Cognitive Tasks Required in Undergraduate Courses: A Comparison of Agriculture and Other Students

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Cognition

- The mental processes by which “sensory input is transformed, reduced, elaborated, stored, recovered, and used.”
  – Neisser, 1967
Bloom's Taxonomy
(Geib, 2006)

- **knowledge**
  - recall
  - understanding
  - using knowledge in new situations
  - breaking things down critical thinking
  - putting things together creative thinking

- **comprehension**

- **application**

- **analysis**

- **synthesis**

- **evaluation**
  - judgement

Knowledge Rentention
Foundation for higher order thinking
Previous Research

• Ewing and Whittington (2009)
  – 21 university agriculture class sessions (12 instructors)
    • 62% of all professor discourse at knowledge or comprehension levels
    • 52.3% of courses had NO professor discourse at synthesis or evaluation levels of cognition
    • 60% of student thought was non-course related
    • 62% of course-related thought was at the knowledge or comprehension level

Results are consistent with those of numerous researchers
## Previous Research

Cognitive Levels by Teaching Method among Five Professors Recognized for Teaching Excellence*

<table>
<thead>
<tr>
<th>Teaching Method</th>
<th>Percent of Class Time (16.1 hrs. total)</th>
<th>Modal Cognitive Level</th>
<th>Highest Cognitive Level Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>45.6</td>
<td>Knowledge (56%)</td>
<td>Synthesis</td>
</tr>
<tr>
<td>Cooperative Learning</td>
<td>26.7</td>
<td>Application (78%)</td>
<td>Application</td>
</tr>
<tr>
<td>Questioning</td>
<td>20.9</td>
<td>Knowledge (34%)</td>
<td>Analysis</td>
</tr>
<tr>
<td>Discussion</td>
<td>5.1</td>
<td>Comprehension (44%)</td>
<td>Analysis</td>
</tr>
<tr>
<td>Individualized Application</td>
<td>1.6</td>
<td>Bimodal (Comprehension, 50%: Application, 50%)</td>
<td>Application</td>
</tr>
</tbody>
</table>

*Authors’ summary of data reported by Estepp, Stripling, Conner, Giorgi, & Roberts (2013)
Problem Statement and Research Question

- Teaching/learning in agriculture focused on lower levels of cognition
- Little if any comparative cross-college research
  - Related research suggests a small negative difference for agriculture majors relative to other majors
- Do the cognitive tasks required of agriculture and non-agriculture students differ?
Objectives

1. Describe and compare the cognitive tasks required in courses as perceived by freshman and senior agriculture and non-agriculture students.

2. Determine if perceptions of cognitive tasks differ between freshmen and seniors within majors (agriculture and non-agriculture).
Methods

• Data: 2005, 2007, 2010, & 2013 National Survey of Student Engagement (NSSE) administered at U of A
  – Data provided by Office of Institutional Research
    • IRB approval
• NSSE collects data from college freshmen and seniors about their level of participation in learning and personal development activities
  – Administered at 1,574 institutions since 2000
  – Approximately 4.5 million students have completed the survey since 2000
    • Extensive validation and reliability studies have been conducted
# UA Respondents and Response Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture Freshmen</th>
<th>Agriculture Seniors</th>
<th>Non-Agriculture Freshmen</th>
<th>Non-Agriculture Seniors</th>
<th>Freshmen Response Rate</th>
<th>Seniors Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>38</td>
<td>32</td>
<td>386</td>
<td>254</td>
<td>34.9</td>
<td>25.5</td>
</tr>
<tr>
<td>2007</td>
<td>48</td>
<td>51</td>
<td>558</td>
<td>421</td>
<td>23.0</td>
<td>20.2</td>
</tr>
<tr>
<td>2010</td>
<td>53</td>
<td>74</td>
<td>562</td>
<td>631</td>
<td>18.1</td>
<td>24.1</td>
</tr>
<tr>
<td>2013</td>
<td>79</td>
<td>144</td>
<td>1071</td>
<td>1056</td>
<td>26.1</td>
<td>33.5</td>
</tr>
<tr>
<td>Total</td>
<td>218</td>
<td>301</td>
<td>2577</td>
<td>2362</td>
<td>24.0</td>
<td>25.2</td>
</tr>
</tbody>
</table>

