

## **Relationships between Critical and Creative Thinking**

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### **Introduction**

*Whereas creative thinking is divergent, critical thinking is convergent; whereas creative thinking tries to create something new, critical thinking seeks to assess worth or validity in something that exists; whereas creative thinking is carried on by violating accepted principles, critical thinking is carried on by applying accepted principles. Although creative and critical thinking may very well be different sides of the same coin they are not identical. (Beyer, 1989; p.35)*

Creative and critical thinking skills are considered essential for students (Crane, 1983). Crane (1983) expressed the importance of both of these skills when she wrote: “When reasoning fails, Imagination saves you! When Intuition fails, reason saves you!”(p. 7). There has been an abundance of research on each construct but very little examining if they are related. Scriven (1979) stated: “Critical skills go hand in hand with creative ones” (p. 37). Only by understanding if there is a relationship between these two essential constructs will educators be able to enhance the capacity of their students to utilize both creative and critical thinking. It is essential to first define each of these constructs to determine if indeed they are correlated.

## Theoretical Framework

### Critical Thinking

Critical thinking is a common "buzz phrase" in educational, psychological, and philosophical, circles today. Much work has been completed in the name of critical thinking in education to date that not only leaves one wondering how it is measured, but also leaves one groping for a cognizant definition of critical thinking. Part of this ambiguity lies in the existence of multiple definitions for critical thinking.

Halpern (1996 p.5) defines critical thinking as "...the use of cognitive skills or strategies that increase the probability of a desirable outcome." 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). 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).

Burden and Byrd (1994) categorize critical thinking as a higher-order thinking activity that requires a set of cognitive skills. In a 1987 comprehensive review of existing literature, Beyer posited that critical thinking requires a set of skills and approaches to be effective. Beyer's critical thinking skills include:

1. Distinguishing between verifiable facts and value claims
2. Distinguishing relevant from irrelevant information, claims, and reasons
3. Determining factual accuracy of a statement
4. Determining credibility of a source
5. Identifying ambiguous claims or arguments
6. Identifying unstated assumptions
7. Detecting bias
8. Identifying logical fallacies
9. Recognizing logical inconsistencies in a line of reasoning
10. Determining the strength of an argument or claim

In an effort to clarify the process of critical thinking, Paul (1995) wrote that critical thinking is a unique and purposeful form of thinking that is practiced systematically and purposefully. The thinker imposes standards and criteria on the thinking process and uses them to construct thinking.

Paul (1995) further refined critical thinking by identifying three thought traits and/or processes possessed by the critical thinker. They are elements of reasoning, traits of reasoning, and reasoning standards.

Elements of reasoning consist of seven components that help guide the reasoning process. These components include the purpose of the thinking or the question at hand, information and/or facts about the question, assumptions made about the question, interpretation of the facts and data collected, theories and concepts related to the question, and inclusion of other points of view. Finally, an assessment of the conclusions is drawn with emphasis on implications and consequences of the decisions reached as a result of the thinking process (Figure 1).

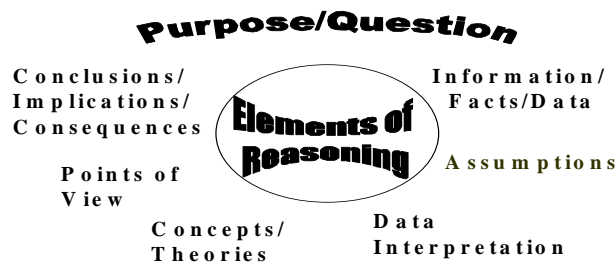


Figure 1: Elements of Reasoning

Traits of critical thinkers include independent thinking, intellectual empathy, intellectual humility, courage, integrity, perseverance, intellectual curiosity, faith in reason, intellectual civility, and intellectual responsibility. These traits are not only present in critical thinkers, they are consciously utilized to guide the thinking process (Paul, 1995).

Rudd, Baker, Hoover, and Gregg (1999) offered the following definition:

Critical thinking is 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.

