Virtual Math Teams: 
Studying and Supporting Online Collaborative Problem-solving

Annie Fetter
Johann W. Sarmiento
The Math Forum @ Drexel University
Overview

• Intro: The Math Forum Services and the VMT
• VMT Goals, Questions and Activities up to date.
• Let’s try it together!
• Analyzing Student’s Online Collaboration
• Research on Cooperative/Collaborative Learning
• Computer-support for Online Collaborative Problem-Solving
• Your students can participate in the VMT project!
The Math Forum’s Services

• Ask Dr. Math
• Math Tools digital library and community
• Teacher2Teacher
• Problems of the Week (PoWs)
• And many more!
The Math Forum’s Problems of the Week (Pow)
www.mathforum.org/pow/

• Designed to provide creative, non-routine challenges for students in grades three through twelve.

• Problem-solving and mathematical communication are key elements of every problem

• 4 areas: Math Fundamentals, Pre-Algebra, Algebra, and Geometry
Virtual Math Teams: Overview

• Promote collaborative problem-solving
• Enable kids to help each other at The Math Forum and make better use of the limited expert mentoring
• Provide an important kind of engaged learning experience for students
• Investigate the nature of online collaboration for math problem-solving
• 5-year NSF-funded project
Driving Questions

• What forms of collaboration are more effective for math learning?
• What types of problems work best for collaborative problem-solving?
• What kind of human and software support are necessary?
• What research methods help us understand online collaboration better?
Some VTM Activities to date

• Invited small groups of students to collaborate online to solve the Math Forum’s Problem of the Week
• Investigated 5 different software platforms: AOLIM, Blackboard, WebCT, Open-Source Chat + Shared Whiteboard, ConcertChat
• Offered series of weekly, one-hour “Pow-wow” sessions with Algebra and Geometry PoWs.
• Conducted initial analysis of chat transcripts
• Explored software-support prototypes
Let’s try a collaborative PoW: “A Tangent Square and Circle”
Let’s Reflect on our Collaborative Problem-solving

• What are possible solution paths?
• How does one come upon those?
• What did you notice in terms of doing it alone or with others?
• How was this experience different than collaborative problem-solving in your classroom?
1. AME  how close are you
2. KIL   i know that its less than four
3. AME  No its more
4. KIL   ya thats wut i meant
5. KOH   hahaha... typo...
6. KIL   anyone else get any closer?
7. AME  I solved it
8. KOH  I solved it, too!
9. KIL   i c
10. KOH  hey, AME, tell me about your way first...
11. AME  I need my pic
        ...
15. KOH  I know you got the right answer, but your way is kinda wrong...
        ...
21. AME  My way is fine
22. AME  Its works
23. AME  If the answer is right than what gives?
24. KOH  well... ok...
25. KOH  all goes well that ends well
26. KOH  but I need explaination...
27. AME  ok …
KOH: so AME, please explain your way...
KIL: yeaa please?
AME: well I just used some equations
AME: equation 1- x + r = 8
KOH: ok... simple equations or complicated ones?
KIL: yes
AME: Simple
KOH: ok...
AME: As I was Saying
KOH: where did that 1 came from?
AME: The first equation is x + r = 8
KOH: yes!
KIL: i get it...
AME: The second is 16 + x^2 = r^2
AME: Now we substitute
KIL: i c
AME: And we are DONE!!!
KOH: thats my way!!!
KIL: i c now!
AME: My way just makes more sense
KIL: i c so 1) x + r = 8
KOH: hey, so where do that x come from and how does it help ya?
KIL: 2) x^2 + r^2 = 16
AME: r + x = 8
1. ALR : Okay, I think we should start with the formula for the area of a triangle
2. SUP : ok
3. ALR : A = 1/2bh I believe
4. PIN: yes
5. PIN: i concur (*concur*)
6. ALR : then find the area of each triangle
7. ALR: oh, wait
8. SUP : the base and heigth are 9 and 12 right?
9. ALR : no
10. SUP : o
11. ALR : that’s two separate triangles
12. SUP : ooo ok
13. ALR : right
14. ALR: i think we have to figure out the height by ourself
15. ALR: if possible
16. PIN: i know how
17. ALR how?
18. ALR right
19. SUP proportions?
20. ALR this is frustrating
21. ALR I don’t have enough paper
22. PIN i think i got it
23. PIN its a 30/60/90 triangle
24. ALR I see
25. PIN so what's the formula
...

