WHAT HAPPENED IN THE SECOND SIMULATION?: ANALYZING THE FORMATIVE FUNCTION OF FEEDBACK ACROSS TEACHING SIMULATIONS

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We share the teaching simulation as one approach to providing formative feedback in teacher preparation and consider the ways in which teacher candidates (TCs) take up the feedback in subsequent simulations. We hypothesize that TCs' uptake depends on the connections between their own resources, the focus of the feedback provided, and the context of subsequent teaching.

Keywords: Instructional Activities and Practices, Preservice Teacher Education, Teacher Educators, Elementary School Education.

Beginning teachers who are "committed to supporting the mathematical success of each and every student" (Association of Mathematics Teacher Educators [AMTE], 2017) integrate strong content knowledge for teaching, skill with high-leverage teaching practices, adherence to professional ethical obligations, and commitments to equitable teaching and learning, alongside tools for learning and growing as professionals across their teaching careers (Davis & Boerst, 2014) into their teaching. For teacher educators (TEs), this implies designing opportunities for teacher candidates (TCs) to develop integrated knowledge and skills in ways that support TCs to build their capacity for reflection and improvement. We share teaching simulations as one approach to providing such opportunities with immediate feedback and we consider the ways in which TCs take up the feedback to demonstrate growth in their mathematics teaching practice.

Theoretical Framework

At the foundation of our work, we view teaching as involving the interactions between and among teachers, students, and the content situated inside of the school environment (Cohen et al., 2003; Lampert, 2001). We view teaching *mathematics teaching* as involving interactions between and among the TE, the TCs, and mathematics instruction, the content of teacher education (Ball et al., 2009; Ghousseini & Sleep, 2011; Shaughnessy et al., 2022). This implies that learning occurs through supported engagement in teaching, with opportunities to improve.

In this context, formative assessment allows TCs to demonstrate the integration of content knowledge for teaching, high-leverage teaching practices, and commitments to equitable teaching and learning This provides the TE with a snapshot of the TC's current knowledge and skill that can be the basis for providing feedback and additional learning opportunities that can foster subsequent improvement. Wiliam (2010) posited that the utility of formative assessments is measured by the extent to which they allow the demonstration of knowledge and skill paired with the extent to which they support decisions about subsequent work. This is the goal of formative assessment in teacher preparation—to elicit information about TCs' practice and to provide feedback and learning opportunities that impact their future practice.

Our work is situated at the intersection of this interactive view of learning to teach and formative assessment. Simulations are used as contexts to practice and demonstrate capabilities with teaching practice. Simulations are approximations of practice (Grossman et al., 2009) that place authentic demands on a TC while controlling the complexity of the work. Simulations allow the TE to control the mathematical content that the TC encounters, the strategies and thinking represented by students, and the teaching moves necessary to accomplish the goals of the simulation (Shaughnessy & Boerst, 2018a). We use simulations in formative cycles, allowing feedback to TCs to be taken up in subsequent simulations.

These simulations focus on two practices that are essential to the daily work of teaching, eliciting and interpreting student thinking (National Council of Teachers of Mathematics, 2014). Put simply, eliciting student thinking focuses on making students' ideas available through asking questions and posing tasks, and interpreting student thinking entails making sense of the information gathered to drive subsequent instructional decisions (Shaughnessy & Boerst, 2018b).

The TC's engagement in a teaching simulation cycle has four parts. First, the TC examines a piece of student work and plans questions to ask the student to learn about their process and understanding of the mathematics. Second, the TC has five minutes to interact with a simulated student to elicit the student's thinking. The simulated student is a live actor trained to use a set of response guidelines that specify the student's process and understanding of the ideas underlying the process. These guidelines include general guidance and specific responses to anticipated questions (see Shaughnessy & Boerst, 2018a). Third, the TE interviews the TC to learn about their interpretations of the student's thinking and their own understanding of the mathematics. Throughout the simulation and interview, the TE uses an observational tool to capture key aspects of the performance. Fourth, the TE engages the TC in a feedback conversation. Our approach allows us to gather evidence of a TC's knowledge and skills in nine performance areas (Shaughnessy et al., 2025) through an observational tool that is tied to feedback suggestions that the TE can use. We sought to explore whether and how feedback was taken up by TCs in a subsequent simulation involving the same teaching practices but differing mathematics content.