### Creative Thinking

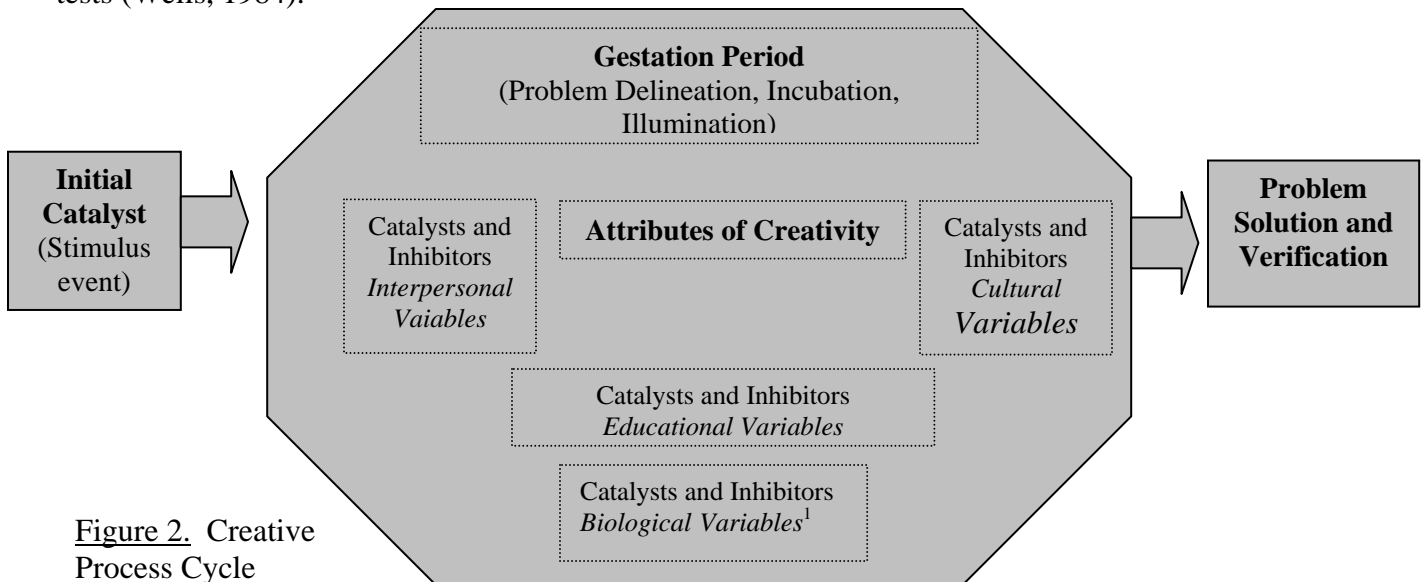
Creativity is a complex construct and is most commonly expressed through a broad range of intelligences including linguistic, musical, mathematical, spatial, kinesthetic, interpersonal, and perhaps even intrapersonal (Gardner, 1985). In a classic study of creativity, Taylor (1959) proposed the existence of five typologies for creativity. These were expressive, productive, inventive, innovative, and emergentive.

Expressive creativity is the type of spontaneous creativity often seen in children and is exemplified in drawings and play. Scientists and artists illustrate productive creativity. An element of spontaneous production remains, yet is characterized by the need to create rather than being restricted by the need to express. The third classification is inventive creativity that may be described as a problem solving or a creation to improve an existing technology. An example would be an engine invented to make farm tractors more fuel-efficient. Innovative creativity deals with the capacity to improve or reinvent an existing organism or object through the utilization of conceptualization skills. An example is the recent movement to reinvent government, in which the existing governmental structure was redefined through reconceptualization. The final type of creative skill is emergentive. It is a new creation opening an entirely new paradigm. An example is the interventions of chemical fertilizers, insecticides, and hybrid seeds that helped to launch the Green Revolution. Emergentive creativity is a discovery that opens an explosion of ideas in a synergetic fashion (Taylor, 1959).

In an operationally problem-oriented definition, Torrance (1966) defined creativity as:

A process of becoming sensitive to a problem, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypothesis about these deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results. (p. 6)

Figure 2 presents forces and factors in the creative thinking process model. This model is one cycle that consists of three distinct phases: (1) an initial catalyst; (2) a gestation period; and (3) a problem solution and verification phase. In one's reality, any problem experienced in his/her livelihood system or expressive creative "seed" could serve as an initial catalyst (Wells, 1984). After the initial catalyst, there is a gestation period where one begins to delineate the problem that he/she wishes to solve. Finally there is a problem solution and verification process in which the individual comes up with a proposed resolution or creation which he or she then tests (Wells, 1984).



