OVERCOME MATHEMATICS ANXIETY IN COLLEGE ALGEBRA WITH GROUP WORK

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AMATYC Annual Conference
Jacksonville, FL, November 8, 2012
Mathematics Anxiety – What is it?

“a feeling of tension, apprehension, or fear that interferes with math performance”

Mark H. Ashraft, Ph.D. in Cognitive Psychology (the study of how people perceive, remember, think, speak, and solve problems), University of Nevada
• Richardson and Suinn introduced the MARS (Mathematics Anxiety Rating Scale) in 1972.
  “high anxiety interferes with performance, and poor performance produces anxiety”
• Hembree determined that math anxiety is related to poor math performance on exams and related to negative attitudes concerning math
• Ashcraft stated that math anxiety causes math avoidance
Possible causes of Math Anxiety

• Mathematics teachers in schools
  Pressure of timed tests, risk of public embarrassment, teachers who are themselves anxious about their mathematical abilities in certain areas

• Parents’ attitude towards mathematics
  Math is often associated with pain and frustration. Unpaid bills, unforeseen debts, unbalanced checkbooks, IRS forms are a few of the negative experiences associated with numbers.

• Common beliefs
  Studies have shown "When asked to explain why some children do better in math than others, Asian children, their teachers, and their parents point to hard work, their American counterparts to ability."
“Numbers don’t lie - it’s time to ditch algebra”-
A. Hacker, Dallas Morning News, 10 August

“A typical American school day finds 2 million college freshmen struggling with algebra. Why do we subject American students to this ordeal? Making mathematics mandatory prevents us from discovering and developing young talent.

A study of two-year schools found that fewer than a quarter of their entrants passed the algebra classes they were required to take. Failing math at all levels affects retention more than any other academic factor. A national sample of transcripts found mathematics had twice as many F’s and D’s as other subjects.

Yes, young people should learn to read and write and do long division, whether they want to or not. But there is no reason to force them to grasp vectorial angles and discontinuous functions.”
National Council of Teachers of Mathematics

suggestions for preventing math anxiety

• Using different learning styles
• Refraining from tying self-esteem to success with math
• Emphasizing that everyone makes mistakes in mathematics
• Making math relevant
• Letting students have some input into their own evaluations
• Allowing for different social approaches to learning mathematics
• Emphasizing the importance of original, quality thinking rather than rote manipulation of formulas
• Everyone is capable of learning, but may learn in different ways.
• Learners are different than they were thirty years ago.
• Different ways to teach a new concept can be through
  - cooperative groups
  - visual aids
  - hands on activities
  - technology
Why Group work?

• Bandura emphasized the value of observational learning in which learners’ behavior changes as a result of observing others' behavior and its consequences.

• Students who observed peer models scored higher on exams and also reported greater confidence in their problem solving abilities.

• Peer modeling is particularly effective for students who have low self-efficacy (Schunk and Hanson).

• Students learn best when they are active rather than passive learners (Spikell, 1993).
Vygotsky’s Social Development Theory

• Social interaction plays a fundamental role in the progress of cognitive development

• The More Knowledgeable Other (MKO) refers to anyone who has a better understanding or a higher ability level than the learner. The MKO could be a teacher or a peer.

• Teachers need to encourage social interaction in the classroom
Students’ feedback:

- “It was good to learn from other students to discover new learning styles”
- “It really did help in comprehension of the material”
- “It was a great chance to get to know your classmates and don’t feel lonely”
- “Multiple minds are better than one”
- “My group helped give me confidence in my work”
- “I love it! It made my College Algebra experience a lot more enjoyable”
- “I didn’t think I would, but I actually really liked it!”
Prerequisite Assessment of Skills for Success (PASS)

• 25 minutes at the end of the first class

• 20 multiple choice questions

• 4 skill levels – 5 questions each level

• Skills assessed:
  • 0300 – Arithmetic
  • 0302 – Pre-Algebra
  • 0305 – Basic Algebra
  • 0310 – Intermediate Algebra
# PASS Results Ranking

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Med+</th>
<th>Med-</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>4-5</td>
<td>3-4</td>
<td>2-3</td>
<td>0-3</td>
</tr>
<tr>
<td>Pre-Algebra</td>
<td>4-5</td>
<td>3-4</td>
<td>2-3</td>
<td>0-2</td>
</tr>
<tr>
<td>Basic Algebra</td>
<td>4-5</td>
<td>3-4</td>
<td>2-3</td>
<td>0-1</td>
</tr>
<tr>
<td>Intermediate Algebra</td>
<td>4-5</td>
<td>3</td>
<td>2</td>
<td>0-1</td>
</tr>
<tr>
<td>Total</td>
<td>16-20</td>
<td>12-15</td>
<td>8-11</td>
<td>0-7</td>
</tr>
</tbody>
</table>
## PASS Results (2009 – 2011)

