Demographic Predictors of Critical Thinking Ability in Undergraduate Animal Science Students

L.M. White[1]
New Mexico State University
Las Cruces, NM

M.M. Beck, G. Birrenkott, P.A. Skewes and K.D. Layfield
Clemson University
Clemson, SC

Abstract

Background information may provide useful indication of ability to think critically and aid instructors in fostering the critical thinking process. Descriptive factors that may predict critical thinking ability include: age, gender, grade point average (GPA), classification and extracurricular activities. The focus of this study was to quantify the critical thinking ability of animal science students and determine what differences in their demographic information exist. The Watson-Glaser Critical Thinking Appraisal (WGCTA) exam provided means to objectively measure critical thinking ability of students enrolled in required animal science courses. Each student completed a questionnaire determining demographic information. Several demographic characteristics demonstrated higher scores on the WGCTA; students in the 18-20 age range ($P = 0.0039$), those who reported ≥ 3.5 GPA ($P = 0.003$) and those who had evaluation experience in an organized youth or collegiate judging team or participated in an evaluation course ($P = 0.00067$). Gender and classification do not appear to accurately describe critical thinking ability. Important considerations for educators include encouraging critical thought from all students, regardless of age. Further, an evaluation course is an important component of animal science curricula and early evaluation experience in programs such as 4-H and FFA may be beneficial when developing critical thinking skills.

Introduction

Challenges faced by American colleges and universities are numerous. Graduating a student capable of critical analysis and proficient at making independent real-world decisions is an ultimate goal (Barrie, 2006; Karantzas et al., 2013; Moore, 2004). Historically, university graduates lack some higher order thinking skills (Behar-Horenstein and Niu, 2011). We believe critical thinking consists of a mental process that utilizes a person's ability to identify and assess a situation, understand and recognize possible relationships between previously learned material and make an informed judgment which is a result of base knowledge interacting with a variety of personal perspectives and subjective focuses. A better understanding of approximate critical thinking ability is advantageous to identify learning endeavors most valuable for developing curricula, augmenting course design and supporting significant programs that enhance critical thinking at a young age.

Multiple demographic predictors have been studied to identify their influence on critical thinking ability, including: age, gender, grade point average (GPA), classification, overall involvement in on-campus clubs and interaction with faculty and peers (Gellin, 2003; Ricketts and Rudd, 2005; White et al., 2012). Evaluation of animals or products is a historically important component of an agriculture curriculum and thought to increase higher order thinking in participating students (Nash and Sant, 2005; White et al., 2012). Therefore, this study sought to determine if demographic information such as gender, age, classification, GPA and previous judging experience are reliable indicators of critical thinking ability in undergraduates majoring in animal science.

Materials and Methods

Three upper level courses required in the major were selected to represent the undergraduate population of animal science students at Clemson University. Students completed a researcher-designed questionnaire (Figure 1) and the Watson-Glaser Critical Thinking Appraisal (WGCTA) exam. All testing and observation was approved by the Institutional Review Board (IRB) at Clemson University.

[1]Corresponding author: MSC 3-I, PO Box 30003 Las Cruces, NM 88003; Lmwhite@nmsu.edu; Ph: 575-646-5595

Figure 1.

Name: Testing No.:

Please take your time to answer every question truthfully and to the best of your ability.

1. Please indicate your classification by circling the appropriate response:

Freshman Sophomore Junior Senior

2. Please indicate your age by circling the appropriate range:

18-20 21-24 >24

3. Please indicate your GPA by circling the appropriate range:

< 1.5 1.5 – 2.0 2.1 – 2.4 2.5 – 2.9 3.0 – 3.4 > 3.4

4. Please indicate your gender by circling the correct response:

Male Female

5. Have you ever been involved in a judging program before (i.e.: 4-H, FFA, or evaluation class in college; must be at least 1 semester of experience)?

Yes No

Researcher developed demographic questionnaire for students enrolled in upper level courses in the Animal Science at Clemson University. In 2008, students (n=81) took the Watson-Glaser Critical Thinking Appraisal exam to determine approximate critical thinking ability. Demographic information about the students was compared to their critical thinking scores to determine if any correlations exist.

