Dynamic Textbooks and their Use in Teaching Linear and Abstract Algebra

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In this poster we present two analyses of two dynamic textbooks. One analysis attends to their dynamic features, the mathematical practices embedded, and the scope of contents. The second analysis uses the documentational approach (Gueudet & Trouche, 2009) to investigate the ways in which these textbooks are used by instructors and their students. Data collection involves seven instructors and nearly 150 students across four states (New York, Texas, California, and Michigan; 50% female, 30% non-Caucasian or Asian) and surveys, logs, student tests, classroom observations, and clinical interviews. In both textbooks the interactive features are prominent via links and interactive computational cells (with Sage). They both include deduction, symbolization, and representation as mathematical practices. There are differences in the scope of contents. Regarding use we found that instructors took advantage of the features only when those could be integrated into their usual practices.

Even though the textbook continues to be one of the most important resources for instructors, textbooks enhanced with technologically advanced features are still in their infancy. In Undergraduate Teaching and Learning in Mathematics with Open Software and Textbooks (UTMOST, Beezer et al., 2016), we investigate whether and how instructors and students take advantage of features that are included in dynamic textbooks enhanced with Sage computational cells (Beezer, 2015; Judson, 2017). Data sources include bi-weekly logs, surveys, video recordings of the planning and the enactment of lessons, interviews, and tests of content knowledge with seven volunteer instructors (one female, five Caucasian), four teaching linear algebra and three teaching abstract algebra. The textbook analysis allowed us to discern textbook characteristics in terms of three emerging thematically connected categories: dynamic features, mathematical practices, and scope of contents. Using the documentational approach (Gueudet & Trouche, 2009) we analyzed two processes, instrumentation (how the textbooks "affect" the instructor) and instrumentalization (how the instructor "affects" the textbooks), present when instructors used the textbooks for planning and teaching. While the textbook analysis indicated that the potential for novel use is embedded in the design of the textbook features, we found that novel use was not as extended, in part, because the instructors lacked familiarity with, or experience using, the features embedded in the textbooks. In particular, we found that instructors took advantage of the features only when those can be integrated into their usual practices. All the participant instructors used their textbooks to create their lecture notes attending to the sequencing of topics presented in the textbooks and maintaining the notation, definitions, and theorems. Their lecture notes nevertheless included either different proofs (because the proofs provided were not satisfactory for the instructors) or additional examples (because the ones available in the textbook were not contextualized or had no geometric visualization). We explained those departures with instructors' personal and professional histories and experiences teaching a particular course, their understandings about how resources should be used, and their goals for teaching the course, according to the documentational approach.

References

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