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CREATIVE THINKING AND LEARNING STYLES IN UNDERGRADUATE AGRICULTURE STUDENTS

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Abstract

Creativity is multidimensional and still not completely understood by psychologists. Much research has given evidence that cognitive style of creative thinking is independent of cognitive level of creative thinking. However, is a student's learning style similar to their cognitive style of creative thinking? This study attempted to examine the presence or absence of relationships between student learning styles and student creative thinking. To determine this relationship the Torrance Test of Creative Thinking and the Gregorc Style Delineator were given to students enrolled in an oral communication course offered by the Department of Agricultural Education and Communication at the University of Florida. The researchers found no significant relationships between creative thinking ability and learning style, except for Abstract Random learners who scored lower in the creativity constructs of fluency and elaboration. Also, students scored high in the creative construct of elaboration with mean scores in the 99th percentile and originality was the only creativity construct with mean scores below the 75th percentile. The results of this study indicate that more research is needed in the area of learning styles and creative thinking.

Introduction and Theoretical Framework

New ideas continually change our world. In every domain, the increase of knowledge and the communication of this knowledge lead to scientific breakthroughs that make our lives better. This phenomenon requires business firms to seek creative individuals to generate more ideas to maintain the firm's competitive advantage. How do colleges and universities supply firms with graduates capable of producing new ideas? What are the cognitive skills of a creative person?

Scholars in agricultural education have investigated higher order thinking skills, styles of learning, and student achievement, but there have been few attempts involving more than one trait that have been completed to allow faculty members in agricultural disciplines to utilize the findings in college classrooms (Rudd, Baker, & Hoover, 2000). This study attempted to examine both student learning styles and their ability to think creatively and then to identify relationships between the two. That is, does the style by which a student learns correlate with how they creatively think? This inquiry should help faculty members to teach for creativity in light of the relationship (or absence of a relationship) with student learning style.

Learning Styles

Learning style theory asserts that students become successful academically in learning environments that match their own learning style (Kolb, 1984). Although students have a learning style preference, all learners have the ability to learn in settings that conflict with their preferred learning style. Rudd et al. (2000) found that there was no relationship between learning styles and critical thinking or intelligence. Scholars in agricultural education have concluded that learning styles affect student learning (Cano, 1999; Dyer, & Osborne, 1996; Garton, Spain, Lamberson, & Spiers, 1999). These studies found significant relationships

between multiple learning styles and student achievement.

The Gregorc (1982b) Style Delineator divides learning styles into how people acquire information (perception) and how people store information (ordering). Perceptual capabilities are categorized as abstract or concrete while ordering capabilities may be sequential or random. Quadrants are thus formed yielding four mediation channels: Concrete Sequential (CS), Concrete Random (CR), Abstract Sequential (AS), and Abstract Random (AR). Gregorc further asserts that many individuals have a preference for one or two of these channels with little flexibility in adapting to learning situations encompassing different learning styles.

Gregorc (1979) proposed that behaviors assist in determining an individual's learning style; giving evidence to how the individual "learns, operates and adapts to his environment" (p. 234). According to Gregorc (1982a), an individual is dominant in one of the four mediation channels and will have distinct learning preferences. An individual with a CS learning style will approach learning sequentially in a step-by-step linear format. Their thinking process is instinctive and deliberate and their creative skills are focused on the refinement and duplication of an already existing idea (Gergorc). Concrete Random (CR) learners approach learning in random three dimensional patterns. Learners with a CR preference think intuitively and impulsively and their creativity is described as inventive, original and visionary (Gregorc). Individuals possessing an AS learning style order information sequentially with various branches. They think logically and are analytical. An AS learner will express creativity by synthesizing ideas based on theory (Gregorc). Finally, the AR learner orders information randomly in web-like structures. A learner with AR characteristics will think primarily using emotions. Their creativity originates in imagination and the fine arts (Gregorc). Gregorc (1979) further elaborated that the Gregorc Style Delineator only measures the salient variables of perception and ordering, and acknowledged other variables contribute to human behavior.

Even though learning styles have been suggested as a factor affecting student learning, the literature has expressed restrictions on the theory. Price (2004) found inconsistencies between students' self-reported learning style and learning style exhibited. She concluded from the use of the Learning Style Questionnaire, the Group Embedded Figures Test and the Cognitive Style Analysis that "the value of learning style tests is limited" (p. 696) with issues of validity and reliability. Jones, Reichard, & Mokhtari (2003) found that learning styles are "subject area sensitive" (p. 373) with students moving from one learning style quadrant to another based on the learning strategies required for the particular situation.

