Argumentative Knowledge Construction in Asynchronous Calculus Discussion Boards

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Research Context

Classroom discourse is a fundamental activity in which students have an opportunity to gain mathematical knowledge.

We are interested in the learning opportunities that students are afforded in asynchronous online mathematical discussion activities.

Research Questions

- What types of knowledge are constructed during asynchronous math discussions?
- How do students co-construct knowledge during asynchronous math discussions?
- How does design of discussion questions impact knowledge construction?

Literature

Few studies on fully online mathematics courses (Trenholm et al., 2019).

It is more challenging mathematics online than other text-based topics such as English (Engelbrecht & Harding, 2005).

Discussions are not widely used in fully asynchronous courses (Trenholm et al., 2015)

AKC has been employed online to study non-mathematical disciplines (Schrire, 2006; Clark & Sampson, 2008; Dubovi & Tabak, 2020).

AKC has also been used to analyze' face-to-face interactions in a group work task (Keene, 2016).

Theory

Emergent Perspective: To study learning, researchers need to coordinate constructivism and interactivism. The reflexiveness of social and individual construction of meaning works well in social learning settings. (Cobb & Yackel,2006.)
Design Research: Research which contributes to theory and to practice. "Design experiments involve both developing instructional designs to support particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them. ((Cobb, 2003, p.1)

Weinberger and Fischer's (2006) AKC Dimensions

Social Modes

- *Externalization*
- *Elicitation*
- *Quick Consensus Building*
- *Integration-oriented Consensus Building*
- *Conflict-oriented Consensus Building*

Argumentative

- *Single arguments (simple, qualified, grounded, grounded & qualified, non-argumentative)*
- *Line of argumentation (argument, counterargument, integration, non-argumentative)*

Epistemic: Construction of …

- *Problem Space*
- *Conceptual Space*
- *Problem Conceptual Space*
- *Problem Prior Knowledge*
- *Non-Epistemic Activities*

Participation

- *Quantity*
- *Heterogeneity*

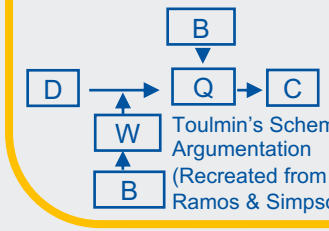
Proposed Changes to the AKC Framework

Argumentation

Macro Codes

- Argument
- Counterargument
- Integration
- Non-argumentative moves

Micro Codes



Toulmin's Scheme for Argumentation
(Recreated from Ingles, Mejia-Ramos & Simpson (2007))

Epistemic

- *Prompt-Specific Understandings*
  - *Derivative (Chain Rule)*
  - *Composition (Chain Rule)*
- *Progress Towards Coordination of Relevant Understandings*
- *Broader Ways of Thinking Mathematically (When Applicable)*

Participation (Unchanged)

- *Quantity*
- *Heterogeneity*

Methods

- **Student population:** Majority part-time, over 25, active military white males
- **Data collection**: Gather records of discussion activities after discussion has been carried out.
- **Segment** discussion into whole posts for social co-construction codes.
- **Segment** posts into individual statements for argumentative and epistemic codes.
- **Quantitatively** track Participation Dimension
- **Code** discussions according to the codebooks for the revised Epistemic and Argumentation dimensions
- **Identify** emergent themes in a cross-dimension analysis.

Sample Discussion Activities

Prompt
This group discussion will center around the following situation, describing a 100m race:

Torty and Harry are competing in a 100m footrace. Torty's average speed on any 5-second interval is always less than Harry's average speed on any 5-second interval, but Torty wins the race! How is this possible?

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Exerpt

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