The Integration of Cognitive Levels

Gerry Stahl

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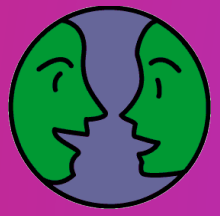
- Main claim: a math topic can integrate individual skills, group collaboration & community knowledge.
- Illustrative resource: a challenging dynamic-geometry topic (pattern of sticks in a diamond pattern, segments in a hexagon array, inscribed polygons).
- Supporting data: Virtual Math Team session by teachers (100 hours) and students (800 hours).
- Current status: analysis underway of 8-session series; sessions to be repeated next year.



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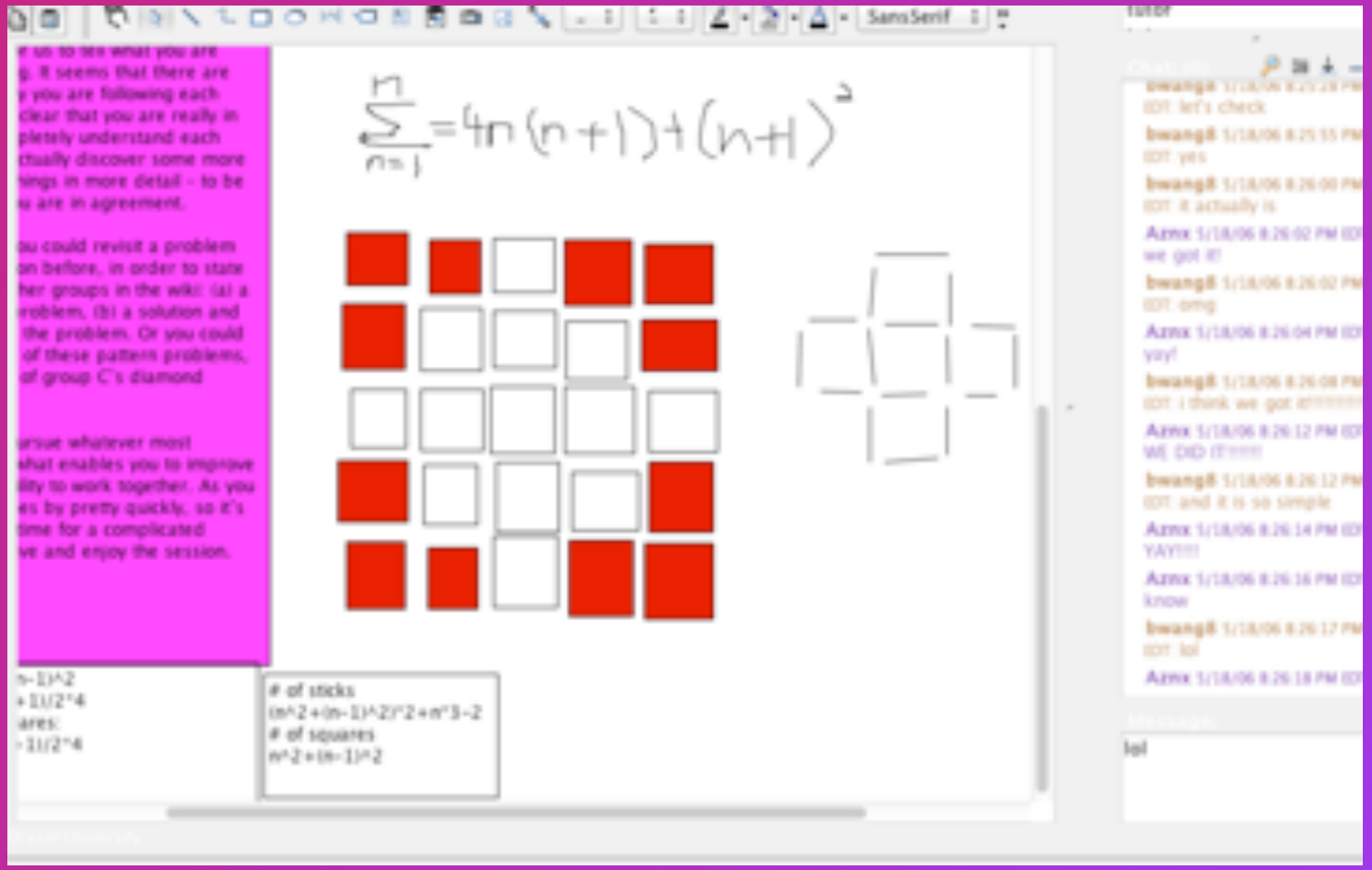
Pattern of sticks in diamond