Population

The target population included all students enrolled in the animal and veterinary science curriculum. The sample population (n=81) consisted of students enrolled in three upper level courses within the department of Animal and Veterinary Sciences at Clemson University. Four students were enrolled in more than one of the courses utilized simultaneously, but were only counted once in the data set. These upper level courses were chosen because all undergraduate students take the courses to receive a Bachelor's of Science degree in Animal and Veterinary Sciences.

Instrumentation

The WGCTA test, form A and B, from Pearson (San Antonio, TX) assessed each student's critical thinking ability. The WGCTA seeks to provide an estimate of an individual's standing on a composite of attitude, knowledge and skills by means of evaluating the student's ability to think critically in five categories; 1) Inference, 2) Recognition of Assumptions, 3) Deduction, 4) Interpretation and 5) Evaluation of Arguments. The Inference section requires the test taker to discriminate among degrees of truth or falsity of inferences drawn from given data. Recognition of Assumptions requires the ability to recognize unstated assumptions or presuppositions in given statements or assertions. Deduction entails determining whether certain conclusions necessarily follow from information in given statements or premises. Interpretation consists of weighing evidence and deciding whether generalizations or conclusions based on the given data are warranted.

Finally, Evaluation of Arguments distinguishes between arguments that are strong and relevant or weak and irrelevant. The components include problems, statements, arguments and interpretations of data. All components are aimed at mimicking real-world situations one might encounter at work, school or in newspaper and magazine articles. Validity and reliability have been established for the WGCTA by the respective authors with a reliability coefficient of 0.74 (Watson and Glaser, 1980). Another study that utilized the WGCTA for high school students (n=384) yielded a reliability coefficient of 0.78 (Cano, 1993). Researchers in Texas found that the WGCTA exam remained reliable and consistent when given to undergraduate and graduate students (n=58) at Southwestern State University (Gadzella et al., 2005).

Students were asked to complete a 5-item researcher designed questionnaire (Figure 1) to determine demographic information at the beginning of the semester in each of the courses. The questionnaire was utilized to formulate correlations between specific demographic information and critical thinking ability as measured by the WGCTA exam. The questionnaire identified characteristics of each student with respect to age, gender, classification, GPA and previous judging experience. Characteristics were self-reported by the student and therefore may be subjective.

Data Analysis

Data were coded and analyzed using Microsoft Office Excel (descriptive statistics) and SPSS 17.0.1 for Mac OS X. Descriptive statistics utilized included means, averages and percentages. All standard deviations reported are for the samples and not the mean. To determine relationships between critical thinking skill level and certain demographic and descriptive attributes of students (and interactions between demographic indicators), a multivariate ANOVA and Pearson's correlation were utilized. A Tukey test was conducted to determine relationships among some variables. Differences were considered significant when $P < 0.05$ and a trend for significance was assessed when $0.15 > P > 0.05$.

Results and Discussion

Mean score for all students on the WGCTA exam was 58.4 ± 7.0 on an 80 point scale which is slightly above national standards for undergraduate students.

Gender

Participants in the study were 79% female (n=64), which is consistent with the target population. No significant differences ($P = 0.47$) between genders with regard to critical thinking ability was found in this sample group. Results from this study are concordant with others who observed no significant influences of gender on the ability to think critically (Friedel et al., 2006; Ricketts and Rudd, 2005; Torres and Cano, 1995). In contrast, Wilson (1989) observed gender as a significant indicator of critical thinking skill in college freshmen using the WGCTA exam.

Age and Classification

Logically, as age increases, so would maturity and the ability to think at a higher level of cognition, however,

the opposite of expected was seen in the current study. Students were grouped by age: 18-20; 21-24; and >24. There were 42 students in the 18-20 group, 37 in the 21-24 group and 2 in the >24 group (Table 1). Because the >24 group was small, data was combined with the 21-24 group. Students in the 18-20 age range scored significantly higher (P = 0.0039) than students in the 21+ category (64.2 ± 6.34 vs. 58.4 ± 7.65, respectively). Age results are presented in Table 1. Critical thinking ability was comparable (P ≥ 0.44) across classification of sophomores (n=24); juniors (n=32); and seniors (n=25); no freshman were enrolled in the upper-level courses studied (Table 2).

