British Society for Research into Learning Mathematics

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Implications of Giaquinto's epistemology of visual thinking to the teaching and learning of fractions

Ph.D. student: Leonardo Barichello

Supervisors: Dr. Peter Gates and Dr. Colin Foster

CAPES

Summary

1) My research

2) Giaquinto's ideas

3) Reasoning

4) Implications

My research goal

Goal: Investigate how do low achieving students learn fractions through an approach emphasizing visual representations.

Motivation: Evidences that visual representations could be particularly beneficial for low achieving students (Gates, 2015; Barichello, 2015)

My data collection

- I observed lessons for low achieving students in one British secondary school;
- Designed 12 lessons* about fractions
  - emphasizing visual representation; and
  - Coherent with school practices;
- Observed 3 teachers enacting the lessons with 1 low achieving group each;
- Collected worksheets and within-class clinical interviews.

* http://www.barichello.coffee/about-my-research/lessons-fractions-visual-representations

My initial impressions

- Students being able to answer "why" questions;
- Students using vocabulary related to visual representations;
- Students being able to extend their knowledge to solve generative questions (Barichello, 2015);
- Teachers noticing that the learning was somehow different.

Summary

1) My research and this presentation

»» **2)** Giaquinto's ideas

3) Reasoning

4) Implications

Giaquinto's ideas

Book: Visual thinking in mathematics: an epistemological study (Giaquinto, 2007)

Article: Visualizing as means of geometrical discovery (Giaquinto, 1992)

Main points: Visualization can form basic geometrical concepts and can trigger new knowledge.

What is visualization?

Visualization: mental ability to notice certain properties of and operate on visual representations. It is:

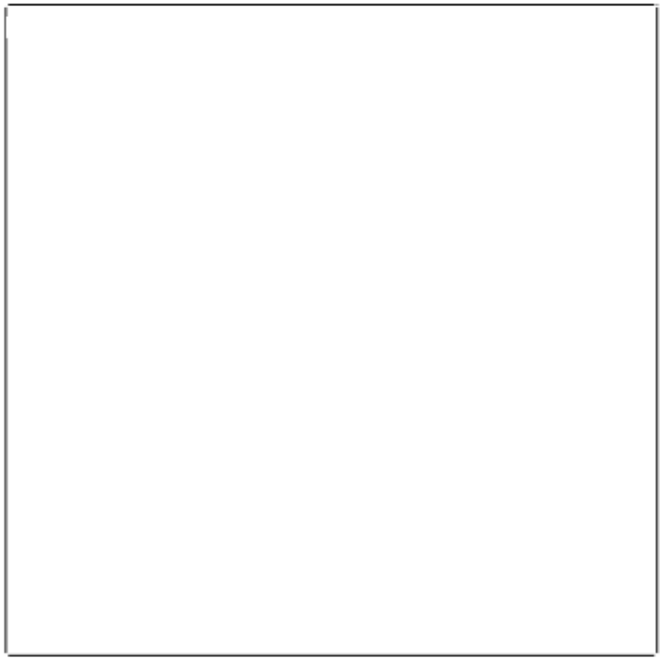
- Partially innate;
- Partially developed by seeing;
- Partially developed by learning where to focus attention.

Giaquinto's main ideas

1) A visual experience can be a constituent of a thought, then lead to concept formation.

Example: *Uncle is a brother of my father or mother.*

2) By applying visual transformations on visual concepts, we can acquire new knowledge.



