence levels of the lower performing students to those higher performing students, as the higher performing students only missed a single question combined, it seems important to try to understand why the lower performing students have such high levels of confidence. Research has shown that students will often overstate their performance by a significant amount (Hacker et al., 2000). Further, those students who perform poorly on an assessment tend to have significantly overpredicted their performance compared to the higher performing students who have generally underpredicted their performance (Miller & Geraci, 2011). These findings beg the question, why? As Miller and Geraci (2011) went on to state, these overpredicted performance ratings student give themselves continue to happen despite the fact that performance in class is not only a situation that gains them testing experience, but they are also getting definitive feedback that clearly lays out how to answer the questions correctly currently as well as on future assessments. Another flaw that is seen in the lower performing students is their forgetting of past performance. Foster et al. (2017) illustrated this phenomenon examining introduction to educational psychology students across thirteen exams. What was learned is that students not only were overconfident consistently with past poor performance not influencing their confidence levels, but that level of overconfidence did not decline over that period. In the current research, the average level of confidence across the lower performing students, who missed half of the questions, was 5.92 out of 10. To be that confident in their answers is definitely cause for concern. While it would be expected that many students would have a higher level of confidence, having previously seen the exact questions, their confidence level for those questions they got correct was only slighter higher with an average rating of 6.64 out of 10. This lack of disparity between the lower and higher performing students illustrates the caution the higher performing student exhibited when asked to think about how they performed relatively to what they know. As research has shown, those students with higher self-awareness and greater metacognitive skills, lead to higher performing outcomes (Everson & Tobias, 1998; Thiede et al., 2003). Further, those higher performing students are making statements about their confidence based not on the grade they hope to achieve, but rather the grades they think they could realistically achieve based on a perceived level of present competency. On the other hand, lower performing students in this study tended to state higher confidence. The effect of this nocent thinking will ultimately lead to creating a behavior of decreased studying and preparation for an exam (Serra & Demarree, 2016). If researchers and educators are to improve student performance, especially at the lower performing level, then there must not only a framework in the curriculum to teach those students to think more critically, but also arm them with the skillset to accurately recognize their current level of performance. Only then, will the student be able to start to understand where they are at and what is needed to get where they want to go.

Limitations of the Current Research

There are several limitations to the current research that need to be addressed. The most evident limitation is the small sample size of participants. Interviews with more students or different students may have left to different findings.

Another limitation is who agreed to participate in the study. However, there was a wide range of students in terms of their achievement in the course.

Another limitation is the number of questions asked and level of difficulty of questions might not have fully captured the range of critical thinking examined. It is possible that asking more questions or extending the items to a broader range of critical thinking may have led to different findings.

Lastly, another possible limitation to the research was the use of virtual interviews. It is possible that this format led to different engagement on the part of the students, although all of the students participated in the same way.

Future Directions and Final Thoughts

More research is needed to better understand critical thinking of community college students. Future research in this area will focus on incorporating critical thinking understanding and strategies into course curriculum, timing of participant recruitment, use of in-person interviews, and solicitation of colleagues for permission to recruit their students at the end of the term.

Incorporating Critical Thinking into Curriculum

Incorporating strategies to help students better apply critical thinking into their approach to course assessments is not a novel concept. For example, mathematics instruction has always been the model for instruction that builds continually in a deductive reasoning format. This approach should transfer easily to any course in that deductive reasoning teaches students to build support in the methodology to arrive at a supported conclusion. Teaching critical thinking strategies is no different. As straight forward as it sounds, it is incumbent on educators to create course activities that deliberately practice critical thinking skills. It is one thing to teach the skills of critical thinking, but creating those opportunities for practice needs to be incorporated into the curriculum. As there is very little research done on the practices of community college educators teaching critical thinking skills (Evangelisto, 2021), an increase in implementation in the classroom should undoubtably lead to an increase in those research strategies.

Timing of Recruitment and Outside Course Solicitation

To address the temporal importance of participant recruitment, the timing appears to be the most straightforward to adjust. This can be done with a modification to the introduction of the research participation opportunity during the course of the semester. In retrospect, my failure to recruit a larger number of the total students from my courses, was affected by the time gap between the end of the semester and the recruitment phase. The incentive to read an email during a break will ultimately relegate the initial contact to a location in the queue that is typically never addressed. By introducing the option as a post-semester opportunity, all students could weigh the likelihood of their participation without the need to make a decision until grades are posted. This strategy should yield higher participation in subsequent semesters. To further increase the potential participant pool, arranging for a short opportunity to speak to colleagues' courses, should provide the opportunity to increase the total participation during each research opportunity. As there are plenty of opportunities during department meetings and casual encounters with colleagues, a prepared abstract to provide and request to speak briefly to a class would typically be accommodated for by most colleagues.

