Ender: an Interactive Geometry Proof Tool

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Motivation

Learning about geometry proofs helps students improve their **sequential logic**, but students struggle with understanding geometry proofs. (Soucy McCrone & Martin, 2004)

Problem

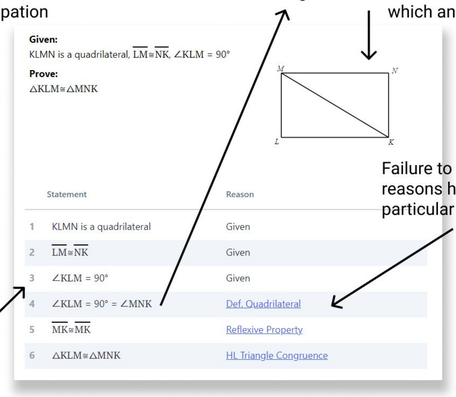
Two-column Style

More teacher presentation, less active student participation

Cognitive load: which segment is ML? which angle is KLM

Failure to understand why reasons has to be in a particular order

Sequential thinking: write extra steps that don't help them reach the end proof



I can't **keep track** of all the segments and angles used in the proof.

I also don't know **why I need to prove this step** or why I have to do this in **this order**.

Ender includes **interactivity** and **visual elements** which makes reading and understanding geometry proofs easier.

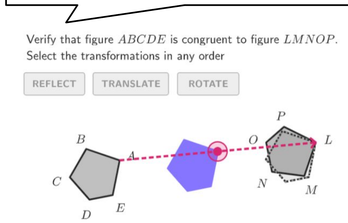
Methods (Semi-structured interview)

- U.S. high school teachers, 1 hour Zoom interview
- Do they use interactive geometry software? What other teaching methods?
- What geometry proof topics do students struggle with the most?
- Do they like our tool, would they use it in their classroom? What other functions would they like to add?

Results (Semi-structured interview)

Overall trends in Geometry learning and teaching:

Focus on the discovery process, learning through active construction of diagram & shapes.



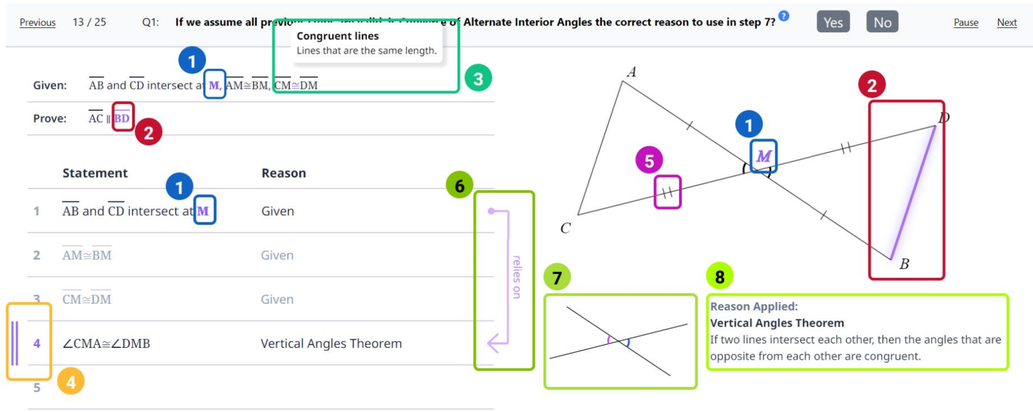
Less traditional formal proofs, because it takes longer to learn, most students struggle.

Ender could help as a teaching aid, or as a review material.

Methods (Experiment)

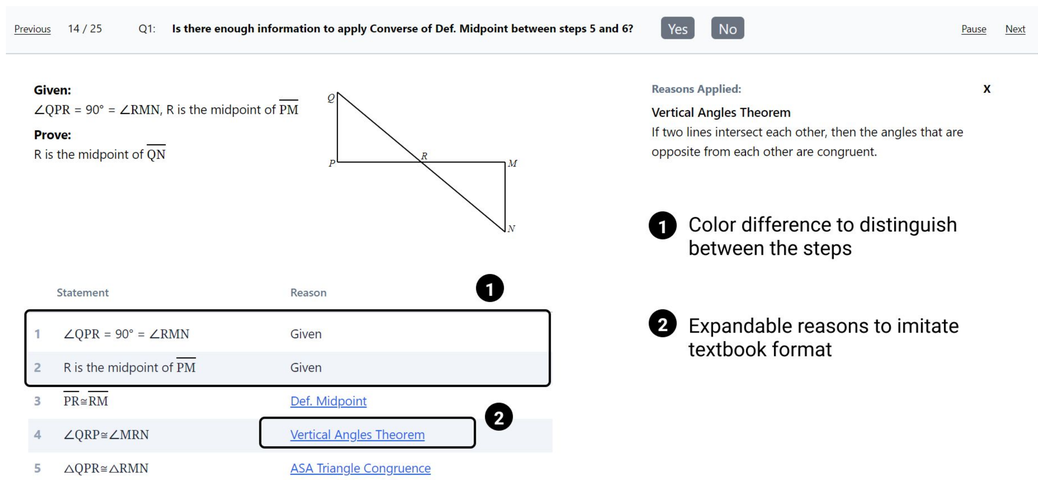
1. Pre-test of Geometry basic logic (tick marks, triangle congruence)
2. Tutorial of interactive layout
3. Stage 1: Test if students used particular elements, do performance improve compared to static layout

Interactive layout



1. On diagram click, highlights the corresponding text
2. On text hover, highlights the corresponding diagram element
3. On symbol hover, shows definition of symbol
4. Highlights current step, hides not seen steps
5. Tick marks according to the current step
6. Relies on: bolds statements that the current statement needs
7. Mini figures: provide graphical representation of current reason
8. Reasons applied: text definition of current reason

vs.



1. Color difference to distinguish between the steps
2. Expandable reasons to imitate textbook format

4. Stage 2: Test the overall layout and how that affects performance

Next Steps

- Conducting the experiment with students who've taken geometry in the past 2 years
- Data analysis of performance, metacognition, usability
- In-depth analysis of interview data