

Mar 23rd, 4:00 PM

# Visualizing geometrical counterexamples using digital tools

Tuyin An

Georgia Southern University, [tan@georgiasouthern.edu](mailto:tan@georgiasouthern.edu)

Ha Nguyen

Georgia Southern University, [hnguyen@georgiasouthern.edu](mailto:hnguyen@georgiasouthern.edu)

Follow this and additional works at: <https://digitalcommons.georgiasouthern.edu/stem>

 Part of the [Science and Mathematics Education Commons](#)

---

## Recommended Citation

An, Tuyin and Nguyen, Ha, "Visualizing geometrical counterexamples using digital tools" (2018). *Interdisciplinary STEM Teaching & Learning Conference*. 21.  
<https://digitalcommons.georgiasouthern.edu/stem/2018/2018/21>

This event is brought to you for free and open access by the Conferences & Events at Digital Commons@Georgia Southern. It has been accepted for inclusion in Interdisciplinary STEM Teaching & Learning Conference by an authorized administrator of Digital Commons@Georgia Southern. For more information, please contact [digitalcommons@georgiasouthern.edu](mailto:digitalcommons@georgiasouthern.edu).

# Visualizing Geometrical Counterexamples Using Digital Tools

Tuyin An

Ha Nguyen

Georgia Southern University



# Background

The researcher noticed it was challenging for the PSMTs to visualize and draw counterexamples using paper and pencil to disprove the given geometrical statements.



What are pre-service secondary mathematics teachers' (PSMTs) conceptions of counterexamples in geometrical reasoning when using the dragging feature of dynamic geometry environments (DGEs)?

The use of the dragging feature of DGEs can promote student understanding and reasoning ability in learning geometry.



Proof and reasoning form part of the core content of secondary geometry curriculum



Students and teachers face challenges in learning and teaching geometry proofs



Secondary teachers' conceptions, knowledge, and prior learning experiences can impact their teaching and thus their students' learning



# Methods

- ◆ Case study

- ◆ A case is a PSMT's work on the two tasks designed for the task-based interview session

- ◆ Task-based interview

- ◆ 40 - 60 minutes, including a short tutorial in the beginning
  - ◆ Tasks are designed based on the Principles of the Nature of Theorems

- ◆ Four to six participants

- ◆ Commit to secondary mathematics teaching, namely, PSMTs
  - ◆ Have taken a university-level geometry course



# Conceptual Framework – *Principles of the Nature of Theorems (Table 1)* (An, 2017)

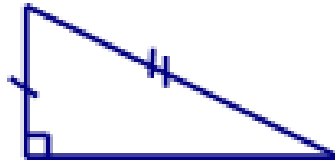
## Nature of Theorems

1. A mathematical statement is not a theorem until it has been proved (using axioms, definitions, postulates, previously proved theorems, lemmas, and propositions) (Task 1)
2. A theorem has no exceptions
  - a. A general statement is true implies that the statement is true for all specific instances. Therefore, a proof must be general to be valid for proving a statement (i.e., non-exhaustive proofs, empirical evidence, and checking a few specific cases are invalid proofs)
  - b. A general statement is not true in one specific instance, proves that the statement is false (i.e., one counter example is sufficient to disprove a statement) (Task 2)

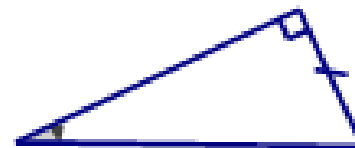
# Task 1

Determine whether the triangles in each of the three pairs are congruent. Explain your reasoning.

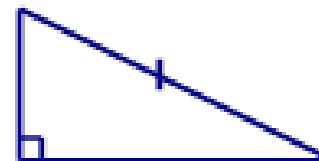
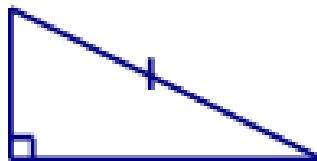
a.



b.



c.

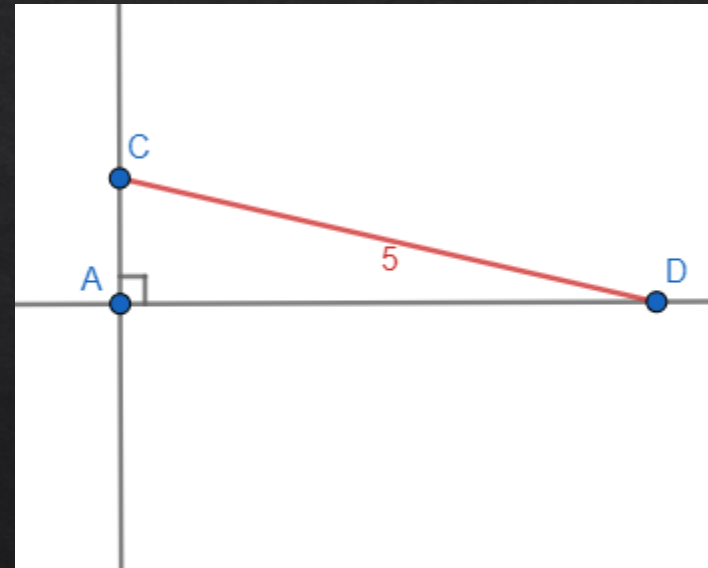
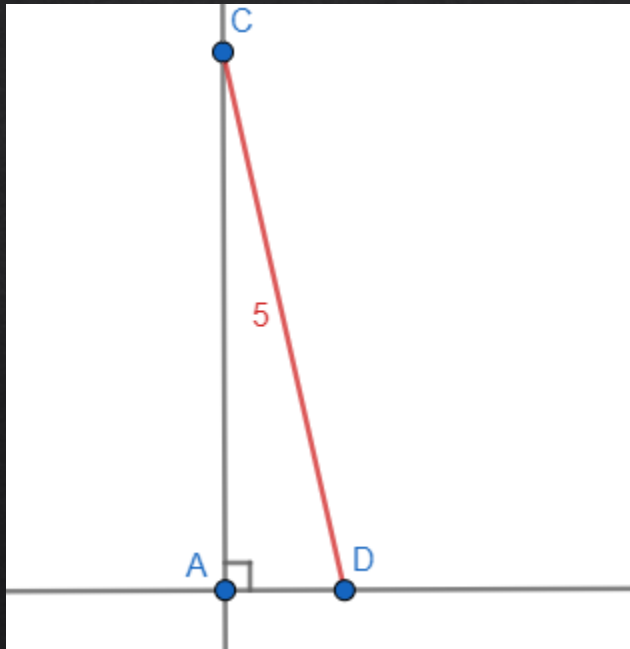


