Colloquial mathematics in mathematics lectures

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In this poster, we focus on mathematics professors' use of colloquial mathematics where they express mathematical ideas using informal English. We analyzed 80-minute lectures in advanced mathematics from 11 different mathematics professors. We identified each instance where mathematicians expressed a mathematical idea using informal language. In the poster, we use this as a basis to present categories of the metaphorical images that professors use to help students comprehend the mathematics that they are teaching.

Key words: Advanced mathematics; Language; Lectures

It is widely accepted that mathematics majors learn less from their mathematics lectures than we would like (e.g., Alcock et al., 2015; Leron & Dubinsky, 1995; Thurston, 1994). To account for this, our research team conducted a case study in which we compared the different meanings that a mathematics professor and his students attributed to the same lecture in real analysis (Lew, Fukawa-Connelly, Mejia-Ramos, & Weber, in press). We proposed the following account, among others, for why students had difficulty comprehending the lecture. The professor used what we called *colloquial mathematics* where he phrased technical mathematical ideas using informal English such that students' intuitions about informal English might help them understand the technical ideas. For instance, the professor framed the process of constructing a real analysis proof as asking how one can make a term small knowing that other quantities are small. His students, however, did not know what he meant by small and consequently did not understand the high-level summary of the proof that the professor attempted to convey. In our current project, we attempt to further investigate how colloquial mathematics is used in advanced mathematics courses.

Methods

At the beginning of the semester in three institutions, we sent an e-mail to every mathematics professor teaching a proof-oriented advanced undergraduate mathematics course, asking him or her to participate in our study. Eleven mathematics participants agreed to participate. For each participant, a member of our research team attended a randomly chosen lecture. We used a LiveScribe pen to audio-record the lecture and record what the professor wrote on the blackboard in real time. The 11 lectures were the corpus of data for our study.

We transcribed each of the lectures. Next, two members of our research team read each transcript, flagging every instance in which the professor used colloquial mathematics. More specifically, we coded a portion of transcript as being an instance of colloquial mathematics if one of the two following conditions held: (i) the professor represented a technical mathematical idea using ordinary English that was not equivalent to a formal description of that idea. An example of this is referring to an ideal that "sucks elements in from both sides", by which the professor meant that left and right multiplication by a ring element and ideal will be contained in the ideal. (ii) the professor discussed a meta-mathematical idea without a formal mathematical correlate, such as a particular structure as being "nice", "well-behaved", "interesting", or "boring". Analysis is ongoing, but we are currently sorting each instance of

colloquial mathematics into categories using an open coding scheme in the style of Strauss and Corbin (1990).

Significance

Professors try to make mathematical concepts and mathematical practices accessible to undergraduates by using colloquial mathematics. Our prior research suggested that such natural and well-intentioned actions may not have their desired effect as students may be unable to interpret the professor's intentions when they hear this colloquial mathematics (Lew et al., in press). We view identifying commonalities between and categories of colloquial mathematics as a first step to a larger research agenda. We will use the categories generated in this study to see: (i) if there is a shared understanding amongst mathematicians as to what terms in colloquial mathematics means; (ii) how mathematics majors understand terms in colloquial mathematics and the ways in which such understandings align or do not align with mathematicians' understanding; and (iii) how mathematicians think students will understand colloquial mathematics and the accuracy of mathematicians' predictions.

References

Alcock, L, Hodds, M., Roy S., & Inglis, M. (2015). Investigating and improving undergraduate proof comprehension. *Notices of the American Mathematical Society*, 62, 742-752.

Leron, U., & Dubinsky, E. (1995). An abstract algebra story. *American Mathematical Monthly*, *102*, 227-242.

Lew, K., Fukawa-Connelly, T.P., Mejia-Ramos, J.P., & Weber, K. (in press). Lectures in advanced mathematics: Why students might not understand what the professor is trying to convey. To appear in *Journal for Research in Mathematics Education*.

Strauss, A. L., & Corbin, J. M. (1990). *Basics of qualitative research* (Vol. 15). Newbury Park, CA: Sage.

Thurston, W.P. (1994). On proof and progress in mathematics, *Bulletin of the American Mathematical Society*, 30, 161-177.