CRITICAL THINKING

I N V E N T O R Y

Manual

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Table of Contents

Introduction to Critical Thinking

Critical thinking has been called one of the most important attributes for success in the 21st century (Huitt, 1998). Meyers (1986) argued that for students to reach their fullest potential in today's society, they must learn to think and reason critically. Paul (2002) contended that "in a world of accelerating change, intensifying complexity and increasing interdependence, critical thinking is now a requirement for economic and social survival."

Critical thinking, a common term in educational, psychological, and philosophical circles, has been defined by researchers and theorists as a "set of intellectual standards" that can be used by individuals while thinking (Paul, 1995). Chafee (1988) defined critical thinking as "our active, purposeful, and organized efforts to make sense of our world by carefully examining our thinking, and the thinking of others, in order to clarify and improve our understanding" (p.29). According to Halpern (1989) critical thinking is "thinking that is purposeful, reasoned and goal directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihood, and making decisions" (p. 5). Norris and Ennis (1989) provided one of the simplest definitions of critical thinking declaring that critical thinking is the "reasonable and reflective thinking that is focused upon deciding what to believe or do" (p. 18).

Facione, Giancarlo, Facione, and Gainen (1995) hypothesized a link between the *disposition* to think critically and critical thinking *skills*. Huitt (1998) argued that rather than a set of generalized skills, critical thinking is a *process* that may best be developed when individuals learn in connection with a specific domain of knowledge through which they can come to pursue the thinking and reasoning process to some actionable conclusion or outcome.

Critical Thinking Defined

Critical thinking definitions range from the simple to the complex. Ennis (1991) simply defined critical thinking as a "reasonable and reflective thinking focused on deciding what to do or believe." Paul (1995) believed that a master of critical thinking used a set of intellectual standards while thinking. These standards guide the thinking process as well as help individuals heighten their ability to think critically. Thinking about thinking for the purpose of improving the thought process is at the heart of critical thinking (Paul, 1995).

Halpern (1996) defined critical thinking as "…the use of cognitive skills or strategies that increase the probability of a desirable outcome" (p. 5). Other definitions include: the formation of logical inferences (Simon & Kaplan, 1989), developing careful and logical reasoning (Stahl & Stahl, 1991), deciding what action to take or what to believe through reasonable reflective thinking (Ennis, 1991), and purposeful determination of whether to accept, reject, or suspend judgment (Moore & Parker, 1994). Burden and Byrd (1994) categorize critical thinking as a higher-order thinking activity that requires a set of cognitive skills. In a comprehensive attempt to define critical thinking, Pascarella and Terenzini (1991) compiled the following:

> "…critical thinking has been defined and measured in a number of ways but typically involves the individual's ability to do some or all of 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 on the basis of the data given, and evaluate evidence or authority" (p. 118).

Some clarity in defining critical thinking was achieved when a group of leading researchers with expertise in the field were asked to define critical thinking through a Delphi study (American Philosophical Association, 1990). The Delphi study participants hypothesized there is a set of intellectual virtues or habits of mind that reflect one's disposition to think critically. These virtues are identified in the Delphi consensus statement:

> "The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (American Philosophical Association, 1990, p. 2).

Extending from their work, Rudd Baker and Hoover (2000) defined critical thinking as,

> "A reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information and for which an incontrovertible solution is unlikely" (p. 2).

Critical Thinking Traits and Processes

In a comprehensive review of existing literature, Beyer (1987) posited that critical thinking requires a set of skills and approaches to be effective. A delineation of cognitive operations included thinking strategies, critical thinking skills, and micro-thinking skills (Beyer, 1987). His thinking strategies included problem solving, decision-making, and conceptualizing. Examples of micro-thinking skills included recall, interpretation, application, synthesis, evaluation, reasoning, and extrapolation. Beyer (1987) proposed the following as critical thinking skills:

- Distinguishing between verifiable facts and value claims;
- Distinguishing relevant from irrelevant information, claims, and reasons;
- Determining factual accuracy of a statement;
- Determining credibility of a source;
- Identifying ambiguous claims or arguments;
- Identifying unstated assumptions;
- Detecting bias;
- Identifying logical fallacies;
- Recognizing logical inconsistencies in a line of reasoning;
- Determining the strength of an argument or claim.

In an effort to clarify the process of critical thinking, Paul (1995) proposed that critical thinking is a unique and purposeful form of thinking that is practiced systematically and purposefully. In Paul's (1995) scenario the thinker imposes standards and criteria on the thinking process and uses them to construct thinking. Paul's (1995) operational definition of critical thinking is delivered by answering the question:

What is Critical Thinking?