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A diagram of a triangle with a height labeled as 30, base labeled as 60, and angles labeled as 90 and 60 degrees.
28. PIN so what's the formula
29. PIN to find it
30. PIN i think i remember
31. AVR to find what
32. AVR the height?
33. PIN ya
34. SUP if it's equilateral it's a 45/45/90 triangle?
35. SUP o wait
36. SUP that's isosceles
37. AVR yeah
38. AVR ...
39. AVR equilateral is 60/60/60 triangle
40. PIN ya
41. AVR not 30/60/90
42. PIN anyone remember formula for 30/60/90 triangle?
43. PIN nooooo
44. PIN but look
45. PIN you drew the triangle
46. PIN here wait
47. AVR no I didn't
48. PIN let me make a pic
49. AVR okay
50. PIN wait a couple min
51. AVR okay
52. SUP so how's it goin
53. AVR I'll try to draw one in the meantime
54. PIN super!
55. AVR equilateral means all sides are equal
56. AVR therefore all angles are equal too
57. SUP yes
58. SUP 60
59. AVR so it can't be 30/60/90
60. AVR it's not a 30/60/90 triangle
61. SUP that's what I was thinking
62. SUP is there a formula for a 60/60/60?
63. AVR I have no idea
64. AVR I think once we find the formula it should be pretty easy
65. AVR I don't think there's a formula, though
66. PIN search google
67. AVR I think we find it some other way
68. AVR that's what I'm doing
69. SUP what does it mean by edgelengths?
70. SUP jone of the 3 sides?
71. AVR edgelength means length of a side
72. SUP ok...
1. AVL: okay, Mod, just a question
2. AVL: basically, he's solving it by trial and error
3. AVL: by like putting random numbers in as sides and seeing if they work out
4. PIN: ya, and im pretty darn close
5. AVL: yeah
6. AVL: but is there any way else to do it
7. AVL: like, using a formula
8. PIN: hey Mod answer me this
9. OFS: thats what i was thinkin ov
10. PIN: is it 21.213X
11. AVL: because if you submit the solution you're not gonna say "do trial and error"
12. OFS: using a formula
13. PIN: where X is another number
14. PIN: is it or no
15. OFS: howd u get 21.213
16. PIN: trial and error
Research on Cooperative/Collaborative Learning and Achievement (Slavin, R.E.)

• “Research on cooperative learning is one of the greatest success stories in the history of educational research.”

• However, there is still some confusion and disagreement about why cooperative learning methods affect achievement and, even more importantly, under what conditions cooperative learning has these effects.

• A great deal of knowledge about the effects of many types of cooperative interventions and about the mechanisms responsible for these effects.

• Cooperative learning is not only a subject of research and theory; it is used at some level by millions of teachers.

Slavin, R.E. Research on Cooperative Learning and Achievement: What We Know, What We Need to Know  http://www.successforall.com/Resource/research/cooplearn.htm
Cooperative/Collaborative Learning

Students who work together to **clarify** questions, **discuss** and **select** problem-solving strategies, **co-construct** solutions, and **resolve** controversies usually demonstrate greater gains in **concept development** and **problem-solving abilities** than similar students who work alone.


Also: Elizabeth Cohen, Paul Cobb, Mercer & Wegeriff
Bridging Research and Practice

• How to achieve effective grouping
• How to motivate participation and use appropriate rewards
• How to provide feedback and teach students to collaborate
• What authentic tasks work best for collaborative activities?
• How to align collaborative activity with curricular goals
Share your experiences…

- Jigsaw?
- Complex instruction / Project-based Learning?
- Student teams-achievement divisions?
- Survivor Algebra anyone?