Creative Thinking

Creativity is still perplexing to many psychologists with many theories unable to completely explain the construct. Research into creative thinking can be divided into the creative product, process, person and place (environment). This study focused on creative thinking skills of the person. Kirton's (1994) Adaption-Innovation Theory separates creative thinking into cognitive style and cognitive level with the two being statistically unrelated. He further elaborates by describing innovators as "undisciplined, looking for alternative avenues of solution and approaching tasks from unsuspected angles" (p. 10); alternatively, he describes adaptors by "precision, reliability, efficiency, prudence, discipline and conformity" (p. 10). An individual who has taken the Kirton Adaption-Innovation (KAI) Inventory is placed on a continuum of adaption and innovation in terms of how they perceive problems.

Much research pertaining to an individual's creative level has been attributed to the work of Guilford (1950; 1975) and Torrance (1998) in developing constructs such as fluency, flexibility, originality, elaboration and redefinition. The Torrance Test of Creative Thinking (TTCT) is an instrument used to measure these constructs. More specifically the TTCT measures creative thinking capabilities including: fluency, flexibility, originality,

elaboration, abstractness of title, resistance to closure, emotional expressiveness, articulateness, movement or action, expressiveness, synthesis or combination, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, and fantasy. Torrance, Orlow, and Safter (1990) stated that creative behavior is not solely determined by these abilities and that the process of creating requires additional knowledge, motivations and skills.

There has been little research presented concerning creativity in the agricultural education literature despite the close link between creativity and problem solving. There is no differentiation between the cognition required for problem solving and that needed for creativity (Kirton, 2003; Torrance & Goff, 1989). However, Baker, Rudd and Pomeroy (2001) used the TTCT and the California Critical Thinking Disposition Inventory (Facione, Facione, & Giancarlo, 1996) to determine the relationship between critical thinking and creative thinking. Their analysis found no significant relationship between the two manners of thought.

The increased interest in cognitive level and cognitive style in the creative thinking literature have lead researchers to examine other measures that could possibly provide insight into these two facets of creativity. Correlations have been found between the TTCT and KAI in the constructs of originality (r = .35), flexibility (r = .33), and elaboration (r = .35) (Kirton, 2003). Kirton argues that these correlations exist because the TTCT is not a pure measure of cognitive level (p. 161). Isaksen and Puccio (1988) called for more research to better understand the interaction between cognitive level and cognitive style.

Torrance (1982) found relationships between the Human Information Processing (HIP) Survey (Torrance, Taggart, & Taggart, 1984), a measure of an individual's problem solving style by left brain, right brain, integrated or mixed, and the Gregorc Style Delineator. Two samples were used in this study. For concrete perceptual capabilities, Gregorc's CS learning style held significant positive correlations with the left hemisphere scale (r = .49 and .67) and correlated negatively (r = -.40 and -.35) with the Right Hemisphere scale. In the same two samples, Gregorc's CR learning style held significant negative correlations (r = -.41 and -.68) with the Left Hemisphere scale and correlated positively (r = .38 and .33) with the Right Hemisphere scale. The findings indicate that sequential ordering was associated with the left hemisphere creative style and that random ordering was associated with the right hemisphere creative style. There were no consistent findings among Gregorc's abstract perceptual capabilities and the HIP in these two samples.

In a study of undergraduate students (N = 135 and N = 109) enrolled in a problem solving class, Joniak and Isaksen (1988) studied the relationships of the Gregorc Style Delineator and the KAI. They found that KAI total scores inversely correlated with Gregorc's learning style construct scores CS (r = -.56) scores and AS (r = -.38) while KAI total scores positively correlated with Gregorc's learning style constructs CR (r = .55) and AR (r = .29) This provides evidence that individuals with sequential ordering are associate with adaptors on the KAI and individuals with random ordering are associated with innovators. However, Joniak and Isaksen discovered the reliability of the Gregorc Style Delineator in this study had low alpha coefficients (α = .23 to .66). These studies give evidence that Gregorc's measure of learning styles associates with cognitive style defined by Kirton. However, what is the relationship of a learning style with a cognitive level?

Purpose and Objectives

This purpose of this study was to explore the relationship between undergraduate students' level of creative thinking and their learning style.

The specific objectives of this study were to:

1. determine selected demographic information;
2. determine student level of creative thinking;
3. determine student learning styles, and;

4. compare student learning styles, student level of creative thinking, and selected student demographic information.

Methods

Students enrolled in Effective Oral Communication (AEE 3030) were selected for this census study. All students at the University of Florida enrolled in the College of Agriculture and Life Sciences are required to take AEE 3030 or an equivalent oral communication course, therefore the class was selected to represent a broad range of majors.

