Methods of Negotiation in Online Collaborative Mathematics Problem-Solving

The Virtual Math Teams (VMT) project is an NSF-funded research program through which researchers at the College of Information Science and Technology (IST) and the Math Forum investigate the innovative use of online collaborative environments to support effective K-12 mathematics learning.

A Scenario

Imagine three participants from different parts of the world solving a math problem online. Each one of them

- understands the problem somewhat but cannot solve it alone,
- has a different approach and wants the other two to help develop and use it,
- thinks the other two may know how to solve some aspect of the problem.

They need to negotiate with each other to frame the problem, figure out an approach from among their different perspectives and produce a solution which satisfactorily meets their collective expectations.

Research Questions

How is negotiation performed in online collaborative mathematics problem solving?

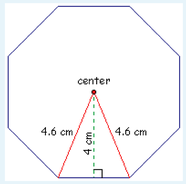
How do members of a group agree on a problem-solving approach?

As team members contribute to producing a solution, how do they negotiate how a specific solution is produced?

How does a collaborative problem-solving team demonstrate to its participants that its solution to a problem is satisfactory?

The Perimeter of an Octagon

Given the regular octagon below, answer the following questions:
1. What's wrong with this picture?
2. If you fix what's wrong, what's the perimeter of the octagon?

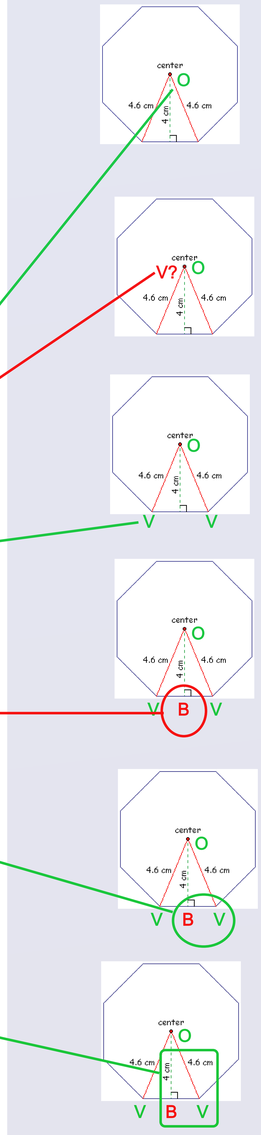


Extra: Assume that the thing you found to be wrong is actually right. What else could you change to make things right? What's the resulting perimeter of the octagon?

* * *

MC (7:03:25 PM): Should we label some points?
MC (7:03:56 PM): Like, center is O
AM (7:04:04 PM): We could do that
MC (7:04:21 PM): Vertex where red line meets is, what, V?
AM (7:04:38 PM): The center?
MC (7:04:47 PM): No, down at the vertex
AM (7:04:52 PM): oh
AM (7:05:00 PM): That might help
AM (7:05:16 PM): Lets find out whats wrong with the pic first.
MC (7:05:20 PM): You name where the green line meets the base
AM (7:05:30 PM): B
AM (7:06:19 PM): I have an idea that might help us find whats wrong with the pic.
MC (7:06:30 PM): We could use good ol' Pythag thm to see what BV is
AM (7:06:40 PM): Lets not
MC (7:06:46 PM): What's your idea?
AM (7:07:01 PM): It states that something is wrong with the pic.
AM (7:07:08 PM): so we can't find what BV is
MC (7:07:31 PM): Yeah, and I think if we 'found' BV, it would be something not possible.
MC (7:08:10 PM): 16 + BV^2 = 21.16
MC (7:08:20 PM): BV^2 = 5.16
AM (7:08:23 PM): I got it
AM (7:08:29 PM): I know whats wrong with the pic
MC (7:08:31 PM): BV = 2.27
FI (7:08:44 PM): ok. now i'm following!
MC (7:08:47 PM): That makes the base about the same as the radius
MC (7:09:01 PM): That can't be

* * *



Our Methodology

We use a methodology based on conversation analysis to identify how negotiation is conducted in online mathematics problem-solving. We seek to locate member methods as negotiation is initiated, processed and concluded. We also use a statistical analysis of utterance lengths and time intervals between utterances. We also compare whiteboard actions with chat postings.

Our data sources are chat logs as well as screen movie captures of chats-in-progress.

Preliminary Results

Initial findings show:

how changes in the tempo of turn-taking indicate shifts in the conduct of problem-solving,

how repetition and 'forced conclusions' are used to negotiate a choice among several problems at hand,

how intervals and transitions are used by participants to indicate preferred responses and responders,

how referencing tools impact negotiation.

Next Steps

We seek to find more instances of negotiation and produce detailed descriptions of negotiation methods.

Significance of This Research:

Findings from this research can assist in the design of CSCL environments, especially in the transformation of generic communication applications to collaborative technology. The identification of design features which enhance collaboration, surface perspectives and minimize unproductive conflict, can lead to better support for negotiation.

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