Simulations in Teacher Education Conference:
Synthesis Review of Papers

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Amanda Benedict-Chambers, Missouri State University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Berg, C. (2019, February 19-21). *Maximizing data collection during a teaching observation, and for analysis, feedback and reflection in the context of teaching simulations using an app-based tool.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Levin, D., Grosser-Clarkson, D.L., Molina, N.G., Haque, A.A., Fleming, E.E., & Chumbley, A.K. (2019, February 19-21). *Pre-service middle school science teachers' practices of leading discussion with virtual avatars.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21). *Rehearsals of Teaching: A simulation of complex practice*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Wilson, C., Fales, H., Lee, C., Lee, T., Dickerson, D., & Castles, R. (2019, February 19-21). *Analyzing the reaction of pre-service teachers using simulation to practice teaching math or science*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

By focusing on different aspects of instruction in the simulations, the authors highlight the various complexities of teaching as well as different ways to provide PSTs with targeted experiences to practice and analyze those aspects.

Ghousseini focuses on instructional activities that can travel back and forth between methods course rehearsals and enactment in classrooms; one or more novice teachers participate as teachers and other novice teachers participate as students, exhibiting their understanding of how children think about math, and the relationships between students and content. Her work investigates the role the teacher educator plays in rehearsals. Rehearsals, compared to virtual simulations, provide the novice teachers with a unique opportunity to role play student thinking and to learn about student ideas.

Levin and colleagues research the use of virtual "avatar" students in the TeachLivE environment. They explore how PSTs engaged the avatars in constructing explanations for scientific phenomena, and their efforts to elicit and respond to student thinking. They also focused on the PSTs' goals for discussion.

Wilson and colleagues also explore PSTs' ability to elicit and respond to student thinking through the experience of a virtual simulation software (Mursion). They found the interactions with the student avatars directed the PSTs to consider the content from a child's perspective and to consider the questions a student might ask—which might resemble the opportunities provided in the rehearsals.

Berg argues that an app could help improve the observation, analysis, and feedback part of the simulation, by giving the teacher more quantitative data to analyze rather than relying on memory to reflect on one's instruction.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Ghousseini's theory of action focuses on the development of adaptive performance—the back and forth between repeated practice of skills and learning to use them adaptively with children in classrooms over time.

Levin and colleagues also emphasize the importance of practice; specifically, in practicing how to elicit and respond to students' thinking in discussions. They also examine PSTs' goals for discussion—hypothesizing that goals that are aligned with attention to student thinking is associated with responsive practices.

Wilson and colleagues also argue that PSTs need opportunities to practice the complexity of teaching in an environment that is less complex. They also emphasize that practicing in a virtual environment should transfer to practice in actual classroom setting. Backgrounded in the others' work, they argue that PSTs also need opportunities to plan—specially, to plan out talk moves and a discussion map prior to the approximation.

Rather than focusing on the chance to practice, Berg's work takes up the importance of reflecting and analyzing the practice given the complex nature of teaching.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

I think all of these lines of research are likely to be productive because they highlight a different, but valuable aspect of simulations that need to be examined.

Ghousseini focuses on the role the TE plays during the rehearsal and raises questions about what *aspects of teaching* can be productively simulated inside of the rehearsal.

Levin and colleagues argue that examining PSTs' *goals for instruction* is key and can both inform TE's practice and support the PSTs as they move into classrooms and student teaching.

Wilson and colleagues highlight the importance of considering the PSTs' *perspective* about the simulated experiences. They also argue that PSTs' *beliefs* about science and math teaching are important to consider and may shift as a result of opportunities to practices.

Berg argues that an app can provide important *data* that captures critical, complex aspects of instruction for a teacher to later analyze.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

Key questions and aspects of the simulations to consider:
- What mathematical/science content is the focus of the simulation? How is it selected?
- How do the PSTs prepare for the simulations? How do the PSTs analyze their practice?
- How are students' ideas and research-based misconceptions included for the PSTs to practice eliciting and responding to? (How do the avatars know how to respond?)
- How do the PSTs develop PCK through the simulation? Which aspects of instruction are foregrounded and backgrounded in each simulation?

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Dr. Craig Berg, University of Wisconsin-Milwaukee

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Chapman, A. & Alvarez-McHatton, P. (2019, February 19-21). *Mixed reality simulation in the preparation of secondary math and science teachers for teaching native Spanish speaking students.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21). *Rehearsals of teaching: A simulation of complex practice*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

All four studies incorporated the content knowledge of math or science, and one of those studies was situated in the context of ELL.