Square A

Giaquinto's ideas - some remarks

- "Sense experience does enter into the causal prehistory of the belief, not as evidence but as raw material from which the mind forms our geometrical concepts" (Giaquinto, 2007)
- It is not the only way of getting to know something;
- It is not automatic, it demands intention;
- It is not only for geometrical concepts;

Summary

1) My research and this presentation

2) Giaquinto's ideas

»» **3)** Reasoning

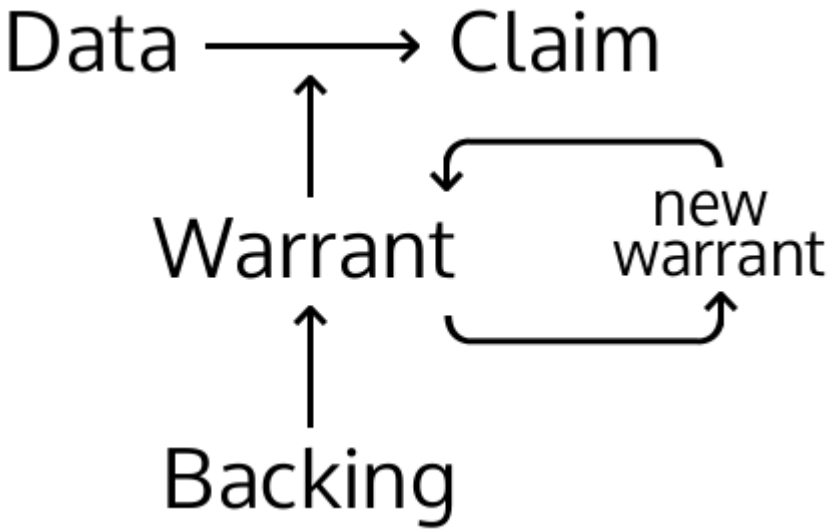
4) Implications

What is reasoning?

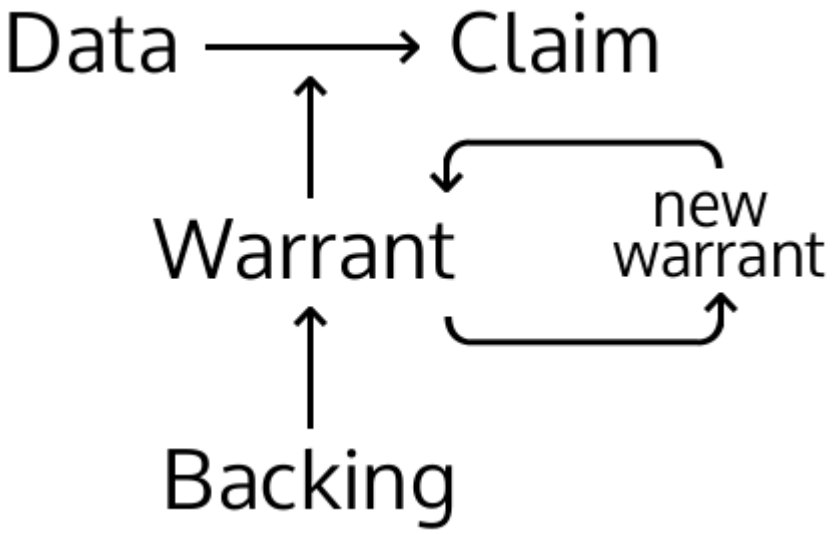
Reasoning: sequence of arguments that supports the solution of a task.

Manifestation: students answering to "why" and "how" questions.

