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# Reading mathematical texts in high-school: Expanding the discursive repertoire in the mathematics classroom

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## Introduction

The mathematical classroom discourse is a collective creation where a teacher and her students are practicing mathematical activities while using mathematical language. It is the teacher who primarily uses various resources to present mathematical discourse to her class and foster her students as they become active participants in the evolving mathematical classroom discourse. The research I am about to introduce examines the use of mathematical texts as a resource, seldom used, for creating a unique mathematical activity (Borasi & Siegel, 2000). The term "mathematical text" is used here in a concrete way to signify original mathematical enrichment articles addressing mathematics teachers or mathematically oriented students. Good examples for such texts can be found in journals like *The Mathematics Teacher* and in various mathematical enrichment books (Posamentier, 2003 pp. 67-69; Usiskin, 1968). These articles are not meant to teach the students new chapters of an intended curriculum, but rather letting them recruit all the mathematics they are by now familiar with for "cracking" this newly introduced mathematical piece. The research aims at delineating the various levels of discourse that emerges when small groups of students guided by their mathematics teacher are engaged in a long-term course of reading mathematical texts.

## Description of the research

In order to dwell into the processes of learning to read mathematical texts, a short course was designed to address small groups of 3-4 twelfth-grade math-majors. The texts to be read in the course were selected according to the following three complementary criteria:

- (1) They refer to mathematics that the students attending the course are generally familiar with, but on the other hand there should be gaps and obstacles in the texts that the students will need to learn how to overcome.
- (2) It should be possible to read and to accomplish some additionally planned activities within one or two lessons of 90 minutes.
- (3) The texts should be considered by the community of mathematics practitioners and educators as presenting an aesthetic dimension of mathematics.

The course was designed according to two leading principles. The first principle refers to the sequencing of texts according to increasing mathematical difficulty, and the second refers to the decreasing level of support (fading) provided by the teacher in the classroom. The last two lessons of the course were planned to let the students experience an independent preparation of a text of their choice, followed by a presentation of that text to an outside supportive audience. The course was enacted twice, addressing two different populations of students. All lessons were audio-recorded and carefully transcribed. The transcriptions were analyzed according to the commognitive framework (Sfard, 2008). Following this framework, the discourse was characterized according to its level (object-level or meta-level), its key words and endorsed narratives detected in it (are they representative of a specific community of discourse?) and its routines (are they ritual or explorative?).

## Main findings

The discourse evolving while a group of students experience a long-term guided encounter with mathematical texts has three interlocutors, namely, the student, the teacher and the text which represents a specific kind of mathematical discourse. As the course advances, the discourse of the learning community slowly shifts towards becoming mainly a dual discourse between the students and the text. Eventually, the students learned to communicate with each other, to question the text and each other and to agree upon a coherent interpretation of the text in an expert-like manner. The students' ability to engage in a meaningful communication with a mathematical text is mainly due to their adoption of some norms or meta-rules that govern that discourse. One of these norms states the legitimacy of sensing and expressing clearly the notion of not-understanding (or understanding) something in the text. Scrutinizing the development of the discourse reveals the process of how the students develop an independent sensitivity to what is clear and what is not. They increasingly express their sense of understanding and use it to share their interpretation of the text with their peers, and by doing that, expose it to criticism. In a similar manner, the students increasingly express their sense of not understanding and through this expression they sometimes implicitly ask for help from their fellow students or in a more active manner, use the text in hand to resolve their queries. These results are in accordance with previous research regarding reading in general (Pressley & Afflerbach, 1995). In addition, they may contribute to the community's efforts to understand and maybe unravel the difficulties students encounter when they are reading mathematical text-books and proofs (Inglis & Alcock, 2012).

## Implications

The study suggests that reading mathematical texts holds the potential to expand and enrich the way in which mathematics is taught in high school. The conclusions stated above, as well as the practical experience, accumulated through the design and enactment of the learning environment, may serve as an empirical and research-based foundation to assist policy-makers and teachers in integrating the reading of mathematical texts within the advanced level high school mathematics curriculum.

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