Instrumentation

Demographic data were collected with an instrument developed by the researchers. Items on this instrument were chosen by the researchers based on demographic information frequently found in the literature concerning learning styles (Cano, 1999) and creativity (Baker et al., 2001).

The Gregorc Style Delineator was administered to measure the dominant learning style of students into combinations of Concrete Sequential, Concrete Random, Abstract Sequential and Abstract Random. A score of 27 points or higher in one of the four categories specifies a dominant learning style with each category having a range from 10 to 40 points. It is possible for participants to have more than one learning style (two categories having scores at or above 27 points) or an individual not having any preference for a learning style (no categories have a score at or above 27 points).

The Gregorc Style Delineator was developed through phenomenological methods instead of an empirical approach (Benton, 1995). Gregorc (1982b) reported reliability alpha coefficients of .89 to .93 and predictive validity correlations of .55 to .76. However, many questions have been raised concerning this instrument. Because the sum of scores for each construct always equals 100, there is no reflection of intensity of a learning style in relation to the other scales; therefore (Benton, 1995) questions if a higher score really indicates a dominant style. In a factor analysis, Joniak and Isaksen (1988) found only 4 to 6 of the 40 words used as describers on the Gregorc Style Delineator loaded on each of the four constructs. The author of the instrument has affirmed that the Gregorc Style Delineator "should not be relied on for predictive or diagnostic purposes" (Ferro, 1995, ¶ 6) until further research is conducted. Despite these limitations, the Gregorc Style Delineator's correlation with other levels of cognitive style justified the use of this instrument.

The TTCT provides quantitative standardized scores and national percentiles for the following constructs: 1. fluency – the ability to produce a number of interpretable and meaningful ideas; 2. originality – unusualness or uncommonness of response; 3. elaboration – number of details that contribute to an idea or response; 4. abstractness – ability to produce good titles capturing the essence of the idea or response; 5. resistance to premature closure – ability to delay closure long enough for original ideas to be possible. Intra-rater reliability coefficients are reported by the developer above the .90 level with content and construct validity established (Torrance et al., 1990).

Torrance (1974) determined predictive validity of the TTCT by measuring quantity of creative achievements, quality of highest creative achievement, and creativeness of future aspirations (N = 46). After six years, results yielded validity coefficients of .50, .46, and .51 respectively with the TTCT total creative thinking score. In a longitudinal case study of 40 years (N = 18), Millar (2002) found predictive validity of the TTCT by interviewing participants and observing creative achievements of students who scored high on the TTCT in 1958. Problems with the TTCT include measuring the construct of originality; which was based on frequencies of 500 unknown participants with no empirical evidence of scoring criteria (Chase, 1985). The variable "creative strength" (¶ 12) is also unclear. The TTCT does not measure every facet of creativity (Treffinger, 1985), which has never been the claim of the developer. Clapham (2004) found that divergent thinking is multidimensional and instruments measuring creativity are not

interchangeable. This includes the TTCT Verbal instrument and the TTCT Figural instrument which only shared 12.96% of their variance even though the two instruments presume to measure divergent thinking. Given the above limitations, the TTCT is "the most researched and analyzed instrument among those available" (Treffinger, 1985, ¶ 9) in measuring creative thinking.

The Torrance Test of Creative Thinking – Form A (Figural), Gregorc Style Delineator and an instrument asking demographic information were administered to students in the oral communication course, AEE 3030. The TTCT was scored by the researchers who were trained by Scholastic Testing Service, Inc. and cross checked by another trained individual not associated with this study. A bi-variate correlation procedure was used to calculate Pearson's correlation coefficient to determine relationships. Descriptive statistics and cross-tabulations were used to determine frequencies.

Results and Findings

The TTCT had a post-hoc reliability alpha coefficient at .81 and the Gregorc Style Delineator had post-hoc reliability alpha coefficients for the constructs of CS ($\alpha = .72$), AR ($\alpha = .70$), AS ($\alpha = .49$) and CR ($\alpha = .64$).

The first question addressed by this study was to determine selected demographic information of the participants. A total of 110 students participated in the study. The population consisted of 69 females and 41 males. The majority of the students were sophomores (51.8%) with a mode age of 19 years. A total of 27 majors were represented with only one major (microbiology) contributing to more than 10% of the population. The self-reported ethnicities of the students were Caucasian (59.1%), Hispanic (13.6%), Asian (11.8%), African American (10.9%) and other (4.5%). Students in this class held a self-reported cumulative GPA mean of 3.28 ($SD = 0.47$).