Methods

As part of ongoing work with TEs and TCs at two universities, we are supporting TEs in using the simulations with their TCs and learning about how TCs take up the feedback. We had 37 TCs engage in a pair of back-to-back simulation cycles with their TE (see the student work in Figure 1). TCs were given 5 minutes to consider the feedback and then engaged in the second simulation. After both cycles, we interviewed each TC to learn about their understanding of the feedback that was provided and their perception of and reasoning about the extent to which they did or did not take up the feedback. The simulations, feedback conversations, and interviews were video recorded. We analyzed the feedback conversations to identify the feedback as well as the interviews to identify the TCs' understanding of the feedback and why it was or why it was not taken up. To understand the corresponding uptake, the research team applied an observational tool to each simulation performance (see Shaughnessy & Boerst, 2018a).

Simulation 1	Simulation 2

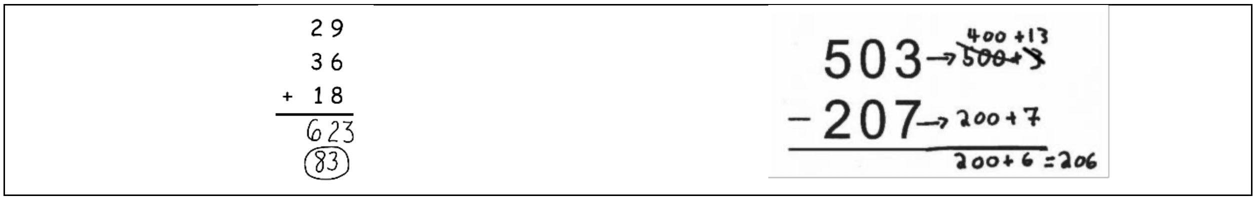

Figure 1: Student Work for Simulation 1 and Simulation 2

How Might a Teacher Candidate Take Up Formative Feedback?

In the first simulation (~3 minutes), a TC, Kendall, began by focusing on where the student had started and why. Kendall then pressed the student on what they had done in the ones place. The student shared how they generated the "23" in 6-2-3. Next, Kendall asked why the student had not carried. The student reiterated that using their approach, they write the answers below the column (and that they do not carry). Kendall then asked the student what would happen if they did carry. Kendall complimented the student on starting with the ones, which was immediately corrected by the student (who had started with the tens). Kendall then (incorrectly) stated that the student needed to start with the ones and asked about the reasonableness of the answer. By the end of the interaction, the student had stated that the answer was reasonable.

As Kendall interacted with the student, her TE used the observational tool to keep track of the sorts of moves she made. The tool revealed that Kendall did not learn about the student's full process. Further, Kendall did not ask about the student's understanding of why the 6 and the 2 can be combined, which is crucial given the student's process. Additionally, the TE noted that Kendall was directing the student to use a different process.

The TE engaged in a 7-minute conversation with Kendall, sharing three main pieces of feedback, which Kendall later described accurately. First, the TE named the importance of learning about the student's full method and shared that one strategy is rewriting the problem and asking the student to solve it again and to talk aloud as they solve it. Second, the TE suggested that Kendall ask probing questions focused on the student's understanding. Third, the TE suggested that Kendall stay open to learning about the student's process rather than imposing her own method to solve the problem or assuming that there is one right approach. Kendall had 5 minutes to consider the feedback and continue to plan for eliciting the second student's thinking.

