

The Influence of Student Learning Style on Critical Thinking Skill

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Abstract

The purpose of this study was to determine the influence of student learning styles on critical thinking skills. The target population for this ex post facto study was 135 students enrolled in a college of agriculture and life sciences leadership development course. Results showed that no critical thinking skill differences existed between male and female students in this study. Students with deeply embedded Abstract Sequential learning style preferences exhibited significantly higher critical thinking skill scores. No differences in critical thinking ability existed between students of other learning styles. These findings have implications for faculty with teaching appointments in colleges of agriculture. If Abstract Sequential learners are inherently adept at thinking critically, teachers may not need to focus as intently on teaching strategies that address this learning style. By contrast, however, Concrete Sequential, Abstract Random, and Concrete Random learners may need additional attention through instructional methods and techniques that enhance the critical thinking skills of these learners.

Introduction

The goal of every teacher is to develop their students' understanding of the content being taught in the class, as well as to assist them in their development to become independent and thoughtful problem solvers (Bransford, Brown, & Cocking, 2000). Identifying the best means by which to accomplish this goal has been the aspiration of educational researchers for many years. Nowhere is this more evident than in agricultural education. For over half a century agricultural educators have promoted the use of instructional strategies that promote the development of problem solving / thinking skills in agriculture students (Hamlin, 1922; Lancelot, 1944; Newcomb, McCracken, & Warmbrod, 1993; Phipps & Osborne, 1988). Two major factors that have been identified as playing a role in this process are student learning style and critical thinking ability. Individually, these factors have been examined in detail for their effect on student learning (Cano, 1993, 1999; Cano & Garton, 1994; Cano & Martinez, 1991; Cano & Metzger, 1995; Dyer, 1995; Dyer & Osborne, 1996a, 1996b; Garton, Spain, Lamberson, & Spiers, 1999; Ricketts, 2003; Rudd, Baker, & Hoover, 1998; Torres & Cano, 1994, 1995b). However, very few studies have investigated the relationship between the two (Rudd, Baker, & Hoover, 2000; Torres & Cano, 1995a).

The theoretical framework for this study lies in the theories of critical thinking and learning style research. Gregorc (1985) suggested that 95% of individuals have specific learning style preferences. Some of those preferences are so deeply embedded that individuals cannot adapt to meet alternative style requirements posed by different learning situations. Gregorc (1979) purports that learning styles consist of "distinctive and observable behaviors that provide clues about the mediation abilities of individuals" (p. 19).

The Gregorc Style Delineator (Gregorc, 1982a) was designed to reveal two types of mediation abilities: perception and ordering. Perceptual abilities, as defined by Gregorc, are the means through which individuals grasp information. These abilities emerge on a continuum consisting of abstractness and concreteness at opposite ends. For example, some individuals perceive things to be either right or wrong, good or bad, black or white. Others, however, see varying degrees of right or wrong, good or bad, and only in shades of gray. The ways in which an individual arranges, systematizes, and references information is referred to as ordering abilities. Ordering abilities also form a continuum with the poles of sequence and randomness at either end. For example, some individuals file materials neatly (alphabetically, by color, etc.), whereas others stack materials in neat piles. Yet others put materials wherever there is an open space with no apparent specific ordering process. By locating the position of an individual on each of these continuums, a person's learning style can be identified as Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR), or Concrete Random (CR).

According to Gregorc (1982a), individuals with a preferred CS learning style view and approach experiences in an ordered and sequential manner. These individuals are naturally structured and are task oriented. This type of learner is able to divide facts and figures into categories and subcategories. They then focus their attention on understanding or solving the issues or problems of each subcategory before moving on to the next. Abstract Sequential (AS) learners rely on intellect and logic in their thinking processes. They approach life using reason and logic and prefer an environment that is ordered and mentally stimulating. Abstract Random

(AR) learners are characterized by Gregorc as having their thinking processes anchored in feelings and concerned with emotions. They view routine and order as boring, and enjoy an environment that is colorful and varied. Concrete Random (CR) learners rely on intuition and instinct in their thinking process. This type of learner is often more concerned with attitudes than facts. They tend to be inventive, competitive, and risk-takers, but sometimes jump to rapid conclusions.

Whereas each of these learning styles consists of a certain set of characteristics, no one style is better or worse than the others (Gregorc, 1982a). Every learner has some capacity to learn within each of the four styles. However, individuals do have a *preferred* learning style. Gregorc noted that very few learners possess the flexibility to meet the demands of learning situations that digress very far from their preferred style. If true, this has major implications in education. Dyer (2002) noted that each preferred learning style has a matching preferred method of instruction. By utilizing appropriate teaching techniques matched with student learning styles, Dyer and Osborne (1996a) noted that student learning could improve.