The second question addressed by this study was to determine the student level of creative thinking as determined by the TTCT. The mean total score of the TTCT of this population was 122.1 ($SD = 17.9$) ranking them in the 80th percentile. The scores ranged from a low score of 51.0 (1st percentile) to a high score of 160 (99th percentile). A total of 22 students scored below the 50th percentile, while a total of 16 students scored at the 99th percentile. Means of the subscale scores for the population include: elaboration 137.0 (99th percentile), resistance to closure 111.6 (85th percentile), abstractness of title 110.9 (83rd percentile), fluency 108.7 (78th percentile), and originality 102.4 (60th percentile) (Table 1).

Table 1
Average Scores of Creative Thinking (N = 110)

Creative Thinking Construct	*M*	National Percentile	*SD*	Min	Max
Elaboration	136.96	99	20.93	68	160
Resistance to Closure	111.58	85	21.80	67	148
Abstractness of Title	110.93	83	28.30	0	160
Fluency	108.69	78	22.03	56	154
Originality	102.35	60	23.63	40	150
Total Score	122.10	80	17.87	51	160

The third question addressed by this study was to determine learning styles of the participants. The Gregorc Style Delineator categorizes participants who score between 27 and 40 points as having a dominant learning style. Students in this population were categorized as a combination of CS and AS styles (20.9%), a combination of AR and CR styles (20.0%) and an additional 17.3% of the students were categorized as CS learning styles (Table 2).

Table 2
Learning Styles by Gender (N = 110)

	Total		Male		Female	
Learning Style	*f*	%	*f*	%	*f*	%
CS-AS	23	20.9	10	24.4	13	18.9
AR-CR	22	20.0	9	22.0	13	18.9
CS	19	17.3	6	14.6	13	18.9
CR	13	11.8	8	19.5	5	7.2
AR	11	10.0	2	4.9	9	13.0
CS-CR	9	8.2	3	7.3	6	8.7
AS	5	4.5	1	2.4	4	5.8
CS-AR	3	2.7	0	0.0	3	4.3
AS-CR	3	2.7	2	4.9	1	1.4
AS-AR	2	1.8	0	0.0	2	2.9

Note. Scores at 27 or higher determined dominant learning style.

The fourth question addressed by this study was to compare student learning styles, student level of creative thinking, and selected student demographic information. Slight significant positive and negative correlations were found within the data when comparing dominant learning styles with demographic information. Considering gender, 36.2% (n = 25) of the females held an AR dominant learning style. Furthermore, there was small significant correlation (r = .249) between gender and the AR learning style. Females were more likely to be AR learners than were males. Gender also displayed a small significant correlation (r = .206) with the CR dominant learning style, with 53.7% (n = 22) of the males in the population as CR dominant learners. The data revealed a small, significant correlation between the CS dominant learning style and self-reported cumulative GPA (r = .239). A large majority 87.0% (n = 47) of the CS dominant learners reported a GPA higher than a 3.0. Additionally in this class, the AS dominant learning style correlated (r = .228) with self-reported GPA. This corresponds with 45.5% (n = 15) of AS dominant students in this class having a GPA between 3.0 and 3.5 (Table 3).

Table 3
Dominant Learning Style by GPA (N = 110)

	GPA >3.75		GPA 3.5-3.75		GPA 3.0-3.5		GPA 2.0-3.0		GPA 1.0-2.0	
Learning Style	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
CS	13	24.0	10	18.5	24	44.4	5	9.3	0	0.0
CR	4	8.5	7	14.9	23	48.9	11	23.4	2	4.2
AS	7	21.2	7	21.2	15	45.5	2	6.1	0	0.0
AR	3	8.3	8	22.2	16	44.4	8	22.2	1	2.8

Note. Individuals can be classified in more than one dominant learning style resulting in greater frequencies than individuals. Percentages reported as total within GPA category.

One significant correlation was discovered when comparing TTCT scores by students' demographic information. Considering gender, a correlation was found with the creative thinking construct of elaboration (r = .374). This corresponds with 69.6% (n = 48) of females scoring in the 99th percentile; while less than half (43.9%) of males scored in the 99th percentile in elaboration (Table 4).

Table 4
Correlations of Creative Thinking and Selected Demographics (N = 110)

Creative Thinking Construct	Gender	Cumulative GPA	Major	Class Status
Elaboration	.374*	.067	.164	-.127
Resistance to Closure	-.004	-.134	-.024	.008
Abstractness of Title	-.047	.114	.068	-.134
Fluency	.077	.122	.095	.054
Originality	.080	.050	.054	.050
Total Score	.125	.078	.118	-.097

*p < .05

Minor correlations were discovered comparing constructs of creative level by dominant learning styles. Students categorized as an AR dominant style learner expressed a small negative correlations with fluency and originality (r = -.206 and -.223) (Table 5).