All four had 10-15 minutes segments of simulation.

Three of the studies included pre-service teachers, while one included practicing teachers.

The nature of the simulation tool differed across the four studies. Three of the four studies defined simulations per use of the Mursion/TeachLive virtual reality experience with the five avatars. One of the studies defined simulation as a PST teaching to peers and the TE (teacher educator).

The nature of the simulation in terms of PST's and TE's participation differed across studies.

1. Workshop and group planning, group practice and group reflection, individual practice and TE feedback, and reflection
2. Co-teach lesson with PST, whole group feedback, or online, then reflection
3. Teach, with Pausing for immediate suggestions and feedback; followed by group suggestions and feedback
4. Observe live or video, then analyze, the prepare and teach to PST's and TE; TE is both coach and student; PST's not scripted rehearsal for simulation, used Pausing during simulation to give feedback, the continue simulation; then teach in the field to real students

How does one know that a specific experience in a simulation approximates what a teacher will experience with a real student, or a real classroom? Many of the simulation scenarios target the goal of finding out what students know or think about the math or science content being taught in the lesson. Do the avatars, or PST's, or TE coach who simulate a student, provide interactions with the teacher or pre-service teacher, that are close, or close enough, to that of a real student who has misconceptions, or a lack of self-efficacy with the math or science content being taught in the lesson, that flavors the exchange between teacher and student. Perhaps, each simulation method should have a check for how well the simulation represents reality regarding the students they are teaching in the simulation?

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

1. The theory of action is a theory of the need to rehearse ambitious change in low stakes environment. The object of the theory of action is that modifications to teach involve posing purposeful questions and facilitating meaningful discourse can be developed and modified in simulations.
2. The theory of action is a theory that using simulations prior to fieldwork improves the use of ELL strategies. The object of the theory of action is that practice and reflection for using ELL strategies would improve using a simulation.
3. The theory of action is a theory of the use of a corrective model during in authentic and safe environments (simulations), involving cycles of teaching, with "pausing" interruptions, followed by corrected teaching to evolve toward deliberate practice. The object of the theory of action is that practice and reflection using this model would improve how PST's ask questions to elicit student thinking and advance use of challenging student's thinking.

4. The theory of action is a theory the use of specific activities that bridge teaching in simulations and fieldwork settings, using "pausing" and feedback at the moment of instruction. The object of the theory of action is using PST's and the TE as students in the simulation for the PST to foster elicitation of student thinking and orient students to each other's ideas of math.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

3.1 Each study utilized some degree of preparation. Each study utilized some form of feedback and reflection. One study used pre-simulation videos to note how the simulation changed interactions between teacher and student – more studies need to do pre and post to note the effect of simulations.

3.2 One student was situated in a school setting, thereby making it easier to note the effect on the simulation on post-simulation teacher-student interactions. One study involving PST's specifically used science or math activities in the simulation that directly transferred to fieldwork activities with students in schools. We need more studies that determine the impact of the simulation on how PST's or teachers teach post-simulation in the context of real classrooms, or real children.

3.3 Pausing – interrupting teaching while in the midst of the simulation, to give feedback, is an interesting format. Is "Pausing" a format that has more impact on changing teacher-student interactions, than other formats where feedback and suggestions are provided post-simulation. I wonder because the act of teaching is complex, and novices are often limited by tunnel vision, and are PST's able to contextualize the immediate feedback, or is watching themselves on video to see all that is taking place, then receiving the feedback linked to the video segment, a more effective way of enacting change in teaching practice?

3.4 A study utilized the PST's and the TE as the students in the simulation (versus avatars). To what degree of reality can PST's simulate real children and real children's thinking? How much reality is added into the simulation when the TE is also one of the simulated students? A TE should be much more aware of misconceptions held by real children and perhaps can add this into the responses of the simulated situation to bring more reality to the scenario?

3.5 A couple studies used groups (2 or more) of PST's or teachers in teaching during the simulation, as co-teachers, or in the same room as the person teaching, and then wondered about the benefits of having more than just the one person in the simulation. I wonder a`bout the effect of the group on a particular individual and uneasiness or

confidence while teaching – it may take a low risk environment and raise the stakes considerably.

