Considering What We Want to Represent

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Abstract Both the fields of mathematics teacher education and research on mathematics teachers have been making extensive use of representations of teaching, whether through written cases, video clips of actual practice, or a range of designed representations (like storyboards or animations with cartoon characters, e.g., Chazan and Herbst in Teachers Coll Rec 114(3):1–34, 2012). This reflection on the contributions to this monograph suggests that as mathematics educators continue to grapple with what representations of teaching are and might be, we give greater attention to the objects to which these representations, as signs, refer.

Keywords Representations of teaching · Mathematics teacher education
Research on teaching

This monograph is a welcome contribution to the growing scholarly attention to representations of teaching and their use in teacher education and research on teaching (e.g., Zazkis and Herbst 2018). In responding to this collection, I suggest that as we continue to grapple with what representations of teaching are, we give greater attention to the objects to which these representations, as signs, refer. In doing so—though it may be challenging—in our publications when we describe uses of representations of teaching, I suggest that we try to specify more clearly the representing that is being done with these representations; said another way, we should try to specify what it is that the representations offered by researchers or teacher educators are intended to represent.

The importance of representing teaching is one of the shared features of research on teaching and the practice of teacher education. This importance of representing practice is not limited to teacher education as a field of professional preparation; indeed Grossman and colleagues document the importance of representing practice for those preparing clergy and clinical psychologists for practice (Grossman et al. 2009). Stimulated in part by ways in which mathematical activity makes use of

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representations of mathematical objects, this monograph focuses on the artifacts, representations, that are used in the process of representing teaching to teachers or teacher candidates. Contributions to the volume use representations of practice to do research on teachers' mathematical content knowledge (Buchbinder and Cook, this volume), to establish the impacts of professional development (Koellner et al., this volume), to seek to understand how particular representations—like Concept Cartoons (Samková, this volume) or video (Hoth et al., this volume)—can be a resource for such research, or to even compare teacher candidates' reactions to different formats of representations to explore the affordances and constraints of these formats for a variety of purposes (Friesen and Kuntze, this volume). Similar to the work in this monograph, recently, other researchers have explored the degree to which teacher candidates treat representations as authentic (Herbst et al. 2013) and the degree to which representations of teaching are effective tools for eliciting knowledge of practice (Herbst and Kosko 2013).

With the advent of technologies that have eased the capturing and sharing of video and those that have supported the creation of graphic arts representations of classroom interaction, self-consciousness about the use of representations of teaching in research on teaching and in teacher education has grown substantially, perhaps explaining the existence of the sort of research presented here. Much of this work has focused on characteristics of the representations themselves. For example, as a way to understand the proliferation of representations of practice used in teacher education and research on teaching, Herbst and colleagues have suggested dimensions for distinguishing representations of practice. First, they suggest that: "Representations [of practice] can be characterized and distinguished according to their origin, from found to transformed to designed" (Herbst et al. 2016, p. 82). One might think of found representations as ones like unedited video clips where it is hard to see the specific decisions that have gone into the creation of the representation (though Hall 2000, reminds us that many such decisions have been made). Transformed representations, like the edited video clip, have undergone an explicit and evident process of editing. Designed representations, like storyboards and animations that use two-dimensional cartoon characters, by contrast, are much more clearly created. Then, Herbst and colleagues offer two other dimensions for characterizing representations: Temporality and Individuality (p. 84). While these dimensions are useful for representations in a range of what Friesen and Kuntze (this volume) label formats, these last two are especially useful for distinguishing designed representations, like storyboards and animations, that use semiotic resources for the creation of representations of teaching (Herbst et al. 2011). Temporality helps distinguish how such representations, as opposed to unedited clips of video, do not seek to represent the ways in which time elapses in classroom interaction. Individuality as a dimension helps a viewer understand decisions the creator of a designed representation has made in selecting what aspects of characters to represent.

The work reviewed so far, focuses on dimensions of the representation itself and how those dimensions make certain qualities of classroom interaction available or not available to the end user. Returning to the analogy to representation of

mathematical objects, and considering more particularly multiple representations of functions in mathematics education, the work reviewed so far helps us understand different formats of representations of teaching as analogous to the tables, graphs, and expressions that provide different insights about the functions they represent. Yet, in much of this work on multiple representations of functions, the learner represents the same function in multiple ways and coordinates what is learned from the variety of representations into a deeper understanding of the mathematical object itself. The situation when it comes to representations of teaching feels quite different. We tend not to have different representations of the same interaction (though Friesen and Kuntze, this volume, explore such a possibility). And, it is unclear whether the object whose representation is intended is indeed the same across the use of different formats of representation, let alone within each format (in this sense storyboards and video are not as different from one another as they might seem on first blush). For example, sometimes a video is intended to represent what happened on a particular day with particular students in a particular teacher's class and thus represents this teacher's practice. But, that same video can also represent a kind of teaching that teacher candidates are meant to emulate. Or, the video can represent a dilemma that is common in teaching. More generally, in the hands of mathematics teacher educators, I suggest that representations of teaching are often not intended as a representation of a particular classroom interaction.

Thus, another way to seek to understand ways in which practice is represented focuses less on the artifacts themselves—their characteristics and the media in which they are created—and more on the nature of the representing activity, on what representational artifacts are meant to represent. In a recent review of the work of one dozen teacher educators using the Lesson*Sketch* platform (Chazan et al., accepted), we note teacher educators' uses of representations of teaching to capture the complexity of teaching practice by articulating dilemmas experienced by teachers, or a particular aspect of practice, or teacher candidates' initial efforts to carry out some aspect of practice. In this reflection on the contributions to this monograph, I would similarly like to close by focusing not on the utility of particular representational formats, but instead on what it is that contributors to this volume seek to represent, though in some cases I find it challenging to identify exactly what is intended.

A number of the contributions to this volume seek to represent actual classroom interaction as it occurred in some particular place at some particular time. For example, the videos of classroom practice that Koellner et al. (this volume) share with teachers are meant to represent practice that teachers should emulate in teaching similarity from a transformational approach and illustrate what they call specified professional development. By contrast, Kuntze (this volume) shares everyday examples of classroom practice, that are not viewed as exemplary, to have teacher candidates review what they see in these representations when they focus on cognitive activation, intensity of argumentation, and learning from mistakes. This focus may actually show teacher candidates that exemplary practice is relatively rare, even as they work to attempting to enact such practice themselves.

By contrast, some of the other contributions to the monograph seem to be the result of a process of what Grossman et al. (2009) might describe as a decomposition of practice into constituent parts. The representing of practice that seems to occur around these representations seems focused on particular aspects of teaching. For example, Webel et al. (this volume) focus on teachers questioning techniques as one aspect of practice that teacher candidates can work on improving. Similarly, Samková (this volume) focuses on how students might respond to a question and how to create discussion around ideas elicited from students.

Looking forward, it seems to me that a continued focus on representations of teaching both in research on teaching and in the context of teacher education is warranted and is quite likely to continue. Perhaps future work will help us learn more about relationships between the dimensions of representations of practice and the nature of the representing of teaching being done both in the context of teacher education and research on teaching.

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