# Task 1

GeoGebra Tool

◇ <https://www.geogebra.org/m/DFfCuFtv>

Counterexamples of case  $c$ :



## Task 2

Determine whether the following argument is correct.  
Explain your reasoning.

The statement “In  $\triangle ABC$ , if  $D$  and  $E$  are points on  $AC$  and  $BC$  respectively,  $BC=2BE$  and  $DE= \frac{1}{2} AB$ , then  $AC=2AD$ ,  $DE \parallel AB$ ” is not always true.

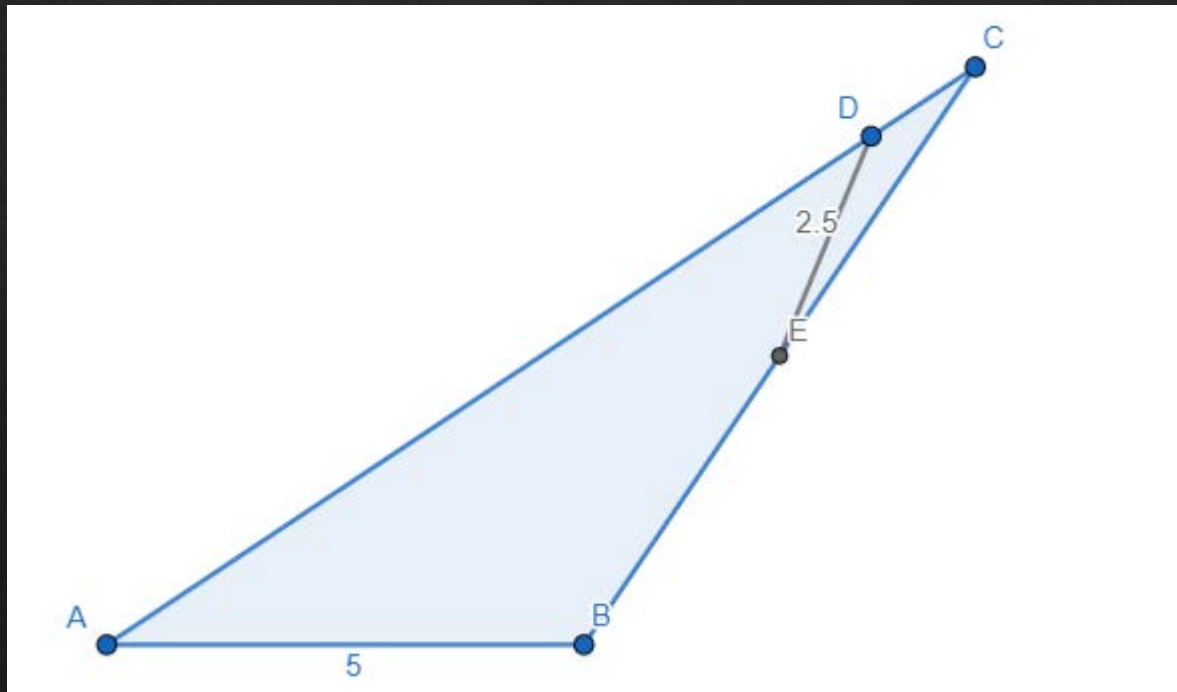


# Task 2

GeoGebra Tool

◇ <https://www.geogebra.org/m/nGkfB6J3>

Counterexample:



# Another Example

SSA triangle: The Ambiguous Case

◇ <https://www.geogebra.org/m/CvtskyRM5>

# Potential Impact

- ◆ Benefit all PSMTs at the university in which the researchers are teaching
- ◆ Benefit secondary geometry education in Georgia
- ◆ Support other geometry educators by sharing designed tasks
- ◆ Contribute an analytical tool for unpacking PSMTs' conceptions.
- ◆ Contribute knowledge about PSMTs' conceptions of the nature of theorems in DGEs
- ◆ Generate discussions about future development in applications of DGEs (e.g., the dragging feature) in college geometry education