**Figure 2.** Creative Process Cycle

The gestation phase includes four groups of often overlapping catalysts/inhibitors of creativity. These are encountered throughout life and either stimulate and/or limit one's capacity to be creative. Wright (1987) listed the factors that influence a creative home environment as "respect for the child, the stimulation of independence and enriched learning environment" (p. 34). Pratt-Summers (1989) found similar results to the one described above. Jausovoc (1988) and Dorner (1979) discovered that the teacher's teaching style (based on Piagtian cognitive theory: exercise training, tactical training, and strategic training) was related to the development of creativity in students. These results support the notion that interpersonal variables are important catalysts and/or inhibitors of creativity.

The second group of catalysts and inhibitors consists of biological variables such as age, genetics, health status, and gender (Krippner, 1991). The majority of the research has been concentrated on gender and birth order. There is not a consensus on the impact of gender upon creativity. Torrance (1983) wrote, "a substantial body of evidence indicates that males and females perform at similar levels of tests designed to measure creative potential" (p. 134). He found that girls did not perceive themselves to be inventors and were largely influenced by their environment. Harriss (1989) found that women were discouraged from becoming artists. Torrance and Allioti (1969) discovered that 13 year old girls had higher verbal creative ability compared to boys of the same age. Gupta (1979) did not find that there was a significant difference between boys and girls in verbal creative ability, but found that there were distinct elements of non-verbal ability in which each scored significantly higher. The research on the impact of birth order has detected that first-born males and females scored significantly higher on creativity tests than the second born (Comeau, 1980; Jaraial, 1985). The unique contribution of age, genetics, and health status to creativity is unclear.

The third catalyst/inhibitor group is cultural variables. Krippner (1991) defined these as socio-economic status, ethnic background, religious experience, and significant emotional events. There is a wealth of research to support the connection between socioeconomic status and creativity (Forman, 1979; Cicirelli, 1966; Singh, 1970; Kaltounis, 1974; and Torrance, 1963). The exception to this was discovered by Warden and Pratt (1971) who found no division in creativity between any ethnic or social class.

Cultural background was found to have an impact upon creativity of individuals from Japan (Torrance and Sato, 1979), India (Sharma and Naruka, 1983; Torrance, 1981), the United States, Western Australia, Western Somoa, Germany, (Torrance, 1981) and the Dominican Republic (Baker et al. 2000). Sharma and Naruka (1983) found a creative difference between the Hindu, Muslim, and Christian religious groups in India.

\_\_\_\_Torrance (1986) suggested the way that significant emotional events may affect creative expression when he wrote: "apparently, an intense emotional experience sets up a need for creative expression and actually facilitates the creative expression" (p. 130).

The final group of catalysts and inhibitors consists of personal attributes/educational factors. These include learning style, critical thinking, knowledge, motivation, creative response style,

and educational setting. Isaacs (1987) examined the importance of learning style and its impact on creativity when she stated:

In some ways creativity is as delicate as the very breath of life. It can be nurtured and expended, or starved and diminished. Thus understanding and applying findings from learning style study is as important for sustaining creativity as for stimulating academic achievement. (p.257)

Understanding the manner in which the individual learns facilitates academic achievement and can lead to an environment that enhances creativity.

In discussing the impact of knowledge on creativity Sternberg and Luppatt (1991) made the distinction between knowledge and usable knowledge. They stated: "knowledge can be learned in a way that makes it inert" (p. 610). Sternberg and Luppatt (1991), when discussing the importance of motivation, identified two key types: Intrinsic motivation and the motivation to excel. Intrinsic motivation was seen as an important element because students are much more likely to be creative if they enjoy what they are doing. Motivation to excel has been emphasized because these individuals are willing to work for creative excellence.