Some Sources:
Software Supports

- Supporting activity awareness and coordination
- Threading
- Opportunistic Group formation
- Full-featured whiteboard
- Math support
- Online Community for sustained participation
Well, why don’t we start with area the small triang

Johann> Should we start?
Mary>  Sure! I have no idea how, though.
Arnold> I don’t remember anything about adding triangles, shouldn’t it be 21?
ConcertChat

**Material:**
- manuel: ConcertChat Flyer

**Moderation, Rollen- und Prozessunterstützung**
- Einfache Konfiguration und Integration

**Chat: (239)**

Allouch (Dec 5, 2004 6:17 AM): komm aber nicht mehr mit dem gleichen nick rein, sagt mir immer, dass der nick bereits genutzt wird:-)

Allouch (Dec 6, 2004 2:56 PM): Also, mit Allouch scheint jetzt sogar zu gehen, gleich mein problem, ob das auch schon direkt nach dem schliessen wieder geht:

Alloc (Dec 6, 2004 2:54 PM): ne, also direkt wieder reingehn geht nicht :-)

martinv (Dec 6, 2004 8:29 PM): welchen Browser, welche Java VM benutzen Sie?

gerry (2:00 PM): wie ein this diagram of the space

gerry (2:02 PM): und ich schaue mal

gerry (2:03 PM): und was meinten links?
gerry (2:04 PM): This is Johann
Chad (Jan 13, 2005 4:24 PM): So we should have something like this to find the length of the two sides of the triangle. 4^2 + 8^2 = sort of 80
Chad (Jan 13, 2005 4:25 PM): Then the area of that triangle is 32
Chink Steve (Jan 13, 2005 4:26 PM): sq rt 32 it
Chink Steve (Jan 13, 2005 4:26 PM): nevermind
Steve^2 (Jan 13, 2005 4:26 PM): Everyone got it now?
Chad (Jan 13, 2005 4:26 PM): 32 is both triangles together
Steve^2 (Jan 13, 2005 4:26 PM): Because we should jump to aim express under escape and do a general chat
Chink Steve (Jan 13, 2005 4:26 PM): That might be better
Chad (Jan 13, 2005 4:27 PM): Since the area of the triangle is 1/2 b^2h
Message:
Well, maybe if we tried pythagorean theorem?
Your students can be part of Virtual Math Teams @ The Math Forum!

http://mathforum.org/vmt/

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Cooperative/Collaborative Learning

• Davidson (1985) reviewed 79 research studies comparing student achievement in small group and traditional whole-class instruction, and found that in more than 40% of these studies students in the classes using small group approaches significantly outscored control students on measures of student performance.

• From a review of 99 studies of cooperative group-learning methods, Slavin (1990) concluded that cooperative methods were effective in improving student achievement. The most effective methods emphasized both group goals and individual accountability.


Virtual Math Teams Research

- How to group students for effective online collaboration (*opportunistic group formation*)
- How to design rich mathematical problems that foster collaboration and deep mathematical reasoning (*task scaffolding*)
- How to structure the online collaborative experience (*interaction design for learning*)
- How to study the forms of collaboration and reasoning that take place (*multidisciplinary research*)
1. Mod: If two equilateral triangles have edgelengths of 9 cubits and ...
2. ALR: hmmm
3. ALR: interesting
4. Mod: If you create a picture that you would like to share...
5. PIN: very
6. ALR: I think we can crack it, though
7. ALR: **begins to scribble on paper**
8. ALR: or should I not do that?
9. PIN: doesn't matter
10. ALR: got it
11. ALR: **proceeds with scribbling..**
12. ALR: Okay, I think we should start with the formula for the area of a triangle
13. SUP: ok
14. ALR: \( A = \frac{1}{2}bh \)
15. ALR: I believe
16. PIN: yes
17. PIN: i concur
18. PIN: concur*
19. ALR: then find the area of each triangle
20. ALR: oh, wait
21. SUP: the base and heigth are 9 and 12 right?
22. ALR: no
23. SUP: o
24. ALR: that's two separate triangles
25. SUP: ooo
26. SUP: ok
27. ALR: right
28. ALR: i think we have to figure out the height by ourselves
29. ALR: if possible
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