A number of studies have investigated the influence of learning style on student achievement. Cano (1999) reported that the majority of students enrolling in a college of agriculture were categorized as field-independent by the Group Embedded Figures Test (GEFT) (Witkin, Oltman, Raskin, & Karp, 1971). This would correspond to CS/CR learners on the Gregorc Delineator. Cano further reported that learning style differences were noted between majors within a college of agriculture. Those students identified as field-independent were found to be more successful in higher education, based on the occurrence of disciplinary action due to poor academics.

The primary demographic variable on which a substantial amount of research has been conducted relating to learning style is gender. However, the relationship of gender and learning style is somewhat disputed in the literature. In the general population, females tend to be more field-dependent (AR/AS learners) than males (Witkin, Moore, Goodenough, & Cox, 1977). However, this finding is not supported by some agricultural education studies (Cano & Garton, 1994; Garton et al., 1999; Rudd et al., 2000; Rudd et al., 1998). In these studies it was reported that females within the field of agriculture tended to be more field-independent than field-dependent. This may be explained, however, by the fact that the field of agriculture attracts learners that are strongly field-independent (Witkin et al.). As such, it is likely that colleges of agriculture predominantly attract only those females students who are strongly field independent (CS/CR), resulting in a skewed sample. Supporting this hypothesis, Torres and Cano (1994) and Dyer and Osborne (1996a; 1996b) reported that their findings concurred with those of Witkin et al.

Various definitions of critical thinking have been offered by researchers (Ricketts, 2003). Some define critical thinking as the process of reasonably deciding what to believe and do (Ennis, Millman, & Tomko, 1985). Chaffee (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). Norris and Ennis (1989) provided a much simpler definition, noting that critical thinking is the “reasonable and reflective thinking that is focused on deciding what to believe or do” (p. 18). A

definition offered by Rudd, Baker, and Hoover (2000) states that “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” (p. 5). Whatever the exact definition, the importance of critical thinking ability in students is widely accepted. Paul (1995) suggested that critical thinking is the essential foundation for all of education. He opined that this foundation is crucial for individuals to be able to adapt to the demands of everyday life.

The literature base is somewhat contradictory on those factors that affect the development of critical thinking skills. Some researchers have reported a relationship between gender, academic major, and grade point average (GPA) to critical thinking skill (Kintgen-Andrews, 1991; Rudd et al., 1998; Torres & Cano, 1995b; Walsh & Hardy, 1999). Cano and Martinez (1991) reported a substantial positive relationship between student cognitive ability and student critical thinking ability. Walsh and Hardy (1999) reported that differences were found in the overall disposition toward critical thinking among college majors, but no differences based on gender.

According to Lundy et al. (2002), critical thinking disposition can be changed over the period of one semester, provided the class is designed to enhance critical thinking skills. Researchers have identified several teaching techniques that can be implemented into a classroom to encourage the development of critical thinking skills. McCormick and Whittington (2000) reported that the use of problem sets, individual and group written reports, group presentations, and laboratory tests were shown to emphasize higher cognitive levels, which in turn lead to better critical thinking skills in students. Meyers (1986) suggested that teaching activities such as debates, presenting problems, and small group work lead to higher critical thinking skill development. Bransford, Sherwood, and Sturdevant (1987) stated that a key to developing critical thinking skills in students is developing their ability to define problems precisely, and then dissecting problems into manageable portions.

Only two studies were found in the agricultural education literature base that investigated the relationship between learning style and critical thinking ability. Torres and Cano (1995a) reported that nine percent of the variance in student critical thinking skill was uniquely explained by learning style after controlling for other personal characteristics such as age, gender, and GPA. However, Rudd, Baker, and Hoover (2000) found no significant difference in critical thinking disposition between individuals of different learning styles. Clearly, further studies are needed to determine this relationship. By gaining a better understanding of the influence of learning styles on critical thinking skill, educators can become better equipped to assist students in developing these skills.

Purpose and Objective

The purpose of this study was to determine the influence of student learning style on critical thinking skills. The objectives of this study were as follows:

1. To describe the learning styles of students enrolled in an agricultural leadership development course.

2. To describe the critical thinking skills of students enrolled in an agricultural leadership development course.
3. To determine the influence of gender on critical thinking skills.
4. To determine the influence of learning styles, as defined by Gregorc (1982a), on critical thinking skills of students enrolled in an agricultural leadership development course.
5. To determine the influence of deeply embedded learning styles on critical thinking skills of students enrolled in an agricultural leadership development course.

Since the research base does not support the use of directional hypotheses, null hypotheses were used to analyze objectives three, four, and five. All null hypotheses were tested at the .05 level of significance.