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Move 1. Open the topic

Bwang: i think we are very close t
Aznx: We can solve on that topic.

Move 2. Decide to start

Bwang: well do you want to solve
Aznx: Alright.

Move 3. Pick an approach

Aznx: How do you want to approach
Bwang: 1st level have 1*4 … 4th l

Move 4. Identify the pattern

Aznx: So it's a pattern of +2s?
Bwang: yes

Move 5. Seek the equation

Bwang: what is it
Aznx: n^2 … or (n/2)^2

Move 6. Negotiate the solution

Aznx: its n^2
Bwang: so that's wrong

Move 7. Check cases

Aznx: would be 4n^2
Bwang: it actually is

Move 8. Celebrate the solution

Bwang: i think we got it!!!!!!!!!
Aznx: WE DID IT!!!!!!

Move 9. Present a formal solution

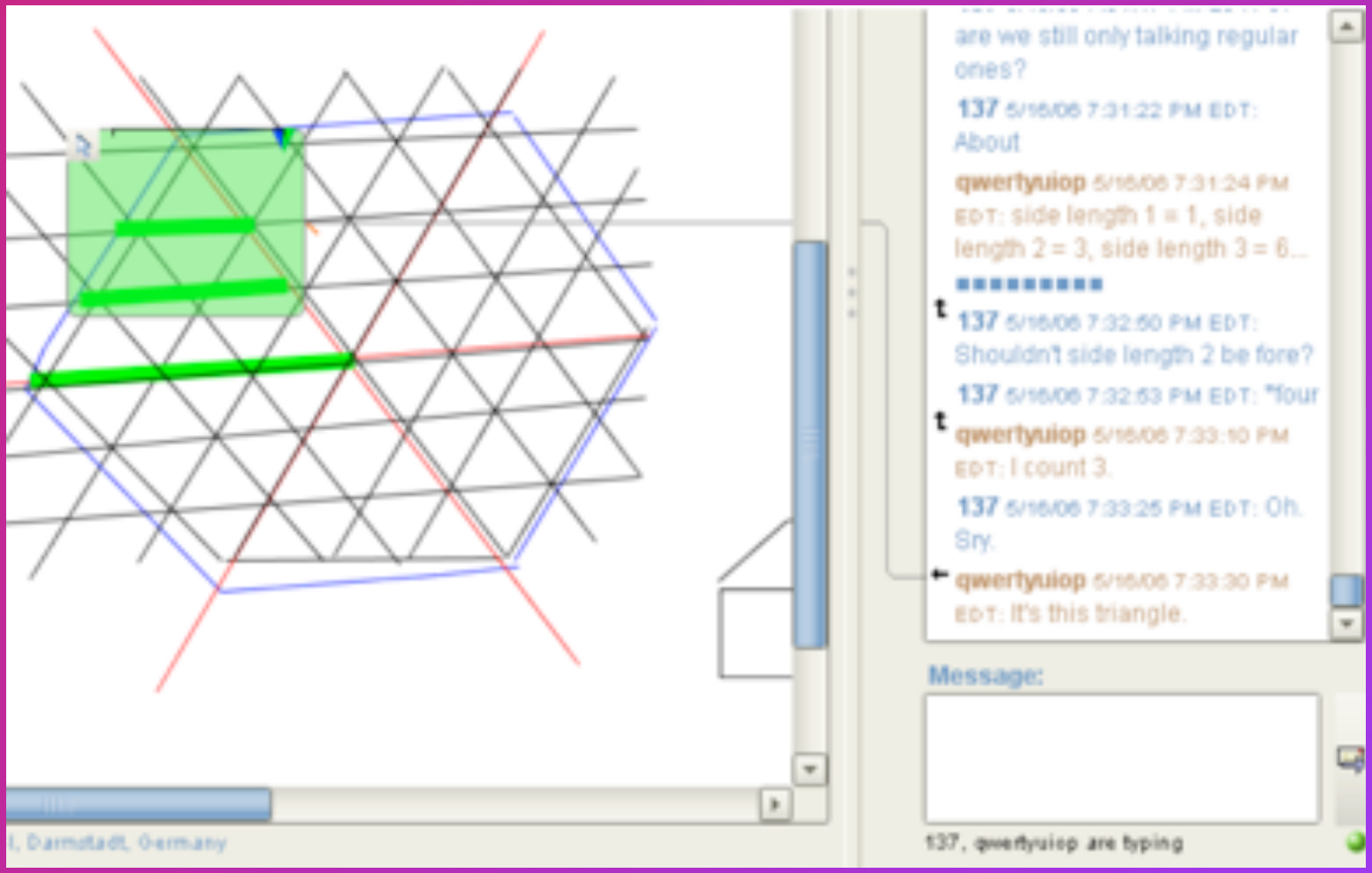
Aznx: So you're putting it in the
Bwang: yes