In the book The Nature of Creativity (1997) Torrance reviewed experiments that examined the effects of educational setting upon creativity. The majority of the research (Boersman and O'Bryan, 1968; Moham, 1970; Hooper and Powell, 1971; Nash, 1971; Ward, 1969; Norton, 1971; Khatena, 1971; and Kogan and Morgan, 1969) found that there was a difference in creativity when the school environment (testing conditions, cue rich and cue poor, etc.) was manipulated. These findings were in contrast to studies by Allioti (1969) and Towell (1972) who did not find any differences in creativity based upon changes in educational environments.

The core of the gestation phase of the creative process model is the creative attributes referred to by Torrance et al. (1990) as creative thinking abilities. These creative attributes were fluency, flexibility, originality, elaboration, abstractness of the title, resistance to closure, emotional expressiveness, articulateness, movement or action, expressiveness, synthesis or combination, unusual visualization, internal visualization, extending or breaking the boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy. The Torrance Test of Creative Thinking (TTCT) is an instrument that can be used to operationalize these creative attributes.

This process may or may not be linear. Each iteration is different in time and shape, depending on its interaction with the other catalysts and inhibitors described in the model. It is even possible that a full iteration may not be completed because of factors such as motivation. The final phase of this model results in an end product and verification of creativity that is expressive in problem solution and verification for the typologies (of creativity) proposed by Taylor (1958). However it is important to point out that there is a very important time dimension to creativity. The time dimension is influenced by the perceived importance of the problem, as well as the motivation, support, and resources available for problem resolution.

## Purpose

The purpose of this study was to explore the relationships between creative thinking abilities and critical thinking disposition. The specific objectives of the study were: (1) to describe the students in terms of academic classification, creative thinking abilities, and critical thinking disposition; (2) to determine the amount of variance in creative thinking ability explained by critical thinking disposition; and to (3) determine the relationship between creative thinking ability and gender.

## Methodology

A purposive sample consisting of students in a senior level project planning and evaluation course (n=32) and two instructional methods courses (n=4) and (n=14). Data were collected spring, summer, and fall semesters of 1999.

The researchers utilized two instruments for data collection. First, the Torrance Test for Creative Thinking – Form A (TTCT) was utilized to measure creative attributes. For this three-part timed test, subjects are asked to construct a picture, complete a series of incomplete drawings, and complete drawings from sets of parallel lines. According to Torrance et al., 1990:

The term "creative thinking abilities" as used in the TTCT, refers to that constellation of generalized mental abilities that is commonly presumed to be brought into play in creative achievements. . . The author has maintained that high degrees of the abilities measured by tests such as the TTCT increase the chances that the possessor will behave creatively. Certainly, the author of these tests would never argue that possession of these abilities guarantees that an individual will behave creatively, any more than a high degree of intelligence guarantees intelligent behavior. . . Creative motivations and skills, as well as abilities, are necessary for adult creative achievement." (p. 1)

The TTCT results in quantitative scores for the following norm-referenced constructs: (1) fluency – the ability to produce a large number of figural images; (2) originality – unusualness or rarity of response; (3) abstractness – the ability to produce good titles and to capture the essence of information involved; (4) elaboration – ability to develop, embroider, embellish, carry out, or otherwise elaborate ideas; and (5) resistance to premature closure – the ability to keep a figure open and delay closure long enough to make the mental leap that makes original ideas possible. Content and construct validity has been established by the TTCT developer (Torrance et al., 1990). Intra-rater reliability coefficients are above the .90 level (Torrance et al., 1990). In addition to the TTCT, the researchers recorded the subjects' academic rank and gender.

The California Critical Thinking Disposition Inventory (CCTDI) was the second instrument utilized. The test consists of 75 Likert-type questions that represent 7 critical thinking constructs (see Table 1). Content and construct validity has been established by CCTDI developers (Facione, Facione, & Giancarlo, 1996). The developers report an overall reliability (Cronbach's  $\alpha$ ) of .90 and scale reliability scored from .72 - .80. Total scores range from 75-450.

The following descriptions of the CCTDI constructs are from the CCTDI test manual (Facione, Facione, & Giancarlo, 1996).

