CONTRASTING CASES IN GEOMETRY: THINK ALOUDS WITH STUDENTS ABOUT TRANSFORMATIONS

Erin E. Krupa
North Carolina State University
eekrupa@ncsu.edu

Brianna Bentley
North Carolina State University
blbentle@ncsu.edu

Joshua P. Mannix
North Carolina State University
jpmannix@ncsu.edu

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Theoretical Framework & Design of Materials

There is strong empirical evidence in support of learning from comparisons in mathematics education research (Rittle-Johnson & Star, 2007; Star, Pollack, et al., 2015; Star et al., 2016). Comparisons have produced gains in students' procedural knowledge, flexibility, and conceptual knowledge of algebra (Lynch & Star, 2014; Star, Newton, et al., 2015; Star, Pollack, et al., 2015). The *Animated Contrasting Cases in Geometry* project seeks to extend this research and transform the learning of geometry for middle school students by designing a supplementary digital animated curriculum.

The curriculum materials for each lesson are organized into Worked Example Pairs (WEPs), which include five unique features: a page for the first student's solution strategy on a given geometry task, a page for the second student's solution to a geometry task (which could be the same or different task as was shown on first student's page), a page with both students' strategies side-by-side, a discussion sheet with four questions for the students to answer, and a thought bubble page summarizing the key mathematical concepts in the problem. The discussion sheet and thought bubble page are designed to make the instructional goal of each WEP more explicit and to scaffold discussions among students as they summarize their work from the WEPs (Star, Pollack, et al., 2015). This paper focuses on the Transformations unit, which is one of four units.

Methods

After fully developing the 8th grade geometry materials, we conducted 56 hour-long think aloud interviews (Piaget, 1976) with individual students ($n = 42$ students). There were 18 think alouds for the Transformations unit conducted with 13 unique students. We transcribed each interview and began *a priori* (Saldaña, 2013) coding based on our key design features. We then added emergent (Saldaña, 2013) Level 1 codes for the students' geometric thinking and curricular form and Level 2 codes as appropriate. In all, there were 556 turns coded.

Findings

We observed 96 (17.27%) turns where students were making comparisons between the WEP characters. Most often they were discussing differences between the characters ($n = 58$), but they also noted similarities ($n = 35$) and used both WEP characters' strategies to verify a mathematical idea ($n = 3$). We observed 119 (21.40%) turns where students were discussing the geometric thinking of the WEP characters. When discussing the thinking displayed by the WEP characters ($n = 44$), students most often provided insight into their personal beliefs about the characters' thinking. Students' geometric thinking accounted for 203 (36.51%) turns of the Level 1 coding. A majority of the codes regarding students' geometric thinking indicated that the student was making sense of the mathematics in the WEP ($n = 105$).

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