For the second simulation (~5 minutes), Kendall began by asking the student to re-solve the problem. She then asked questions about the student's steps, and after the student talked about the process of the trade, she pressed on where the 10 added to the 3 came from. After getting the student to talk about why they hadn't crossed out anything in the subtrahend, Kendall returned to probing the student's understanding of what they were adding to the "3." The student stated they had taken 100 from the 500 and only added 10 of that 100 to the ones place. The student also expressed that the number (the minuend) is supposed to be "the same" after a trade. Kendall pressed around the reasonableness of the answer and the student stated the answer was not reasonable. Kendall asked about other approaches and the student acknowledged that it was their first time solving a problem "without tens."

Looking at the uptake of the feedback, first, we see that, as suggested by the TE, Kendall had the student re-solve to support knowing about the entirety of the student's method. However, Kendall did not have the student talk while reworking the problem. Second, Kendall took up the TE's suggestion to ask probing questions by pressing on the student's understanding of core ideas. Third, the TE suggested that Kendall stay open to learning about the student's process, which was evident as Kendall did not encourage the student to solve the problem another way.

Contrasting Case: Lack of Feedback Uptake

We next turn to a case in which a TC, Sammie, did not appear to be taking up the feedback provided by her TE focused on probing understanding and posing a follow up problem.

Probing Understanding

In the first simulation, Sammie asked a question about the value of the 6-2-3. Sammie did not ask the student about their understanding of the combining of the 6 (tens) and 2 (tens). Sammie received feedback focused on asking questions to probe the student's understanding. The TE said, "Do you remember how we've been talking about different kinds of questions we ask kids and following up with the whys? That's what I want you to practice doing and continuing to do." In the second simulation, Sammie asked why the student added the minuend and subtrahend together, and the student responded that they "subtracted," but Sammie asked no questions focused on the student's understanding of core ideas. When interviewed by a research team member about how she had taken up the feedback provided by her TE, Sammie said she had heard the feedback and tried to use it but forgot what the student said and filled in her own thinking, noting that she had tried to probe the student's understanding but used the wrong operation. Later, Sammie said, "I think if I had worked with the same style of problem, I think I would've be able to get it right." Thus, Sammie noted that the differences in the approaches used by the two students factored into her ability to probe the student's thinking in the moment.

Posing a Follow Up Problem

As part of the first simulation, Sammie was asked in the follow-up interview to identify a problem that could be posed to the student to confirm their process and understanding. Sammie carefully identified a task and talked through her reasoning. In the feedback, the TE highlighted the care with which Sammie selected the numbers and named that posing another problem can be a useful strategy. In the second simulation, Sammie did not pose an additional problem to the student. Later, she said, "I was like, I don't know what problem I would give this child."

Uptake of Feedback

We note that it is challenging to ask about understanding in a context where there is a wrong answer or an unfamiliar algorithm and that the problem solved was a special case that surfaced a challenge that would not typically arise. Even though the feedback given by the TE could have been applied, Sammie may have needed additional support in learning about the sorts of understanding questions that could be useful in this particular mathematical situation, how to ask those questions in a situation where the answer is incorrect, and how to manage other complexities of interacting with the student in this context. Similarly, Sammie may have needed additional support to think about generating and using a follow up problem in this context.

Discussion

Across the broader data set, TCs varied in their ability or willingness to utilize the feedback provided by their TE. We hypothesize that TCs' uptake depends on the connections between their own resources, the feedback provided, and the context of subsequent teaching. We conceptualize resources as the combination of content knowledge for teaching, skill with high-leverage teaching practices, and orientations to teaching and learning that TCs bring to the work of mathematics teaching. In terms of the feedback, we are examining both the content (e.g., asking questions about student's understanding of core ideas) and the nature of guidance (reminding the TC about something already known, convincing the TC about the importance of something, and/or teaching the TC something new to try or think about). Given that the TC's teaching is influenced by the simulation context in which it occurs, we are considering the demands implied by particular mathematics content (invented/standard process, correct/incorrect answers) and particular characteristics of the student's thinking (degrees of procedural fluency and components of conceptual understanding) designed into the simulation.

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