A unique kind of purposeful thinking	In any subject area or topic whether academic or practical, requiring intellectual training for the mind, akin to physical training for the body
In which the thinker systematically and habitually	Actively develops traits such as intellectual integrity, intellectual humility, fair-mindedness, intellectual empathy, and intellectual courage.
Imposes criteria and intellectual standards upon the thinking	Identifies the criteria of solid reasoning, such as precision, relevance, depth, accuracy, sufficiency, and establishes clear standards by which the effectiveness of the thinking will be assessed.
Taking charge of the construction of thinking	Awareness of elements of thought such as assumptions and point of view that is present in all well-reasoned thinking. A conscious, active, and disciplined effort to address each element is displayed.
Guiding the construction of the thinking according to the standards	Continually assessing the course of construction during the process. Adjusting, adapting, and improving using criteria and standards.
Assessing the effectiveness of the thinking according to the purpose, criteria, and standards	Deliberately assessing the thinking to determine its strengths and limitations according to the defining purpose, criteria, and standards. Studying the implications for further thinking and improvement.

Creating the CTI

In 2000, Rudd, Moore, and Penfield conducted a factor analysis of the California Critical Thinking Disposition Inventory (Facione, Facione, & Giancarlo, 1998), an inventory designed to measure whether a person habitually exhibits the mindset of an ideal critical thinker using the seven critical thinking dispositions proposed by Facione et al. (1995). Dispositions are assumed to be measurements of how individuals approach certain qualities of critical thinking. Rudd et al. (2000) determined that the constructs were not represented in the analysis. After a study conducted on over 800 subjects failed to produce the constructs proposed by Facione et al. (1995), researchers at the University of Florida began to develop an instrument that more

accurately measure critical thinking disposition. The researchers utilized the 1990 Delphi study and searched the critical thinking literature to build a new instrument. The resulting instrument, the UF/EMI, was developed and submitted to pilot testing in 2003.

The UF/EMI instrument represented three constructs of critical thinking disposition derived primarily from the work of Facione, et. al. (1995): Engagement, Cognitive Maturity, and Innovativeness. The UF/EMI instrument assigned each participant with an overall critical thinking disposition score, ranging from a 26 -130, with a high score signifying a high disposition for critical thinking and a low score signifying a low disposition for critical thinking. Over the next five years, the UF/EMI instrument was tested with a variety of populations and settings.

In several subsequent data collections the engagement and cognitive maturity constructs proved to be stable when tested. However, the reliability reported on the innovativeness construct fluctuated. In addition, qualitative data collected examining critical thinking disposition did not match the high/low critical thinking disposition assumption. Rather than having a high or low disposition for critical thinking, participants were reflecting a range of critical thinking tendencies when thinking critically (Lamm et al., 2011). Items within the UF/EMI instrument were examined for collinearity with items eliminated based on statistical issues. Even with these adjustments the innovativeness construct ranges remained unreliable. In addition, questions surrounding a high/low disposition for critical thinking continued to be raised in terms of interpreting the meaning of a high/low score during a new test phase conducted on the UF/EMI in 2009-2010 (Friedel, Irani, Rhoades, Fuhrman, & Gallo, 2008; Lamm et al., 2011; Lamm, Strickland, & Irani, 2010).

In response to these two issues with the UF/EMI, researchers chose to develop a new inventory to more accurately measure critical thinking style rather than disposition (Friedel et al., 2008; Lamm et al., 2011). While disposition is an individual's habitual inclination or tendency towards critical thinking (Facione et al., 1995), style represents the way critical thinking is expressed, or performed, or done by an individual.

CTI

The CTI was created by adapting the scaled UF/EMI instrument from a measure of high/low critical thinking disposition to a continuum examining critical thinking style. The CTI measures a range between two constructs of critical thinking style: Engagement and Seeking Information.

Engagement style ⟵——————————⟶ Seeking Information style

In the CTI, each participant is assigned an overall critical thinking style score, ranging from 26-130, with a high score signifying a style that seeks information when thinking critically and a low score signifying a style that engages when thinking critically. Ideally, the ultimate critical thinker would land in the middle of the two constructs on the continuum, exhibiting an interest and ability to engage in both styles when thinking critically. Over the next three years, the CTI

went through rigorous testing on multiple populations, factor analysis was run on several versions of the CTI, and the CTI was refined until it was a reliable measure over time.