Many researchers investigating critical thinking ability related to demographic information reported that age had no significant effects on critical thinking ability (Facione, 1990, 1991; Jenkins, 1998; Rudd et al., 2000; and Ricketts and Rudd, 2005). Cano (1993) found conflicting results regarding the influence of age on the cognitive level of performance associated specifically with critical thinking abilities, using the Developing Cognitive Abilities Test (DCAT) and the WGCTA exam. Researchers reported significant differences between senior students' and freshman/sophomore students' scores (48.71 and 43.81/ 47.45, respectively) on the DCAT. However, the WGCTA showed no effects of age on final scores using the same students. Previously, Cano and Martinez (1991) observed similar results of increased cognitive score with regard to age/grade level using the DCAT to test high school agriculture education students. The DCAT measures multiple constructs and characteristics of higher order thinking, including critical thinking, while the WGCTA only measures a student's ability to think critically.

Age may be an indicator of ability and competence for higher order thinking in general, including critical thinking ability. Although as age and assumed maturity increase, in these findings, critical thinking ability was lowest for the older students. The higher critical thinking scores for the younger population is most likely due to the individuals enrolled in the courses sampled. The youngest students were enrolled in upper level courses potentially ahead of their peers and might have higher cognitive abilities than their counterparts with more drive to perform well on exams, which will be expanded on in the next section.

Table 1. Watson-Glaser Critical Thinking Appraisal (WGCTA) exam results for student age categories.

	18-20	21-24	P value
n	42	39	
WGCTA Score	64.2	58.4	0.0039
Standard deviation of the sample	6.34	7.65	

In 2008, students (n=81) enrolled in the Animal and Veterinary Sciences department at Clemson University completed a 5-item investigator developed demographic questionnaire to determine student age and completed the WGCTA exam to determine critical thinking ability. A multivariate analysis of variance was utilized to determine if a correlation between critical thinking ability and student age existed.

Table 2. Watson-Glaser Critical Thinking Appraisal (WGCTA) exam results for student classification categories.

	Sophomore	Junior	Senior	P value
n	24	32	25	
WGCTA Score	60.3	59.3	60	≥ 0.44
Standard deviation of the sample	6.05	7.35	7.27	

In 2008, students (n=81) enrolled in the Animal and Veterinary Sciences department at Clemson University completed a 5-item investigator developed demographic questionnaire to determine classification and completed the WGCTA exam to determine critical thinking ability. A multivariate analysis of variance was utilized to determine if a correlation between critical thinking ability and student classification existed.

GPA

Students were grouped into five GPA categories. Only 2 students fell in 1.5-2.09 category (2 %), 8 in the 2.1-2.49 (10 %), 25 students fell in the 2.5-2.99 (31 %), 22 in the 3.0-3.49 (27 %) and 24 fell in the ≥ 3.5 range (30 %). Because of low sample size, the 1.5-2.09 and 2.1- 2.49 groups were combined (Table 3). Students in the ≥ 3.5 GPA category scored significantly higher (P = 0.003) on the WGCTA than the 2.5 – 2.99 category and tended to score higher than the ≤ 2.49 (P = 0.129) group (Table 4). The youngest age group (18-20) had a Pearson's correlation coefficient of 0.76 (P < 0.01) with the highest GPA group (>3.5). Obviously the younger students were high performing students, as evidenced by their correlation to the highest GPA category and higher WGCTA scores. Conceivably, students with a higher critical thinking skills also score higher on standardized tests and have higher GPA's. GPA has been a significant predictor of critical thinking ability and in some cases, the only useful predictor (Giancarlo, 1996; Jenkins, 1998; Thompson, 2001).

Table 3. Watson-Glaser Critical Thinking Appraisal (WGCTA) exam results for grade point average categories.

	≤2.49	2.5-2.99	3.0-3.49	≥3.5
n	10	25	22	24
WGCTA Score	59.39	58.13	60.77	64.83
Standard deviation of the sample	6.55	6.50	7.12	6.13

In 2008, students (n=81) enrolled in the Animal and Veterinary Sciences department at Clemson University completed a 5-item investigator developed demographic questionnaire to determine GPA and completed the WGCTA exam to determine critical thinking ability.

Table 4. Tukey test results for undergraduate student grade point average (GPA) categories based on the Watson-Glaser Critical Thinking Appraisal exam scores reported in Table 2.