HO₁: There is no difference in the critical thinking skills of students based upon gender.

HO₂: There is no difference in the critical thinking skills of students based upon learning style.

HO₃: There is no difference in the critical thinking skills of students based upon deeply embedded learning style.

Methods/Procedures

The target population for this ex post facto study was students enrolled in the college of agriculture and life sciences at a land grant university during the 2002 Fall Semester. The accessible sample consisted of an intact group of students enrolled in a leadership development course ($n = 135$). Usable instruments were obtained from 111 students. As a clinical study, the findings of this research are not generalizable beyond the sample.

The Gregorc Style Delineator (Gregorc, 1982a) was administered to assess the preferred learning styles of each student. The Gregorc instrument separates learning styles into combinations of four categories: Concrete Sequential, Concrete Random, Abstract Sequential, and Abstract Random. Scores of 26 or higher indicate a general preferred learning style in a particular category. Individuals may exhibit preferences in one or more categories, or may not exhibit a preference for any of the categories. Deeply embedded learning styles are defined as those scores exceeding the median score within a preferred learning style (e.g., a score of 33 represents the median of scores ranging from 26 to 40).

The Gregorc Style Delineator is a standardized instrument that has been used in educational research for approximately 20 years (Gregorc, 1982a). Validity and reliability of the Delineator was established by the developer of the instrument. Gregorc (1982b) reported internal consistency using standardized alphas ranging from .89 to .93. Stability was reported using test-retest correlation coefficients ranging from .85 to .88.

The Cornell Critical Thinking Test – Level Z (Ennis et al., 1985) was administered to determine the critical thinking skills of each student. The Cornell Critical Thinking Test is a nationally used, standardized instrument considered to be a valid measure, as reported by the authors (Ennis et al., 1985). Reliability of this instrument was calculated by Ennis et al., using

Spearman-Brown and Kuder-Richardson 20 and 21 formulas. Reported reliability estimates ranged from .50 to .77.

Both the Gregorc Style Delineator and Cornell Critical Thinking Test were administered to all students in a college leadership development course during the first week of the fall semester, 2002. The Cornell Critical Thinking Test was administered a second time during the last class session of the fall semester. Descriptive statistics were generated on test scores. An independent *t*-test and analyses of variance were used to test hypotheses. An alpha level of .05 was established a priori.

Results

The first objective of this study sought to describe the learning styles of students enrolled in an agricultural leadership development course. According to Gregorc (1982a), most individuals possess more than one preferred style of learning, but one style is often more dominant. Accordingly, almost all participants in this study exhibited more than one learning style (see Table 1).

For females, 62.2% of the participants possessed characteristics of Concrete Sequential learners, followed by Abstract Random (47.6%), Concrete Random (41.5%), and Abstract Sequential (34.1%). A higher percentage of males were classified as Concrete Sequential learners (72.4%). Males also exhibited characteristics of Abstract Sequential (41.4%), Concrete Random (31.0%), and Abstract Random (27.6%) learning styles.

The second objective of this study was to determine critical thinking skills of students enrolled in an agricultural leadership development course. As shown in Table 2, the mean score for all participants on the Cornell Critical Thinking Test was 27.87. The mean critical thinking skill scores of females and males were 28.77 and 26.76 respectfully.

Table 1

Learning Style by Gender (n = 111)

Learning Style ^a	Female		Male		Total	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
CS	51	62.2	21	72.4	72	64.9
AR	39	47.6	8	27.6	47	42.3
CR	34	41.5	9	31.0	43	38.7
AS	28	34.1	12	41.4	40	36.0

^a Assignment to learning style classifications based upon a score of 26 or more in that category on the Gregorc Style Delineator. Note that subjects are classified in more than one category as defined by Gregorc (1982a).

Objective three sought to test the null hypothesis of no differences in the critical thinking skill of students based upon gender. A test of significant difference produced a *t*-value of 1.90 (*p* = .17). Therefore, the null hypothesis of no difference in the critical thinking skill of students based upon gender failed to be rejected.

Table 2

Differences in Critical Thinking Skill by Gender

Gender	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Female (<i>n</i> = 82)	28.77	4.94	1.90	.17
Male (<i>n</i> = 29)	26.76	5.46		
Total (<i>n</i> = 111)	27.87	5.10		

The fourth objective of this study sought to determine the influence of learning styles on the critical thinking skills of students. To test the null hypothesis of no differences in the critical thinking skills based upon learning style, scores were divided into two levels: General and Deeply Embedded learning style preferences. General learning styles are defined by Gregorc as those individuals who score 26 or higher on the 40-point Gregorc Style Delineator. Whereas Deeply Embedded learning styles are defined as those who score 33 or higher on the Gregorc Style Delineator. An analysis of variance revealed no significant differences in the critical thinking skill of students based on their general learning styles (see Table 3). Therefore, the null hypothesis of no difference in the critical thinking skill of students based upon general learning style failed to be rejected.