Final Thoughts

While the results from the current research can help guide future curriculum development, there needs to be attention placed on the most effective way to incorporate critical thinking into instruction without taking away significant lecture time needed to cover the required course topics. To create an environment that fosters critical thinking will not only advance the student's ability to apply critical thinking strategies in the classroom, the classroom environment itself will become the source students see as the vehicle to their success. Further, to truly understand the level of critical thinking present in the students, there needs to be an a priori effort to measure critical thinking skillsets of the students to shape the instruction over the course of the semester. Only through this, can there truly be an improvement of student success in course summative assessments.

I realize that it is incumbent on educators like myself to continue doing research with this population that is rarely investigated. It is not surprising, as there is very little incentive nor requirement for community college faculty to conduct research as part of the job requirements. As Townsend (2009) further confirmed another compounding factor is most of the research funding takes place at the 4-year institutions. To better improve those learning environments in the community college student population, we as community college educators must answer the call, even when not required nor funded. It is my hope that by example it can be the catalyst my colleagues need to join this call to research.

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APPENDICES

Appendix A

Psychological Critical Thinking Questions

1. What is the quality of the evidence to support the claim? (In general, the evidence is very weak if the person has only testimonial or anecdotal evidence or no evidence at all; the evidence is quite strong if the person's findings have been published in a respectable scientific journal and other researchers have replicated the findings.)
2. Could the event or relationship have occurred by chance (e.g., you just happened to have a car accident on the day that a psychic predicted your car would be damaged)?
3. Is there a control or comparison group against which to assess the performance of the experimental group?
4. Is the person concluding there is a causal relationship on the basis of correlational data?
5. Are there confounding variables that might account for the findings (e.g., participants selecting themselves into the groups, experimenter expectancies, demand characteristics, or some other variable that varies systematically with the independent variable)?
6. Is the person trying to generalize the findings to a larger group based on a biased or unrepresentative sample?
7. Did the person ask questions of participants in a biased manner (e.g., leading questions, loaded or emotional wording, confusing wording)?
8. Has the person made it impossible to falsify his or her theory or hypothesis? Does he or she consider positive evidence as support for the theory, but negative evidence as not being relevant?
9. Does he or she claim that the phenomenon disappears once you try to test it? Is the person claiming to have found the cause of some behavior or phenomenon? (Most complex behaviors or phenomena have multiple causes.)

Appendix B

Psychological Critical Thinking Questions (2015 Update)

1. Could the event or relationship have occurred by chance (e.g., you just happened to have a car accident on the day that a psychic predicted your car would be damaged)?

2. Is there a control group or comparison group against which to assess the performance of the experimental group? We might see improvement in the experimental group, but would it have occurred anyway without any treatment or intervention (i.e., due to placebo effects, passage of time, regression toward the mean, etc.)?

3. Is the person concluding there is a causal relationship on the basis of correlational data?

4. Is the person trying to generalize the findings to a larger group based on a biased or unrepresentative sample?

5. Did the person ask questions of participants in a biased manner (e.g., leading questions, loaded or emotional wording, or confusing wording)?

6. Has the person made it impossible to falsify his or her theory or hypothesis? Does he or she consider positive evidence as support for the theory and negative evidence as not being relevant? Does he or she claim that the phenomenon disappears once you try to test it?

7. Is the person claiming to have found the cause of some behavior or phenomenon? Most complex behaviors or phenomena have multiple causes.

Appendix C

Psychological Critical Thinking Exam (2015 Update)

Directions. For each of the following examples, state whether or not there is a problem with the person's conclusions and explain the problem (if there is one):

1. A researcher located 100 pairs of identical twins who had been reared apart and reunited them. The twins discovered that they had an extraordinary number of things in common. For example, one set discovered that, among other things, both have a daughter named Cindy, a work- shop where they restore old cars, cocker spaniels, and they both crush their beer cans with their left hands. The other pairs of twins also had numerous similarities. The researcher concluded that these stories are evidence that our personalities are influenced by genetics. (Question 1)

2. A group of researchers claim that they have discovered THE cause of aggression. One of their studies showed that individuals with damage to an area of the brain called the amygdala were less aggressive than individuals with- out such damage. Another study found that surgically destroying a small area of the amygdala in cats caused them to behave less aggressively than normal cats. A third study found that electrically stimulating the amygdala in hamsters caused them to behave more aggressively. The researchers concluded that the cause of aggressive behavior is abnormalities of the amygdala. (Question 7)

