Math phobia in agricultural classrooms: A three-year study of student attitudes and skills

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and Lori K. Warren
Projected Job Growth

- Postsecondary Teachers: 20%
- Biological/Ag./Envir. Scientists: 27%
- Physical Scientists: 35%
- Math/Computer Scientists: 47%
- Home Care Practitioner: 58%

Percent increase over average job growth (2010 – 2020)

BLS (2013)
International Adult Numeracy

1 in 4 adults lacks basic math skills

Numeracy Score

Japan, Finland, Belgium, Sweden, Denmark, Czech Republic, Austria, Germany, PIAAC average, Canada, South Korea, UK, United States, Ireland, France, Spain

NCES OECD PIAAC (2016)
Math Anxiety & Achievement

Ma (1999)

Overall correlation

$r = -0.27$

$P < 0.001$
Budgeting
Feed/Fertilizer Scheduling
Management Evaluating Markets
Objectives

1. Assess student perceptions, skills, and previous math experiences in an equine science course
2. Determine if math skills increase following application to an area of student interest
ANS 3405 - Equine Nutrition

- Applied nutrition course focusing on feeding programs for all classes of horses
  - Feed selection, nutrient requirements, diet evaluation/formulation, feeding management
- Prerequisites: Algebra & Animal Nutrition
- Requirement for Equine Specialization
- Traditional lecture based class
  - Assignments, case-studies, exams
Survey

- Pre and post course survey
  - First and last 2 weeks of class
  - Responses recorded anonymously

1. Attitudes Toward Mathematics Inventory (*Tapia and Marsh, 2004*)
2. Math Skills
3. Demographic Information
### Attitudes Toward Mathematics Inventory (Tapia and Marsh, 2004)

<table>
<thead>
<tr>
<th>Factor</th>
<th># Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student’s Self Confidence</td>
<td>9</td>
</tr>
<tr>
<td>Value of Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>Enjoyment of Mathematics</td>
<td>6</td>
</tr>
<tr>
<td>Motivation</td>
<td>3</td>
</tr>
</tbody>
</table>

*Positively and negatively phrased questions*

<table>
<thead>
<tr>
<th>Likert-Type Scale</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
Math Assessment (10 Questions)

- Unit Conversions
- Percentages
- Simultaneous Equations

- Fill in the blank
- I cannot answer this question

**DIRECT:** What is 15% of 30?

**WORD:** A feed contains 0.9% calcium. If you feed 6 kg of this feed, how many grams of calcium are you feeding?
Statistical Analysis

- **ANOVA**: Performance on math questions
  - Percent correct responses
    - Type of question
    - Pre vs. post response

- **Logistic regression**: Math attitudes and skills
  - ATMI total and factor scores between pre- and post-assessment
    - Stratified by year
<table>
<thead>
<tr>
<th>Year</th>
<th>Students</th>
<th>Math GPA</th>
<th>Last Math Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>31</td>
<td>3.05</td>
<td>1.5 y</td>
</tr>
<tr>
<td>2017</td>
<td>40</td>
<td>3.03</td>
<td>2.5 y</td>
</tr>
<tr>
<td>2018</td>
<td>40</td>
<td>3.02</td>
<td>1.5 y</td>
</tr>
</tbody>
</table>
Student Math Responses

Correct: Pre > Post
Incorrect: Pre < Post
Cannot Answer: Pre < Post

$P = 0.042$
Cannot Answer

<table>
<thead>
<tr>
<th>Percent Responses</th>
<th>Direct</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question Format**

Pre vs. Post

$P = 0.034$
Case Study: Picking a Suitable Ration

_Oprah Whinney_ is a 15-yo, 1250 lbs Haflinger. Evaluate each of the 3 rations to determine if they meet the nutrient requirements of the horse.

**Ingredients and Amounts**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td># 1</td>
<td>44 Lbs Legume Forage Silage</td>
</tr>
<tr>
<td># 2</td>
<td>26 Lbs Cool-Season Grass Hay</td>
</tr>
</tbody>
</table>
| # 3 | 14.5 Lbs Cool-Season Grass Hay  
  6.0 Lbs Rolled Oats |

Which ration is best suited for Oprah Whinney?
Math Skills by Type of Question

![Bar chart showing percent correct for Unit Conversions, Percentages, and Simultaneous Equations before (Pre) and after (Post) training. The chart indicates a statistically significant improvement in performance across all categories, with a p-value of 0.002.](image-url)
ATMI Response

- **Enjoyment**: 50% Strongly Disagree, 50% Neither, 0% Strongly Agree
- **Motivation**: 50% Strongly Disagree, 50% Neither, 100% Strongly Agree
- **Self Confidence**: 50% Strongly Disagree, 50% Neither, 0% Strongly Agree
- **Value**: 50% Strongly Disagree, 50% Neither, 100% Strongly Agree

Percent of Responses
Math Skills Differed by ATMI

OR: 1.075
P < 0.001
# ATMI Factors Affect Math Skills

<table>
<thead>
<tr>
<th>Factor</th>
<th>OR</th>
<th>95% CI for OR</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment</td>
<td>2.54</td>
<td>1.61 – 3.99</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Motivation</td>
<td>1.67</td>
<td>0.98 – 2.85</td>
<td>0.061</td>
</tr>
<tr>
<td>Self Confidence</td>
<td>1.92</td>
<td>0.65 – 5.69</td>
<td>0.238</td>
</tr>
<tr>
<td>Value</td>
<td>1.63</td>
<td>1.03 – 2.58</td>
<td>0.037</td>
</tr>
</tbody>
</table>
Word Problem Performance

Strongly Disagree  Neither  Strongly Agree

Percent Correct

<table>
<thead>
<tr>
<th>Enjoyment</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR: 2.39 P &lt; 0.001</td>
<td>OR: 1.65 P = 0.017</td>
</tr>
</tbody>
</table>

UF IFAS UNIVERSITIY OF FLORIDA
Final Grades in Equine Nutrition

OR: 1.061
$P = 0.033$

Anticipated Grade

Actual Grades

A: 45%
B: 36%
C: 15%
D/E: 4%

ATMI Score

A B C D/E

Anticipated Grade

Actual Grades

A B C D/E

70 80 90 100
Key Findings

Completing equine nutrition improved student math performance

- Attempt to answer word problems
- Simultaneous eqn.

66% of math questions answered correctly
Competence and Learning

- Voluntary math support programs (Johnston et al., 2016)
  - Increased confidence in math and chemistry
  - Still anxious to answer chemistry problems requiring calculations

- Major challenge in science is applying math skills in a new setting (Tuminaro and Redish, 2004)
Before Students Start College

Math effort is related to competence beliefs in secondary schools (Chouinard et al., 2011)

Parents’ beliefs influence children’s self perceptions of math ability and career choices (Bleeker and Jacobs, 2004)
Questions?