Toulmin's layout of an argument

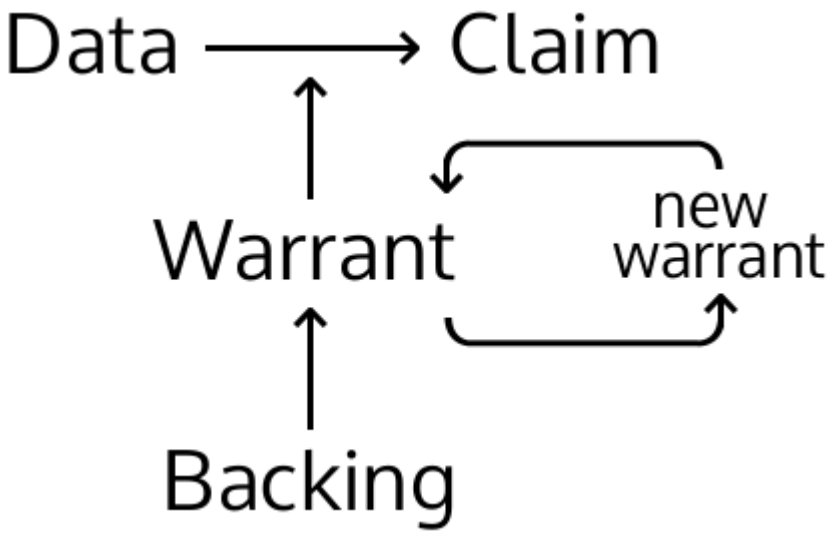


What kind of warrants are there?



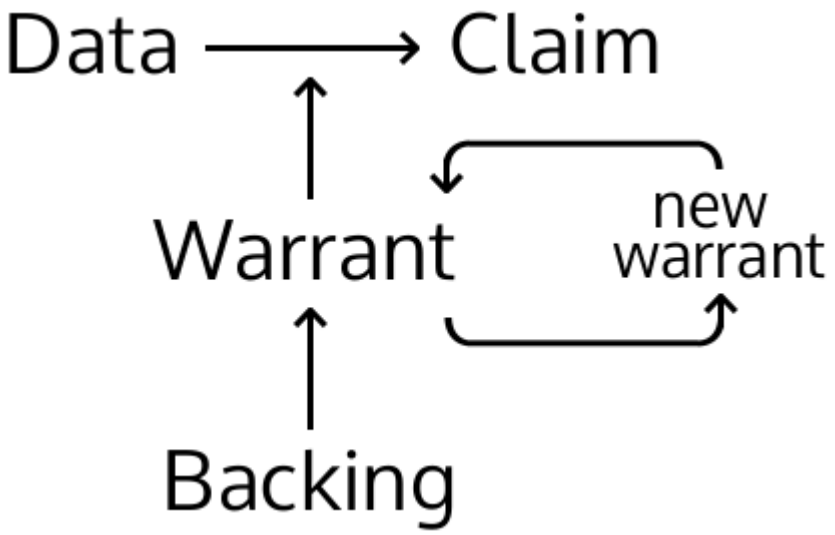
1st possibility: Authority

What kind of warrants are there?



2nd possibility: Algorithm

What kind of warrants are there?



3rd possibility: Prior knowledge (mathematical)

What kind of warrants are there?

4th **possibility:** visualization

"visualizing can constitute a warrant for mathematical belief" (Rodd, 2000)

Summary

1) My research and this presentation

2) Giaquinto's ideas

3) Reasoning

»» **4)** Implications

Implications

Remember that visualization is:

- Partially innate;
- Partially developed by seeing;
- Partially developed by learning where to focus attention.

Implications

Therefore:

- Teachers should focus on a small number of powerful models;

- Teachers have to teach the orthography and grammar of a model;

- Teachers have to recognize the validity of visual arguments;

Thank you!

barichello@gmail.com

LibreOffice
The Document Foundation

Bibliography

Barichello, L. (2015). Possible parallels between visual representations and informal knowledge. BSRLM (Vol. 35, pp. 13–18).

Gates, P. (2015). Social Class and the Visual in Mathematics. In S. Mukhopadhyay & B. Greer (Eds.), 8th MES Conference.

Giaquinto, M. (1992). Visualizing as a means of geometrical discovery. Mind & Language, 7(4), 382–401.

Giaquinto, M. (2007). Visual thinking in mathematics: An epistemological study.

Rodd, M. M. (2000). On Mathematical Warrants: Proof Does Not Always Warrant, and a Warrant May Be Other Than a Proof. Mathematical Thinking and Learning, 2(3).

Toulmin, S. E. (1969). The uses of argument. Cambridge University Press.