GPA categories		Mean Difference	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
≤ 2.49	2.5-2.99	1.26	2.44	.955	-5.15	7.68
	3.0-3.49	-1.38	2.51	.946	-7.96	5.19
2.5-2.99	≥ 3.5[b]	-5.44	2.46	.129	-11.89	1.01
	≤2.49	-1.26	2.44	.955	-7.68	5.15
	3.0-3.49	-2.64	1.90	.510	-7.64	2.35
3.0-3.49	≥ 3.5[a]	-6.70	1.84	.003	-11.53	-1.87
	≤ 2.49	1.38	2.51	.946	-5.19	7.96
	2.5-2.99	2.64	1.90	.510	-2.35	7.64
≥ 3.5	≥ 3.5	-4.06	1.92	.158	-9.1	.98
	≤ 2.49[b]	5.44	2.46	.129	-1.01	11.89
	2.5-2.99[a]	6.70	1.84	.003	1.87	11.53
	3.0-3.49	4.06	1.92	.158	-.98	9.1

Students were grouped by grade point average (GPA), ≤ 2.49 (n=10); 2.5-2.99 (n=25); 3.0-3.49 (n=22); and ≥ 3.5 (n=24). In 2008, students (n=81) enrolled in the Animal and Veterinary Sciences department at Clemson University completed a 5-item investigator developed demographic questionnaire to determine GPA and completed the WGCTA exam to determine critical thinking ability. Within GPA categories, the superscript letter "a" indicates a critical thinking difference (P = 0.03) and the superscript letter "b" indicates trend for a difference in critical thinking ability (P = 0.13).

Table 5. Watson-Glaser Critical Thinking Appraisal exam results for students who had previous judging experience and for students without prior judging experience.

	Judging	Non-Judging	P value
n	42	39	
WGCTA Score	64.3	57.9	0.00067
Standard deviation of the sample	4.9	7.1	

Previous judging experience was characterized as completion of a formal university course, collegiate evaluation team experience, or youth (4-H/FFA) training. In 2008, students (n=81) enrolled in the Animal and Veterinary Sciences department at Clemson University completed a 5-item investigator developed demographic questionnaire to determine previous judging experience and completed the WGCTA exam to determine critical thinking ability. A multivariate analysis of variance was utilized to determine if a correlation between critical thinking ability and student evaluation experience existed.

Previous Judging Experience

Students were asked to indicate their level of experience with evaluation (judging) training. Students with one semester or more of evaluation experience (n=42) characterized as completion of a formal university course, collegiate evaluation team experience, or youth (4-H/FFA) training were categorized separate from students who had no evaluation experience whatsoever (n=39). Students who had been involved in previous evaluation/judging activities scored significantly higher (P = 0.00067) on the WGCTA compared to students who had no previous judging experience (64.3 ± 4.9 vs. 57.9 ± 7.1, respectively) (Table 5).

These findings agree with previous research reporting that students who had participated on a competitive collegiate judging team demonstrated higher critical thinking scores compared to their peers who had no previous evaluation training (White et al., 2012). Evaluation training is perceived to benefit students in a number of ways, including improving problem solving skills and increasing higher order thinking capabilities (Nash and Sant, 2005).

Summary

The results of the current study suggest there are several useful predictors of an undergraduate's ability to think critically. We recommended that opportunities for critical thinking be built into every possible classroom situation and instructors realize that not every student will reach the same level of critical thinking ability during any given semester. Educators need to recognize that the best performing students (≥3.5 GPA) are not the only students capable of critical thought and to employ challenges that assist all students in developing enhanced skills in critical thought processes. Further, younger students are well equipped to think critically and instructors should expect more independent thought from these students. In the past it was thought students early in their college career lacked critical thinking abilities (Tsui, 1999), an assumption that is not corroborated in the current research. The current study brings to light the lessened critical thinking ability of the older students compared to the younger students, which has not been reported before. Most likely the younger students in this study are the highest achieving of their peers as they are enrolled in upper level courses potentially ahead of schedule. Most importantly, evaluation training may be beneficial to enhancing critical thinking ability of animal science undergraduate students and should be included as an important component of the curricula in an animal science program. This finding is also a strong advocate for including evaluation training through early learning programs such as 4-H and FFA.

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