Move 10. Close

Aznx: we should keep in touch
Bwang: yeah

- Longer sequence of interactions (adjacency pairs)
- Persistent co-attention to problem-solving process
- Shared understanding of problem & solution
- *Community* contributes problem & standards of math discourse
- *Individual* contributes computations, math content, candidate solutions
- *Group* organizes, negotiates, accepts

Segments of a hexagon array



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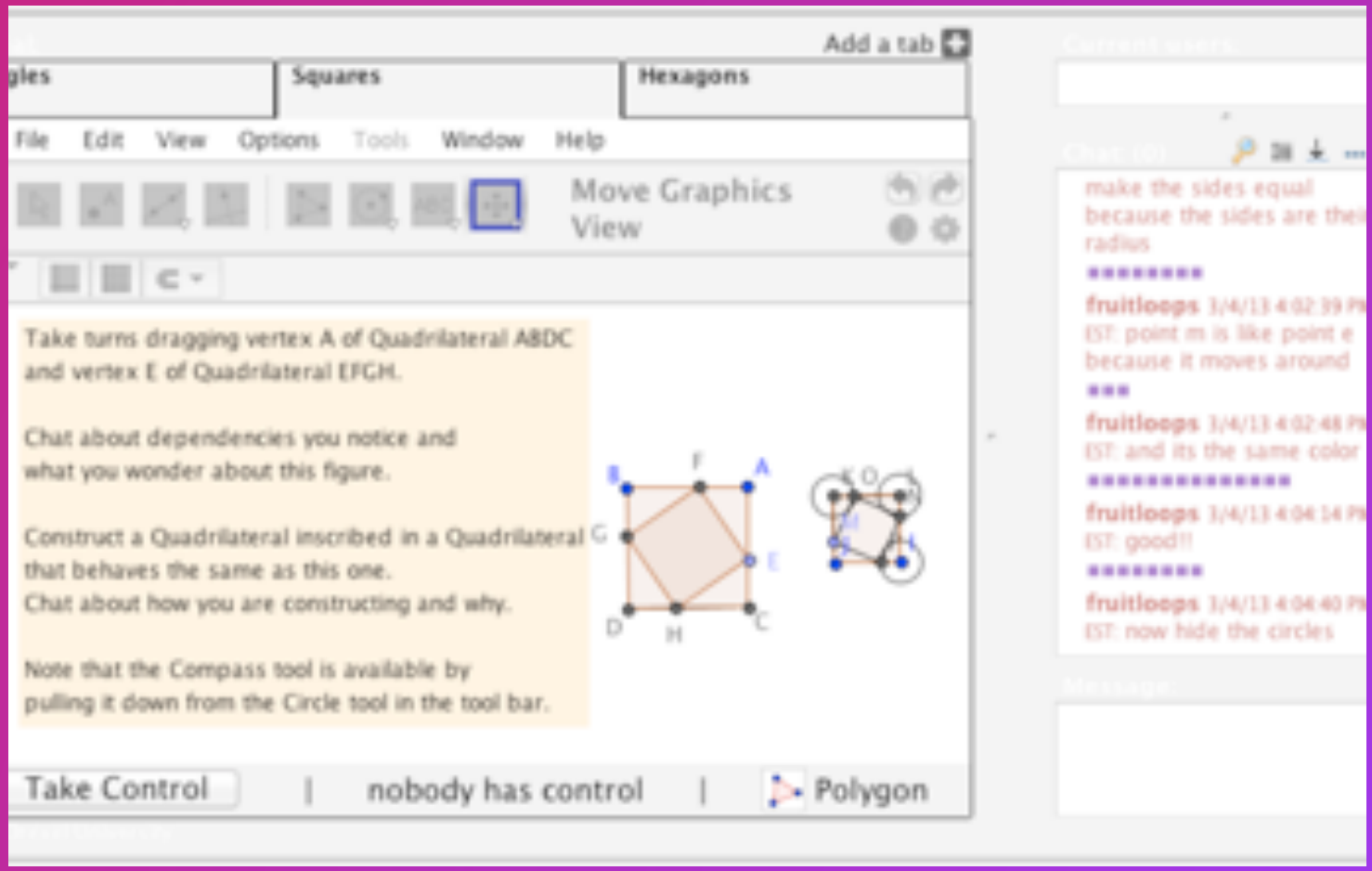
705	19:15:08	137	So do you want to first calculate the number of triangles in a hexagonal array?
706	19:15:45	qwertyuiop	What's the shape of the array? a hexagon?
707	19:16:02	137	Ya.
708	19:16:15	qwertyuiop	ok...