Based upon Gregorc's (1985) assertion that some individuals have deeply embedded learning style preferences, this study also investigated the differences in the critical thinking skill of students who possess a learning style score in the upper one-third of the Gregorc Style Delineator. (A score of 33 on the Delineator represents the median of the minimum score of 26, which defines a general learning style, and the maximum score of 40.) More explicitly, individuals with scores of 33 or higher on the Gregorc Style Delineator can be thought of as being more purely CS, AS, AR, or CR in their primary style, and likely would only exhibit one preferred style of learning. Therefore, this group of individuals (with scores of 33 or higher in one of the four learning style categories) was analyzed for differences in critical thinking skill.

Table 3

Analysis of Variance of Critical Thinking Skill by General Learning Style^a

Learning Style	<i>df</i>	<i>F</i>	<i>p</i>
CS	23	1.15	.31
AR	23	.99	.49
CR	23	.97	.51
AS	23	1.35	.16

Note: Subjects may be classified in more than one category as defined by Gregorc (1982a)

^a Score of 26 or more on the Gregorc Style Delineator

The fifth objective of this study sought to determine the influence of deeply embedded learning styles on the critical thinking skill of students. No significant differences were found

between the critical thinking skill scores and embedded learning style classification for Concrete Random ($p = .65$), Abstract Random ($p = .54$), or Concrete Sequential ($p = .67$) learners. However, Abstract Sequential learners exhibited significantly higher ($p = .00$) critical thinking skill scores (Table 4). Therefore, the null hypothesis of no differences in critical thinking skill based upon deeply embedded learning style was rejected.

Table 4

Analysis of Variance of Critical Thinking Skill by Deeply Embedded Learning Style^a (n=38)

Learning Style	<i>df</i>	<i>F</i>	<i>p</i>
CS	23	.84	.67
CR	23	.86	.65
AR	23	.94	.54
AS	23	18.30	.00

^a Score of 33 or more on the Gregorc Style Delineator

Conclusions

A majority of both male and female learners were found to possess a preferred Concrete Sequential learning style. This finding supports previous research by Cano and Garton (1994), Garton et al. (1999), Rudd et al. (1998, 2000), and Witkin et al. (1971). This finding also supports the contention that individuals in the field of agriculture typically prefer a learning style that is ordered and problem specific.

Males and females in this study possess similar levels of critical thinking skills. No differences were found between the critical thinking skills of male and female students in this study. This finding contradicts earlier work by Rudd, Baker, and Hoover (2000). However, both studies were clinical by nature. The mean critical thinking ability score of students involved in this study was 27.87. This is slightly lower than the mean critical thinking scores for undergraduate students reported by Ennis et al. (1985). A continuing need exists for research to investigate ways in which student critical thinking ability can be improved.

No significant differences exist between the critical thinking skills of students across general learning styles for students in this study. This concurs with the findings of Rudd, Baker, and Hoover (2000).

Students with deeply embedded Abstract Sequential learning style preferences exhibited significantly higher critical thinking skill scores than students of other deeply embedded learning styles. Although this finding should be interpreted with caution, due to the limited sample size, there are still several items to be noted. According to Gregorc (1985), Abstract Sequential learners tend to base their judgments upon intellect and laws of logic. They are capable of introspection based on scientific rationale and are better able to detach themselves emotionally from a situation. Paul and Elder (2001) noted the ability to think logically and to reflect upon known information are key critical thinking skills. Facione (1990) also noted that by critically examining and critiquing one's own reasoning processes that critical thinking skill could be

improved. Further research is needed to determine the effect of teaching techniques on the critical thinking skill development of students of all learning styles.

Implications/Recommendations

These findings have implications for faculty with teaching appointments in colleges of agriculture. If deeply embedded Abstract Sequential learners are inherently adept at thinking critically, teachers may not need to focus as intently on teaching strategies that address this learning style and can therefore focus more attention on strategies targeting CS, AR, and CR learners. Likewise, instructional methods and techniques that enhance the critical thinking skills of CS, AR, and CR learners should be employed. Further research is needed to identify these teaching strategies.

This study was one of the first to investigate the phenomenon of deeply embedded learning styles. By gaining a better understanding of this group of individuals, it is possible that teaching strategies, methods, and techniques that can be used to assist in the development of critical thinking and other important skills can be identified and improved. Further research that builds upon the foundation laid by this study is needed.

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