<table>
<thead>
<tr>
<th>Success%</th>
<th>2009 Spring</th>
<th>2009 Fall</th>
<th>2010 Spring</th>
<th>2010 Fall</th>
<th>2011 Spring</th>
<th>2011 Fall</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>7%</td>
<td>6%</td>
<td>6%</td>
<td>9%</td>
<td>9%</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Med+</td>
<td>30%</td>
<td>31%</td>
<td>27%</td>
<td>33%</td>
<td>30%</td>
<td>27%</td>
<td>30%</td>
</tr>
<tr>
<td>Med-</td>
<td>42%</td>
<td>44%</td>
<td>39%</td>
<td>41%</td>
<td>42%</td>
<td>42%</td>
<td>42%</td>
</tr>
<tr>
<td>Low</td>
<td>21%</td>
<td>19%</td>
<td>28%</td>
<td>17%</td>
<td>19%</td>
<td>25%</td>
<td>22%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proficiency%</th>
<th>2009 Spring</th>
<th>2009 Fall</th>
<th>2010 Spring</th>
<th>2010 Fall</th>
<th>2011 Spring</th>
<th>2011 Fall</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td>71%</td>
<td>73%</td>
<td>67%</td>
<td>70%</td>
<td>72%</td>
<td>66%</td>
<td>70%</td>
</tr>
<tr>
<td>Pre-Algebra</td>
<td>60%</td>
<td>65%</td>
<td>56%</td>
<td>70%</td>
<td>67%</td>
<td>67%</td>
<td>64%</td>
</tr>
<tr>
<td>Basic Algebra</td>
<td>38%</td>
<td>40%</td>
<td>39%</td>
<td>39%</td>
<td>39%</td>
<td>41%</td>
<td>39%</td>
</tr>
<tr>
<td>Intermediate Algebra</td>
<td>37%</td>
<td>29%</td>
<td>32%</td>
<td>34%</td>
<td>29%</td>
<td>30%</td>
<td>32%</td>
</tr>
</tbody>
</table>

Success% - % of participating students who ranked High, Med+, Med-, Low
Proficiency% - % of the 5 prerequisite categorical questions answered correctly
Learning Groups as a Lab component

• Participation is mandatory for achieving Lab Grade (10% of the total grade)

• Groups are assigned based on PASS results (2-3 students, 1 is MKO)

• One mistake per assignment is allowed to achieve completion grade

• Participation is voluntarily, with 10 points added to Lab score for survey completion (Individual work is graded the same 10%)

• Students are choosing group partners

• Only completion is graded
Learning Groups as a Lab component

- 2-3 people in one group
- 1 class meeting before each of 4 exams
- Assignments are distributed 1 week in advance
- Help is encouraged (Professor’s office hours, Math Lab, tutoring services)
- Every member of a group must be present at the time of submitting group assignment
- Every group member must be able to explain every solution given by the group
Learning Groups as a Lab component

- 4 assignments per semester, before each exam
- 10 – 12 partial credit questions, similar to exam questions with a higher level of difficulty
- 2-3 applications
- Instructor as a Facilitator
- Study groups outside the classroom
Survey results (Fall 2010 – Spring 2012): 4 semesters, 9 sections, 203 students)

• Have you been a part of the same group?
  Yes – 96%  No – 4%

• Why did you decide to join a group?
  To get help from my group members – 87%
  To split up the problem workload – 8%
  Bonus points – 4%
  I work better in groups – 1%
Survey results (cont-d):

• Did you like working in the group? Why?
  The other group members helped me understand College Algebra – 91%
  It was easier to get work done – 27%
  It became more interesting to study – 9%
  I learned at a more efficient pace – 6%
  You can help other group members out – 5%

• Did group work help you to succeed on exams?
  Yes – 100%
Survey results (cont-d):

- Did group work help you to learn College Algebra?
  Yes – 100%

- Would you recommend College Algebra’s instructors to use group work?
  Yes-100%

- What would you do differently for the group work if you were the instructor?
  Nothing – 81%
  Make it worth more points on your grade – 11%
  Choose our groups for us – 2%
  Change groups for each assignment so we could work with different people – 0.5%
## Retention/Success distribution for College Algebra sections with group work
### Fall 2010-Spring 2012

<table>
<thead>
<tr>
<th>Semester/Section</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
<th>W</th>
<th>Retention/Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>F’10 S06</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>92% / 65%</td>
</tr>
<tr>
<td>F’10 S14</td>
<td>13</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>83% / 73%</td>
</tr>
<tr>
<td>F’10 S04</td>
<td>13</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>100% / 68%</td>
</tr>
<tr>
<td>Sp’11 S03</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>89% / 61%</td>
</tr>
<tr>
<td>Sp’11 S05</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>88% / 69%</td>
</tr>
<tr>
<td>Sp’11 S09</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>90% / 73%</td>
</tr>
<tr>
<td>F’11 S04</td>
<td>9</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>87% / 68%</td>
</tr>
<tr>
<td>F’11 S13</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>87% / 80%</td>
</tr>
<tr>
<td>Sp’12 S05</td>
<td>7</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>83% / 76%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td><strong>89% / 71%</strong></td>
</tr>
</tbody>
</table>

42 sections of College Algebra Sp’11  90% / 65%

11/27/2012
Group work simulation

- **Groups/Facilitator**
- **Einstein puzzle:** Alex, Betty, Carol, Dan, Earl, Fay, George and Harry are eight employees of an organization. They work in three departments: Personnel, Administration and Marketing with no more than three of them in any department. Each of them has a different choice of sports from Football, Cricket, Volleyball, Badminton, Lawn Tennis, Basketball, Hockey and Table Tennis not necessarily in the same order.

Who are the employees working in the Administration Department? In which Department does Earl work? Who does like Cricket?
Einstein Puzzle details:

Dan works in Administration and does not like either Football or Cricket.
Fay works in Personnel with only Alex who likes Table Tennis.
Earl and Harry do not work in the same department as Dan.
Carol likes Hockey and does not work in Marketing.
George does not work in Administration and does not like either Cricket or Badminton.
One of those who work in Administration likes Football.
The one who likes Volleyball works in Personnel.
None of those who work in Administration likes either Badminton or Lawn Tennis.
Harry does not like Cricket.
Solution:

- Betty, Carol, and Dan work in Administration
- Earl works in Marketing
- Earl likes Cricket
http://www.youtube.com/watch?v=Rn_OhPKBjB0

2:20
So long as people believe themselves to be disabled in mathematics and do not rise up and confront the social and pedagogical origins of their disabilities, they will be denied "math mental health."

Tobias defines math mental health as “the willingness to learn the math you need when you need it."
References

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