OVERCOME MATHEMATICS ANXIETY IN COLLEGE ALGEBRA WITH GROUP WORK

Sofya Antonova
COLLIN COLLEGE,
Dallas, TX

AMATYC Annual Conference

Jacksonville, FL, November 8, 2012

COLLIN COLLEGE

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."

COLLIN COLLEGE

"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."

COLLIN COLLEGE

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

COLLIN COLLEGE

- 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

COLLIN COLLEGE

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).

COLLIN
COLLEGE

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

COLLIN COLLEGE

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!"

COLLIN COLLEGE

11/27/2013

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

COLLIN COLLEGE

PASS Results Ranking

	High	Med+	Med-	Low
Arithmetic	4-5	3-4	2-3	0-3
Pre-Algebra	4-5	3-4	2-3	0-2
Basic Algebra	4-5	3-4	2-3	0-1
Intermediate Algebra	4-5	3	2	0-1
Total	**16-20**	**12-15**	**8-11**	**0-7**

PASS Results (2009 – 2011)

Success%	2009 Spring	2009 Fall	2010 Spring	2010 Fall	2011 Spring	2011 Fall	Mean
High	7%	6%	6%	9%	9%	6%	7%
Med+	30%	31%	27%	33%	30%	27%	30%
Med-	42%	44%	39%	41%	42%	42%	**42%**
Low	21%	19%	28%	17%	19%	25%	**22%**

Proficiency %	2009 Spring	2009 Fall	2010 Spring	2010 Fall	2011 Spring	2011 Fall	Mean
Arithmetic	71%	73%	67%	70%	72%	66%	70%
Pre-Algebra	60%	65%	56%	70%	67%	67%	64%
Basic Algebra	38%	40%	39%	39%	39%	41%	**39%**
Intermediate Algebra	37%	29%	32%	34%	29%	30%	**32%**

Success% - % of participating students who ranked High, Med+, Med-, Low
Proficiency % - % of the 5 prerequisite categorical questions answered correctly

COLLIN COLLEGE

11/27/2012

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

COLLIN COLLEGE

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

COLLIN COLLEGE

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

COLLIN COLLEGE

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 decided 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%

COLLIN
COLLEGE

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%

COLLIN COLLEGE

Retention/Success distribution for College Algebra sections with group work
Fall 2010-Spring 2012

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

COLLIN COLLEGE

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

Group work simulation
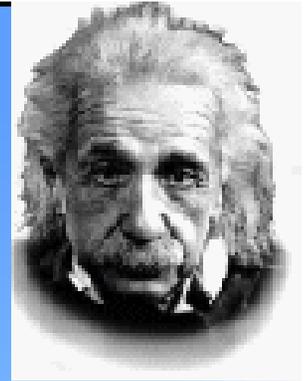
- **Groups/Facilitator**

- **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:
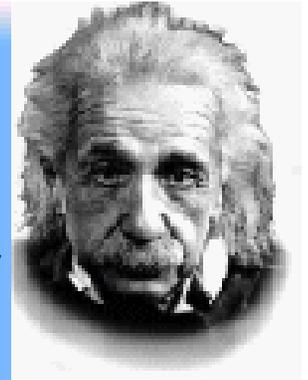
Dan works in Administration and does not like either Football or Cricket.

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

COLLIN COLLEGE

[http://www.youtube.com/watch?v=Rn_Oh PKBjB0](http://www.youtube.com/watch?v=Rn_OhPKBjB0)

2:20

COLLIN COLLEGE

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

- Ashcraft, M.H. (2002). Math anxiety: Personal, educational, and cognitive consequences. Directions in Psychological Science

- Tobias, S. (1993) New York : W.W. Norton

- Curtain-Phillips, M. (1999). Math Attack: How to Reduce Math Anxiety in the Classroom, at Work and in Everyday Personal Use

- Richardson, F. C. & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. Journal of Counseling Psychology

- Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. Journal for Research in Mathematics Education

- Bandura, A. (1977). Social Learning Theory. New York: General Learning Press.

- Schunk, D. H., & Hanson, A. R. (1989). Self-modeling and children's cognitive skill learning, Journal of Educational Psychology

- Vygotsky, L.S. (1978). Mind and society: The development of higher mental processes. Cambridge, MA: Harvard University Press.

- Bock, E., Collin College, ebock@collin.edu

COLLIN COLLEGE

Contact information

Sofya Antonova

Collin College

Mathematics and Natural Science Department

2800 E.Spring Creek Pkwy

Plano, Texas, 75074

972-8815961

santonova@collin.edu

COLLIN
COLLEGE