Assessment of the Critical Thinking Skills in an Animal Science Curriculum

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What is Critical Thinking?

- “a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information for which an incontrovertible solution is unlikely” (Rudd, Baker, & Hoover, 2000, p. 5).

Review of Literature

- Critical Thinking Assessments
  - Animal Science Department Utilizes the Critical Thinking Assessment Test (CAT) by Tennessee Technological University
    - STEM Based Questions
    - Fifteen Essay Questions
      - Four CT Domains:
        - » Evaluate and Interpret Information
        - » Problem Solving
        - » Creative Thinking
        - » Effective Communication
    - Faculty and staff score the exams according to a provided rubric

Background of Critical Thinking in the Animal Science Curriculum

- Fall 2013- Critical Thinking Assessment was performed on Seniors in Animal Science program
  - Utilized the Critical Thinking Assessment Test (CAT)
  - Senior scored:
    - At national norm for overall domains ($p<0.05$)
    - Seniors scored significantly below national norm
      - Skill Three: “Provide alternative explanations for a pattern of results that has many causes” ($p<0.05$)

Questions Left Unanswered from 2013 Critical Thinking Study

- What impact does the Department of Animal Science curriculum have on the animal science student's critical thinking skills?
- What are the levels of critical thinking when the students enter the program?
- Where are critical thinking skills being taught in the curriculum?
- Are instructors effectively teaching critical thinking in their courses?

Objectives of Study

1. Compare Freshmen and Senior Animal Science students to the national critical thinking skill norms
2. Determine if there's a difference between freshmen and senior Animal Science students in critical thinking
3. Determine if there's a difference in critical thinking skills based upon selected demographic variables

Methods of Study

- Instrument
  - Critical Thinking Assessment Test (CAT)
- Participants
  - Freshmen (n=55): 17 males, 38 females
  - Seniors (n=60): 13 males, 47 females
- Data Collection
  - Students were enrolled in: AnS 110 or AnS 411
  - Freshmen: came to the university from high school
  - Seniors: took all their core animal science courses at the university

Assumptions and Limitations

- Assumptions:
  - Groups of students were randomly sampled to represent the department's population
  - Senior group had similar life and coursework experiences

- Limitations:
  - Number of students
  - Time
    - The same student wasn't tested as a freshmen and then as a senior

Objective One: Results

Freshmen

Skill Assessed by CAT	National Mean	Institution Mean	Effect Size
Q10) Separate relevant from irrelevant information	3.01	3.51**	+0.56
Q12) Use basic math skills when solving a real-world problem	0.75	0.89*	+0.37
Total CAT Score	13.66	15.19*	+0.32

Note: Significant at *p<.05, **p<.01

Objective One: Results

Seniors

Skill Assessed by CAT	National Mean	Institution Mean	Effect Size
Q2) Evaluate how strong data supports a hypothesis	1.21*	0.92	-.027
Q7) Identify additional information needed to evaluate a hypothesis	0.82**	0.57	-0.4
Q15) Explain how changes in a real-world problem situation might affect the solution	1.15**	0.69	-0.51
Total CAT Score	19.04*	17.47	-0.28

Note: Significant at *p<.05, **p<.01

Objective One: Conclusions

- Department of Animal Science **Freshmen** are able to critically think above the level of peer institutions

- Department of Animal Science **Seniors** are not able to critically think at the level of peer institutions

Objective One: Recommendations

- Typically, coursework starts at the lowest level of cognitive thinking and work the students up (Fisher and Grant, 1983)

- Challenge the freshmen right away in the program
  - Above national norm= start a higher level of critical thinking

Objective Two: Results

Overall Score Comparison

Grade Level	Std. Error	Mean
Freshmen	0.68	15.19
Seniors	0.73	17.47*

Note: Significant at *p<.05

Objective Two: Results

Critical Thinking Domains

CT Domain	Freshmen	Seniors	p- value
Evaluate and Interpret Information	1.19	1.35	0.03*
Problem Solving	1.26	1.41	0.08
Creative Thinking	0.8	0.97	0.02*
Effective Communication	0.92	1.14	0.01*

Note: Significant at *p<.05

Objective Two: Results

Individual Skill Comparison

CT Skill	Senior Mean	Freshmen Mean	p-value
Q3) Provide alternative explanations for results	1.10	0.71	0.03*
Q5) Evaluate whether information supports a hypothesis	0.72	0.55	0.05*
Q11) Use and apply relevant information	1.28	1.00	0.03*
Q13) Identify solutions for a problem	1.22	0.80	0.02*

Note: Significant at *$p<.05$

Objective Two: Conclusions

- There's a significant difference between the two grade levels ability to critically think
  - Might have multiple factors to cause the change
- Even with change in the two grade levels, seniors don't achieve the level that other institutions are providing for their students

Objective Two: Recommendations

- Start at a level of critical thinking according to the freshmen's ability
- Integrate critical thinking in curriculum as the overall outcome of the program (Broadbear, 2012; Swartz, 2000)
- Implement new teaching techniques
  - Problem-solving based assignments (Wagner, 2008)
  - Assignments, assessments, and outcomes must align (Haynes et. al., 2016)

Objective Three: Results

Gender

Gender	Std. Error	Mean
Male	0.86	14.87
Female	0.51	16.91

No Significance Found

Objective Three: Results Gender within Grade Level

Level and Gender	Mean	Std. Error
Male, Freshman	14*	1.34
Male, Senior	16	1.30
Female, Freshman	15.72	0.76
Female, Senior	17.88*	0.68

Note: Significant at *p<.05

Objective Three: Conclusions

- No difference within gender for critical thinking skills
- There is a difference between freshmen males and senior females

Objective Three: Recommendations

- No further research needed for gender based study in critical thinking skills
- Focus on other demographics in future studies

Impact on Animal Science Curriculum

- Importance of the studies:
  - Most employers (75%) want colleges to put an emphasis on critical thinking skills
  - According to employers they want their employees to have learned critical thinking skills in school not in the industry

  (Scanlon, Bruening, & Cordero, 1996; AACU, 2013)
- This study provides department personnel:
  - Students' critical thinking skills
  - Provides base knowledge for further research

Further Research

- Analysis on the specific teaching techniques and assessments tools being utilized in the curriculum for alignments and effectiveness
- Research the alignment of the courses and goals and outcomes of the curriculum
- Implement follow up assessments for continuous collaboration between courses to ensure the courses are building upon one another

Questions?

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