709	19:16:41	Jason	wait-- can someone highlight the hexagonal array on the diagram? i don't really see what you mean...
710	19:17:30	Jason	hmm.. okay
711	19:17:43	qwertyuiop	oops
712	19:17:44	Jason	so it has at least 6 triangles?
713	19:17:58	Jason	in this, for instance

- Being-there-together at the math object as seen by the group
- Wait!!! The group cannot continue until everyone sees the same
- The group has a shared understanding from the same perspective
- The shared view is locally created and repaired constantly
- The group develops group practices to see the same: deictic pointing, highlighting with colors, lines, arrows, names, ….
- Math: "hexagon"; group: inscription; individual: understanding

Inscribed polygons



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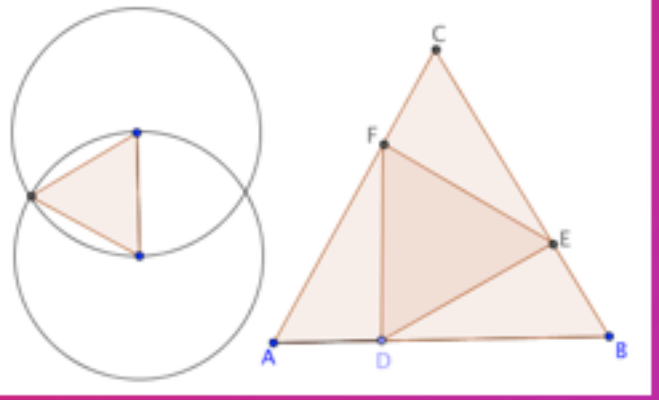