*Analyticity* is a construct consisting of 11 items from the CCTDI. This construct targets the disposition of being alert to potentially problematic situations, anticipating possible results or consequences, and prizing the application of reason and the use of evidence even if the problem at hand turns out to be challenging or difficult. The analytically inclined person is alert to potential difficulties, either conceptual or behavior, and consistently looks to anticipatory intervention, reason giving, and fact-finding as effective ways to resolve matters.

*Self-confidence* is a construct consisting of 9 items from the CCTDI. This construct refers to the level of trust one places in one's own reasoning process. Critically thinking, self-confident persons trust themselves to make good judgments and believe that others trust them as well, since they believe that others look to them to resolve problems, decide what to do, and bring reasonable closure to inquiry.

*Inquisitiveness* is a construct consisting of 10 items from the CCTDI. The inquisitive person is one who values being well informed, wants to know how things work, and values learning even if the immediate payoff is not directly evident.

*Maturity* is a construct consisting of 10 items from the CCTDI. The maturity scale addresses cognitive maturity and epistemic development. CCTDI scoring gives preference to those disposed to approach problems, inquiry, and decision making with a sense that some problems are ill-structured, some situations admit of more than one plausible option, and many times judgments based on standards, contexts, and evidence which precludes certainty must be made.

*Open-mindedness* is a construct consisting of 12 items from the CCTDI. This construct targets the disposition of being open-minded and tolerant of divergent views with sensitivity to the possibility of one's own bias. The open-minded person respects the rights of others to holding differing opinions.

*Systematicity* is a construct consisting of 11 items from the CCTDI, targeting the disposition to being organized, orderly, focused, and diligent in inquiry. No particular kind of organization, e.g. linear or nonlinear, is given priority on the CCTDI. The systematic person strives to approach specific issues, questions or problems in an orderly, focused, and diligent way, however that might be accomplished.

*Truth-seeking* is a construct consisting of 12 items from the CCTDI, representative of those eager to seek the truth, who are courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's interests or one's preconceived opinions. The truth-seeker would rather pursue the truth than win the argument.

*Total Score* is a measure consisting of the 75 items from the CCTDI.



The CCTDI is used extensively in military science, law enforcement, allied health, engineering, and business. Although the researchers did not find evidence of CCTDI use in agriculture, the instrument was deemed appropriate for the purpose of identifying agriculture student's disposition to think critically (Facione, Facione, & Giancarlo, 1996).

The data were analyzed by using SPSS/7.5 for Windows software. Descriptive statistics, multiple linear regression and point biserial correlational analysis was used to summarize and analyze the data.

## Results

Objective number one was to describe the students in terms of academic classification, creative thinking abilities, and critical thinking disposition. Sixty-two percent of the students in the sample were female, and 74% were classified as a senior. Approximately 12% of the students were juniors, and ten percent were classified as post-baccalaureate students.

In terms of creative thinking ability, TTCT percentile scores were calculated from the raw scores based upon the adult population in the U.S. The students ranked in the 58<sup>th</sup> percentile in fluency; 75<sup>th</sup> percentile in abstractness; 51<sup>st</sup> percentile in originality; 46<sup>th</sup> percentile in elaboration; and 64<sup>th</sup> percentile in their resistance to premature closure.

Clearly the percentile scores reflect an average ability in fluency, originality, elaboration, and resistance to premature closure. The students had a greater ability to produce good titles and to capture the essence of information involved when compared to the general adult population.

In terms of the critical thinking disposition, the CCTDI consists of seven sub-scales or constructs and an overall CCTDI Total Score. The recommended cut score for each scale or construct is 40 and the suggested target score is 50. All scores range up to 60. Persons who score below 40 on a given scale are weak in that critical thinking dispositional aspect, persons who score above 50 on a scale are strong in that dispositional aspect. In recording a 50, a person is demonstrating consistent strength in that dispositional aspect. Inversely, scoring below 40 indicates that, on average, the person responds in opposition to the critical thinking dispositional aspect measured by a given scale.

On six of the seven subscales, students in this sample could not be described as being particularly strong or weak (Open-mindedness -  $M=44.88$ ,  $SD=5.39$ ; Inquisitiveness -  $M=45.64$ ,  $SD=6.28$ ; Systematicity -  $M=42.33$ ,  $SD=5.71$ ; Maturity -  $M=45.92$ ,  $SD= 6.41$ ; Self-confidence -  $M=43.26$ ,  $SD=5.73$ ; Analyticity -  $M=44.13$ ,  $SD=5.48$ ). On the construct of Truth-seeking, they could be described as slightly weak ( $M=39.10$ ,  $SD=7.01$ ).