- Response rates were typical for RU/VH institutions
- “Few meaningful differences exist between respondents and non-respondents in terms of their academic engagement” (Kuh, 2003, p. 13)
- “Non-response effects are minimal” (Chen et al., 2009, p. 37)
Study Variables

• During the current school year, how much has your coursework emphasized the following?
  – **Memorizing** course materials [Knowledge]
  – **Applying** facts, theories, or methods to practical problems or new situations [Application]
  – **Analyzing** an idea, experience, or line of reasoning in depth by examining its parts [Analysis]
  – **Forming** a new idea or understanding from various pieces of information [Synthesis]
  – **Evaluating** a point of view, decision, or information source [Evaluation]

• Response options:
  o Very little [1]
  o Some [2]
  o Quite a bit [3]
  o Very much [4]

• Class Rank and College matched by UA IR
Results
Testing for Major x Year Interaction

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Freshmen</th>
<th></th>
<th>Freshmen</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorize (Knowledge)</td>
<td>$F$ 0.28</td>
<td>$p$ 0.8383</td>
<td>$F$ 0.43</td>
<td>$p$ 0.7340</td>
</tr>
<tr>
<td>Application</td>
<td>$F$ 0.33</td>
<td>$p$ 0.8007</td>
<td>$F$ 0.17</td>
<td>$p$ 0.9195</td>
</tr>
<tr>
<td>Analysis</td>
<td>$F$ 0.12</td>
<td>$p$ 0.9489</td>
<td>$F$ 0.55</td>
<td>$p$ 0.6483</td>
</tr>
<tr>
<td>Synthesis</td>
<td>$F$ 0.92</td>
<td>$p$ 0.4281</td>
<td>$F$ 0.10</td>
<td>$p$ 0.9627</td>
</tr>
<tr>
<td>Evaluation</td>
<td>$F$ 0.51</td>
<td>$p$ 0.6754</td>
<td>$F$ 0.47</td>
<td>$p$ 0.7054</td>
</tr>
</tbody>
</table>
Freshmen: Mean (± 1 SD) extent to which coursework has required:

Cohen’s $d = 0.17$, $0.15$, $0.14$, respectively; negligible effect sizes

<table>
<thead>
<tr>
<th></th>
<th>Memorize</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Little</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Some</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td>Quite a Bit</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Very Much</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>b</td>
<td>b</td>
</tr>
</tbody>
</table>

Agriculture | Non-Agriculture
Seniors: Mean ($\pm 1$ SD) extent to which coursework has required:

- Cohen’s $d = 0.24$ and $0.16$, respectively; small and negligible effect sizes
Agriculture Freshmen and Seniors:
Mean (±1 SD) extent to which . . .
Non- Agriculture Freshmen and Seniors: Mean (± 1 SD) extent to which . . .

Cohen’s $d = 0.08$ to $0.20$; negligible to small effect
Conclusions and Questions

• Cognitive task levels were stable across years (2005, 2007, 2010, and 2013) for both agriculture and non-agriculture students
  – In an increasingly digital world, should use of higher-level cognitive skills also increase OR does the need to “know the basics” remain most(?) important?

• Agriculture students report less frequent use of cognitive tasks at the analysis, synthesis, and evaluation (freshmen only) levels
  – Differences are small – should we be concerned?
  – If so, what should we be doing differently?

• Agriculture students do not report more frequent use of application-level cognitive tasks
  – As an applied science, should this be the case?
  – What (if any) changes in instructional methods or approaches should be considered?
Conclusions and Questions

• Little if any difference in level of cognitive tasks required of freshmen and seniors
  – Shouldn’t we expect seniors to use previously learned knowledge in working at higher cognitive levels (analysis, synthesis and evaluation)?
  – Should we encourage more widespread use of capstone courses, cooperative-learning, and problem-based learning?

• These results are consistent with previous research (Estepp et al., 2013; Ewing & Wittington, 2009; Rhoades et al., 2009)
  – Would the results be different at your university?