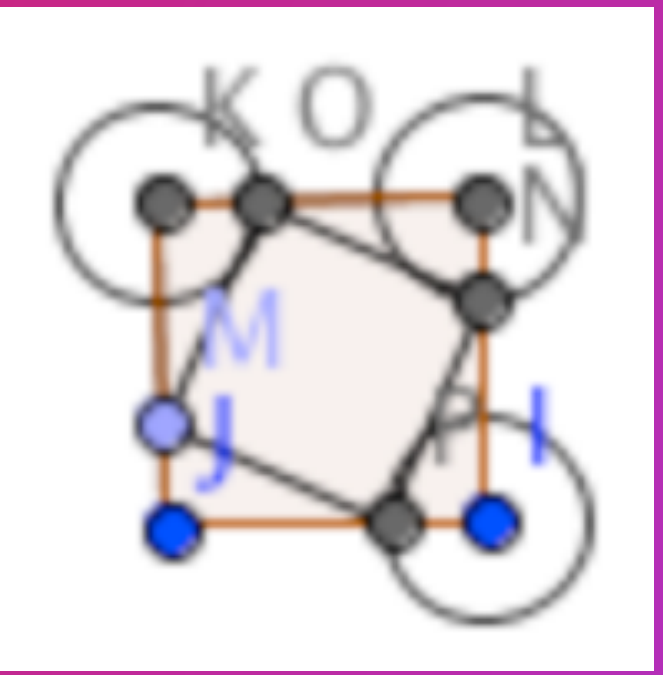

- Community: Euclid's 1st proposition (construct equilateral triangle), problem of inscribed triangles, definitions of regular polygons.
- Individual: perception of equal lengths, coordinated movements, explorative dragging, memory of similar problem solutions
- Small group: group practices of taking turns, dragging, coloring, naming, discussing
- Group cognition: shared attention, collaborative discourse, joint solution

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Further Reading

- Stahl, G. (2012). Traversing planes of learning. *ijCSCL. 7*(4), 467-473.
- Stahl, G. (2013). Learning across levels. *ijCSCL. 8*(1), 1-12.
- Stahl, G. (2013). Transactive discourse in CSCL. *ijCSCL. 8*(2).
- Stahl, G. (2013). *Translating Euclid: Creating a human-centered mathematics*: Morgan & Claypool Publishers. Web: http://gerrystahl.net/elibrary/euclid.
- Stahl, G. (2013). Workshop presentation: The integration of cognitive levels. Presented at CSCL 2013. Web: http://GerryStahl.net/pub/cscl2013levels.pdf.

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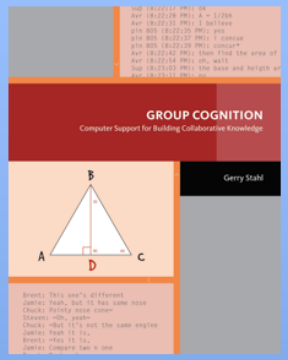
The Virtual Math Teams Trilogy

Group Cognition (2006)



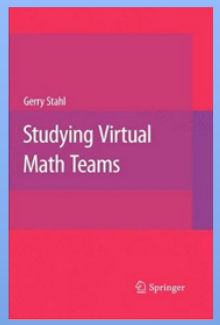
Computer Support for Building Collaborative Knowledge

MIT Press, 510 pages
Available for Kindle

The theory of group cognition emerges from several studies of CSCL and CSCW technologies. Analysis of interaction. Theory of CSCL.

www.GerryStahl.net/elibrary/gc

Studying Virtual Math Teams (2009)

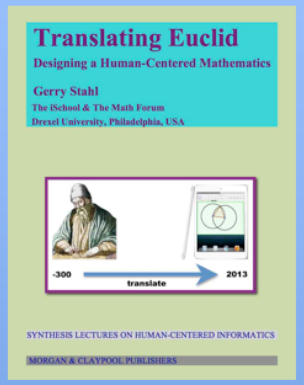


Springer Press, 626 pages
CSCL Book Series, paperback

Studies of the VMT Project technology, pedagogy, analysis, theory by team members and international collaborators

www.GerryStahl.net/elibrary/svmt

Translating Euclid (2013)



Creating a Human-Centered Mathematics

Morgan Claypool Publishers, 325 pages, e-book & paperback

Latest results of this design-based CSCL research from many perspectives.

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