Table 5
Correlations of Creative Thinking and Learning Styles (N = 110)

	Learning Style			
Creative Thinking Construct	AR	CR	AS	CS
Fluency	-.206*	-.011	.031	.182
Originality	-.223*	-.128	.180	.186
Elaboration	.072	.043	.030	-.139
Abstractness of Title	-.060	-.028	.084	.012
Resistance to Closure	-.071	.093	-.124	.083
Total Score	-.111	.023	.048	.042

*p < .05

Conclusions

The students participating in this study were predominantly female (62.7%) and represented 27 majors. The mode age was 19 years. Individuals were mostly Caucasian (59.1%) with the remainder of the students attributing to a diverse population of Hispanic (13.6%), Asian (11.8%), African American (10.9%), and other (4.5%). No correlations were found between ethnicity and creative thinking ability.

According to the TTCT, students' mean total creative thinking ability score (M =

122.1) was relatively high at the 80th percentile. Students scored incredibly high in the TTCT construct of elaboration with the mean (M = 136.96) at the 99th percentile. Specifically, 48 females (69.6%) scored in the 99th percentile in the construct of elaboration, while 18 males (43.9%) scored at the same level in elaboration.

Approximately one third (36.2%) of the females in the population were AR dominant learners, while approximately half (53.7%) of the males in the population were CR dominant learners. There were significant correlations concerning learning style and self-reported cumulative GPA. In a particular area of interest, correlations were found with CS dominant learning style and self-reported higher cumulative GPA with 87.0% (n = 47) of CS learners having above a 3.0. Furthermore, 27.7% (n = 13) of CR dominant learners held a cumulative GPA at or less than 3.0.

There were no correlations between learning styles and creative thinking ability; except for negative associations found between AR and the creativity constructs fluency and originality. According to Kirton's (1994) Adaption-Innovation Theory of cognitive style, all people have original ideas. However, adapters tend to produce a smaller number of original ideas that tend to be more relevant, sound, and useful; while innovators generate a larger number of original ideas of which many are not as sound, relevant or useful. If adaptors tend to have sequential perceptual capabilities and innovators tend to have random perceptual capabilities (Joniak & Isaksen, 1988) then this study's findings conflict with previous research.

The Gregorc Styles Delineator suffered from poor reliability alpha coefficients for the constructs of AS (α = .49) and CR (α = .64). Despite the questions raised concerning this instrument, it may have potential to be a measure of cognitive style of creative thinking defined by Kirton (1994), if further researched and developed.

Recommendations and Implications

Creative thinking is multidimensional with many factors contributing to the construction of an idea. Why did the creative thinking construct of elaboration score high in this study? More research is needed to determine if course design and teaching methodology has an affect on elaboration as well as other constructs of creative thinking. Furthermore, gender was a significant variable in the creative ability construct of elaboration. Females tended to score high in elaboration with 69.6% (n = 48) of the females scoring in the 99th percentile. Why does this exist? More research is needed to account for variables that can distinguish these differences.

Originality was the only creative thinking construct with mean scores below the 75th percentile. Why is this construct lower than other constructs of creative thinking? Given that originality is a construct measured by both instruments of style and ability (Isaksen & Puccio, 1988), more research is needed to examine the construct of originality and how it can be accurately measured. Faculty at the University of Florida may need to focus instruction to support students' ability to form original ideas.

It is important to realize the slight relationship between learning style and creative thinking. Is learning style (Gregorc, 1982a) and cognitive style (Kirton, 1994) of creative thinking synonymous? This study only used one type of learning style, however many others exist. Learning style research may bring potential contributions to understanding creativity if learning styles can be accurately measured (Price, 2004). More research is needed to identify the significance of learning styles as a component of creative thinking and its implications in creatively solving problems.

Learning styles were significantly related to the students' self-reported cumulative GPA with CS learners having higher cumulative GPA and CR learners having a lower cumulative GPA. If this is true, university faculty need to rethink their teaching methodology and design instruction to meet the needs of other learning styles; especially if style is not related to intelligence (Kirton, 2003).

Many questions were raised about the Gregorc Style Delineator, but it may have potential to measure a style of creative

thinking. Still, the researchers recommend that the Gregorc Styles Delineator not be used until it is further researched and developed.

This study is limited to the population studied and the reader should not apply the results beyond this population of students. However, many questions are raised for additional research. It is the researchers' hope that further investigation of cognitive style and cognitive level will improve curriculum to meet the demands of businesses' need for creative individuals.

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