3. A researcher tested a new drug designed to decrease depression. She gave it to 100 clinically depressed patients and discovered that their average level of depression, as measured by a standardized depression inventory, declined after 4 months of taking the drug. She concluded that the drug reduces depression. (Question 2)

4. Sylvia claims she can use her psychic powers to deter- mine what happened to individuals who have been reported missing. She points out that she correctly predicted that several individuals who had been missing for months were dead. A skeptical researcher asks her about several additional people who were recently reported missing, and she predicts that they are also dead. How- ever, the researcher discovers that all of them are still living. The researcher asks Sylvia whether these cases cast doubt on her psychic abilities. Sylvia explains that skeptical researchers' negative vibes often disrupt psychic abilities, and if she had made the predictions without the presence of the researcher, she would have been accurate. Thus, she believes the evidence supports her psychic abilities. (Question 6)

5. Years ago, some psychologists observed that the parents of autistic children appeared very aloof and detached from their autistic children than were parents of normal children. These psychologists concluded that parental detachment was the cause of autism. (Question 3)

6. A survey research company hired by the Democratic Party contacted a large, representative sample of Americans to examine their beliefs about new legislation designed to reduce crime. They asked the respondents, ‘‘Would you agree that this new legislation that will reduce crime and make our streets safer is a good piece of legislation for America?’’ Close to 92% of the sample answered ‘‘yes.’’ The research company concluded that most Americans support the legislation. (Question 5)

7. A developmental psychologist conducted a longitudinal study of moral development using a group of 1,000 boys beginning at age 8 and continuing through age 14. The findings demonstrated that there are identifiable stages of development occurring across the age periods studied. In the publication of the results, the psychologist named the stages and concluded that

they represent the stages of typical moral development for all children of ages 8–14. (Question 4)

8. An animal advocacy group studied the effects of animal ownership on owners' health. They studied a large, representative sample of older adults and obtained their medical records. Their findings showed that adults who had owned pets (i.e., dogs or cats) for a longer period of time had fewer medical problems than did adults who never owned pets or owned them for a shorter time period. They concluded that owning pets decreases the likelihood of developing health problems. (Question 3)

9. In order to test-market their new detergent, a company sent free samples to 300 randomly selected households. A few weeks later, they called them and asked, ‘‘Are you amazed at how much cleaner and brighter your clothes are after using our new detergent?’’ About 90% of the 300 respondents said, ‘‘yes.’’ The company concluded that their new detergent cleans and brightens clothes very effectively. (Question 5)

10. Researchers randomly assigned male juvenile offenders to conditions where they watched either violent or non- violent films. They discovered that those in the violent film group were less likely to go for help when they witnessed a later real-life violent episode than those in the nonviolent film group. On that basis, the researchers concluded that violent films harden all filmgoers to real-life aggression. (Question 4)

11. Dr. Jones is testing a new treatment for cancer. He administered the treatment to a large sample of patients and kept track of who lived and who died after receiving the treatment. For each person who lived, he attributed the success to the treatment. For each person who died, he attributed the death to the severity of the person's cancer. He concluded that his treatment was effective. (Question 6)

12. A researcher tested a new weight loss supplement. She gave it to 200 overweight adults and discovered that their average weight, as measured by a precise weight scale, declined after 2 months of taking the supplement. She concluded that the supplement promotes weight loss. (Question 2)

13. A group of biological researchers concluded that they have found THE cause of alcoholism. They discovered that alcoholics do not have a small cluster of cells, common to non-alcoholics, located near the hypothalamus. They have also demonstrated that destroying this area of the brain in normal rats caused them to develop a preference for alcohol in their water. Moreover, in another study, they found that normal humans who had this part of the brain damaged in accidents later became alcoholics. (Question 7)

14. Over the past few years, Jody has had several dreams that apparently predicted actual events. For example, in one dream, she saw a car accident and later that week she saw a van run into the side of a pickup truck. In another dream, she saw dark black clouds and lightning and two days later a loud thunderstorm hit her neighborhood. She believes these events are evidence that she has a psychic ability to predict the future through her dreams. (Question 1)

Appendix D

Demographics Inventory

Please complete the following demographics information. All information is kept confidential.

Gender: _____M _____F _____Prefer Not to Answer

Age: _____

Ethnicity/Race: _____White _____Black/African American _____Hispanic _____Asian

_____Other/Prefer Not to Answer

Current GPA: _____

Hours of College Credit Completed: _____