The CTI is comprised of 20 items each scored 1 to 5 as follows: 1, *strongly disagree,* 2, *disagree*, 3, *neutral*, 4, *agree*, and 5, *strongly agree*. Scores for the seeking information and engagement constructs are independently calculated. The score for the seeking information construct is created by summing the points obtained from an individual's responses to the respective items of the construct. The score for the engagement construct is created by transposing the participant's score on each of the engagement items, summing the transposed scores, and multiplying the summed score by 1.866. To calculate an overall critical thinking style score, simply sum the final seeking information and engagement construct scores.

Constructs

Seeking Information

A person with a high tendency for a **Seeking Information** style is aware of their own predispositions and biases, recognizing current opinions and positions have been influenced by who he is, his environment, and experiences. This person is a "hungry learner," open to the opinions of others and takes care to seek out divergent points of view, consistently looking for new knowledge, considering them objectively when making decisions or arriving at a solution. They have a desire to know the truth, even if the truth conflicts with presently held beliefs and opinions. These Individuals actively seek out research, reading, and questioning to enhance their knowledge of their profession, their situation, their life, and their world. They recognize that most problems are more complex than they appear on the surface and understand that rarely is there "one-right-answer" to problems they encounter.

Engagement

An individual with a high tendency towards the **Engagement** style is aware of their surroundings and is able to anticipate situations where good reasoning will be necessary to employ. They look for opportunities to use their reasoning skills and are confident in their ability to reason, solve problems, and make decisions. This person is also a confident communicator and is able to explain the reasoning process used to arrive at a decision or problem solution.

Interpreting Scores

It is important to recognize that the CTI is measuring a critical thinking style, not a level to which the participant engages in critical thinking. A low score is not better than a high score or vice versus. A score of 78 indicates little to no variation in response (signifying the same response was given for all 20 items) and is not interpretable.

[79 or above overall CTI score]
An individual exhibiting a **high** overall **CTI** score is considered a "Seeker." These individuals:

- are aware of their own predispositions and biases, recognizing current opinions and positions have been influenced by who he is, his environment, and experiences
- are "hungry learner," open to the opinions of others and takes care to seek out divergent points of view
- consistently look for new knowledge, considering the new knowledge objectively when making decisions or arriving at a solution
- desire to know the truth, even if the truth conflicts with presently held beliefs and opinions
- actively seek out research, reading, and questioning to enhance their knowledge of their profession, their situation, their life, and their world
- recognize most problems are more complex than they appear on the surface
- understand there is rarely "one-right-answer" to problems they encounter.

[77 or below overall CTI score]
An individual exhibiting a **low** overall **CTI** score is considered an "Engager." These individuals:
- are aware of their surroundings
- have the ability to anticipate situations where good reasoning will be necessary to employ
- look for opportunities to use their reasoning skills
- have confidence in their ability to reason, solve problems, and make decisions
- are confident communicator and is able to explain the reasoning process used to arrive at a decision or problem solution

Samples

The initial sample (Group 1) included a total of 195 responses that were all able to be included in the data analysis with equivalent numbers of males and females. Participants in Group 2 were 166 upper classmen representing 26 different undergraduate majors. Study 3 involved 173 students and 161 subjects participated in Group 4.

Validity

Two dominant factors from a principal component analysis were interpreted as support for bi-dimensional scale composed of 20 items. When compared with Kirton's (2000) adaption/innovation inventory, a highly reliable instrument to measure problem solving style, individuals with an innovative preference for forming solutions and dealing with structure while problem solving tended to have an engager critical thinking style. This was especially true as it relates to the individual's ability to acknowledge their own predisposition when thinking critically and their ability to recognize how their environment can have an effect on the way they think (Lamm et al., 2011). When compared to Kolb's (2007) learning style inventory (LSI), another highly regarded instrument measuring individual learning style, the LSI's active experimentation preference was related to the engager tendency within the CTI while the reflective observation preference was related to both the engagement and seeking information constructs. Overall, the results showed that individuals with a preference for "doing" were more likely to have an engager critical thinking style.

CTI Statistics

Reliability Estimates	**Typical Score Ranges**	**Possible Score Ranges**
Seeking Information: .80	Seeking Information: 35-60	Seeking Information: 13-65
Engagement: .80	Engagement: 10-40	Engagement: 13-75
Overall CTI: .87	Overall CTI: 63-83	Overall CTI: 26-130

Using the CTI

The CTI development team welcomes educators and researchers the opportunity to use the CTI in broader contexts. Please contact Dr. Alexa Lamm, alamm@uga.edu, to obtain the resources needed to implement and score the instrument correctly.

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