Just as scores of less than 40 shows weakness, an overall CCTDI score of less than 280 shows serious overall deficiency in the disposition toward critical thinking. An overall score of 350 or more is a solid indication of across the board strength in the disposition toward critical thinking. However, an overall score of 350 is rare. People tend to have both strengths and weaknesses. The overall CCTDI score for this sample was 305.25 ( $SD=27.91$ ).

The second research objective was to determine the amount of variance in creative thinking ability explained by critical thinking disposition. Five multiple linear regression analyses were utilized, with raw TTCT scores as the dependent variable, and CCTDI subscales as the independent variables. Although none of the analyses were statistically significant, critical thinking disposition accounted for 24% of the variance in resistance to premature closure ( $F=1.96, p=.08$ ), 5% of the variance on fluency ( $F=.35, p=.93$ ), 8% of the variance on abstractness ( $F=.55, p=.78$ ); 2% on originality ( $F=.49, p=.83$ ); and 1% on elaboration ( $F=.06, p=.99$ ).

The final research objective was to examine the relationships between creative thinking ability and gender. Low to negligible (Davis, 1971) bivariate relationships were found between gender and resistance to premature closure ( $r=.07$ ), fluency ( $r=-.03$ ), abstractness ( $r=.24$ ), originality ( $r=-.11$ ), and elaboration ( $r=.15$ ).

### **Conclusion and Implications**

It appears that the collegiate educational experience has had little effect upon the students' ability to be creative or their disposition to think critically. Teaching students to remember factual information and return it in the form of an examination is the prevalent teaching mode employed in secondary and post-secondary institutions today. Teaching thinking skills is a difficult and much different endeavor. Teaching to promote thinking takes more time to prepare, is difficult to plan, and limits the amount of content "taught." Teachers can no longer be information givers. Students must learn thinking and reasoning skills to reach their fullest potential in today's society (Meyers, 1986).

The "more information is better" attitude unfortunately prevails in modern education. This is unfortunate considering that often the factual matter has a relatively short life span with students (Terezini, Springer, Pascarella, & Nora, 1993). When coupled with the fact that information learned today quickly becomes outdated, is it any wonder that our students struggle when they reach the work place? Good thinking skills will not develop on their own, they must be taught (Beyer, 1987). Teaching students to think must be a priority of our schools today. In any thought process we engage in both critical and creative thinking (Beyer, 1987).

The term critical thinking is common in educational, psychological, and philosophical circles today. Employers, parents, administrators, and students themselves want critical thinking skills developed in today's graduate. Developing critical thinking skills is not a new idea. Osborne (1932, p.402) stated that, "...it is assumed that development of thought power is one of the major aims of education." Dressel and Mayhew (1954) believed that educational institutions were responsible for teaching students to go beyond the simple mental activities of recall and restatement of ideas and facts to the higher-level skills and habits involved in critical thinking.

Anderson (1990) explored the importance of creativity in higher education when he wrote:

The college experience should include an opportunity to discover one's potential and achieve higher levels of creative expression. The extent to which this happens depends on curriculum and the commitment of the faculty members to nurture this development both inside and outside of the classroom. The learning environment as reflected by the classroom and campus setting, supportive extra-curricular and the advisor/student relationship all impact the total educational mission of developing creativity. (p. 55)

Sutton and de Oliveira (1995) asserted that although students complete basic courses they have only a superficial understanding of what they have learned. In fact, few students are taught the skills needed to examine principles, values and facts.

This study was limited to the groups that participated. The results from this study suggest that the two constructs (critical and creative thinking) are not closely connected. These researchers emphasize that much more research needs to be conducted with different age ranges, gender, and socio-economic background to confirm the results of this study. This research should help to answer very important questions on how to enhance the capacity of students to critically and creatively think. The preliminary findings in this study suggest that educators must prepare specific curriculum that stimulates creative and critical thinking separately.

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