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Distinct mathematics teaching practices: Patterns of argumentation

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This analysis of several mathematics lessons in two teachers' classrooms looks for characteristic patterns of argumentation and justification, specifically at the presence and types of warrants required, provided, and accepted – in the social environment of the classrooms – for mathematical claims. A question is posed whether these could be useful as descriptors of distinct justification-related teaching practices.

Keywords: Argumentation, teaching practices, middle school, warrant types, participation.

THEORETICAL FRAMEWORK AND RELATED RESEARCH

The process of mathematical argumentation, explanation and justification in mathematics education has long been an important subject of study. Toulmin (1969) proposes a framework of analysis for arguments in general, and his model of argumentation has been successfully adopted, adapted and accepted as a useful tool in analysis of qualities of (students') mathematical argumentation itself as well as of the collective learning experiences in a classroom (e.g., Yackel, 2002; Rasmussen & Stephan, 2008; Krummheuer, 1995, 2007; Tabach, Hershkowitz, Rasmussen, & Dreyfus, 2014), helping to shed light on students' learning in a social context.

Yackel (2002) points out two different roles that teachers play in collective argumentation (in an inquiry-oriented environment): that of using it as a means to start introducing new concepts and that of carefully supplementing either data, warrants or backings for claims that would otherwise not be explicit to all students, and/or that help students make connections between mathematical concepts.

Krummheuer (2007) analyses argumentation in a mathematics classroom and adds the criteria of participation. He is then able to reconstruct “different grades of autonomy according to the interactional contribution of a student” (p. 60) as well as his status as a participant in the argumentation process.

Our own study also looks at the use of argumentation and justification in a mathematical classroom as a whole, i.e. a closed learning community, but through the lenses of two teachers' distinct beliefs and their respective teaching practices.

THE METHOD

Data were collected from two different classrooms: a cycle of teacher interview-lesson observation-interview was conducted for a sequence of 5 lessons in two lower-secondary classrooms with different teachers (the lessons were about percentage in one classroom and operations on fractions in another). The two teachers were selected as professing distinct beliefs about mathematics teaching and learning, one characteristically leaning towards an inquiry-based conception of the norms for mathematics teaching and learning (as described in Yackel, 2002).

Data collected from observations (transcripts of collective interaction) were analysed for episodes involving the justification of mathematical claims. Cases of argumentations were further characterized using Toulmin's model (especially for data, warrants, and backing) and analysis of participation on warrants and backing.

RESULTS AND IMPLICATIONS

While pupils' participation in providing warrants was proportionally similar in both classrooms, the differences that emerged concerned especially the

types (forms) of warrants. Those varied more in the inquiry-oriented classroom, while argumentation in the other classroom was typically centred around procedures. There is evidence that backing for warrant forms and relevance (although not always correctness), is provided by the teacher in both classrooms. These results show that patterns of argumentation are partly useful as descriptors of a teacher's practice, however, more investigation is necessary in the connection between teacher's beliefs about the role of argumentation and the socio-mathematical norms of argumentation as well as the impact of mathematical tasks on argumentation patterns in a particular classroom.

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