3.6 One study examined the impact of the simulation on PST's use of ELL strategies. During the simulation, the PST's who were bilingual, after encountering the avatar who responded in Spanish (CJ), then proceed to refrain from interacting with CJ – this is extremely interesting behavior and needs to be explored further.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I think that 3.3 – 3.6 noted above are interesting and need more attention if we are going to realize the full impact of simulations on PST's or teachers.

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Review Written by Rebekah Berlin, University of Virginia

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Benedict-Chambers, A. (2019, February 19-21). *Learning to notice elementary students' ideas and use of science practices in tool-supported rehearsals.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Pecore, J. & Lew, S. (2019, February 19-21). *Linguistically responsive teaching for English learners in virtual classrooms.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycle.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Wild, A. & Karamcheti, M. (2019, February 19-21). *Design Principles and Process of Designing Mursion Scenarios with Teaching Candidates.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The word simulation was used in a variety of ways across the four papers. Sometimes, the word simulation was used to specifically denote mixed-reality practice experiences where teacher candidates attempted various teaching practices with digital student avatars. In fact, three of the four papers described mixed-reality simulations using the Mursion software platform. However, two of the papers, including a paper that focused on the Mursion mixed-reality platform, used the term simulation more broadly. These authors used the word "simulate" interchangeably with "rehearse." Both terms were used to describe structured practice opportunities where teacher candidates had the opportunity to attempt particular teaching practices with or without digital aids.

Across these four papers then, there seem to be two competing conceptions of simulations. Under the first, simulations are a particular *type* of rehearsal—one that incorporates digital student avatars. In this framework, rehearsals and/or approximations of practice are large umbrella terms that encompass several different ways to attempt and improve teaching practices. These include rehearsals with classmates and/or instructors in methods courses as

well as rehearsals with avatars in a digital learning environment (simulation). Under the second framework, simulations, approximations, and rehearsals are synonyms. That is the three terms are used interchangeably to refer to role-play-like practice opportunities for particular facets of teaching.

While there are similarities between rehearsing a teaching practice with classmates and rehearsing a teaching practice with a classroom of digital avatars, there are also marked differences. Therefore, it seems having separate words that denote these related but distinct pedagogical opportunities would be helpful for the field. In particular, this distinction will be necessary as the field moves toward a better understanding of which practices may better lend themselves to one practice environment versus the other (e.g., the technological constraints of the Mursion platform mean that several teaching practices cannot be practiced with the avatars).

Another major difference across these papers is the degree to which the terms "simulation" "rehearsal" and "approximation" refer to a formal pedagogical structure. In some papers, these words were used to describe general practice opportunities. In others, these terms referred to an explicitly defined pedagogy that included a practice opportunity and also some sort of formalized preparation and debrief. Again, the field needs clarity as to whether these are interchangeable common nouns or whether they are proper nouns that demarcate predetermined pedagogical structures.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

There were several commonalities in the theories of action described in these four papers. First, two of the four theories of action were situated within the context of supporting English Learners (ELs) during science instruction. In particular, these authors highlighted the importance of candidates using a codified set of teaching practices when teaching ELs. This general idea was actually present in all four papers. While the other two papers did not focus on supporting ELs, all four papers were focused on a particular object – providing candidates the opportunity to practice a facet of teaching the authors felt was critical to success of students *before* candidates actually attempt this with students.

Despite these similarities, there were also several differences. The theories of action the authors explicitly documented in the Theory of Action section of the paper operate at two different levels. Three of the theories of action described operated at the teacher candidate

level. That is, they were focused on developing candidate behaviors (teacher candidate noticing and improvement of particular high-leverage practices). One paper was focused on the process of simulation design rather than the content of a given simulation. Therefore, this theory of action operated at the level of simulation designers or teacher education faculty, rather than at the level of teacher candidates.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

Across all four papers, the authors appear to have bought into the importance of practice-based teacher education. Underpinning the research laid out in each paper were three ideas. 1) Rehearsal is crucial to improved teacher practice. 2) There are aspects of teaching that *can* be rehearsed. That is, teaching is not so context-dependent or improvisational that nothing can be formally identified, taught, practiced, or improved. 3) It is possible to simulate some, but not all, aspects of a classroom environment. The authors of each paper were explicit about the affordances and constraints of each type of simulation or rehearsal they studied. These three ideas lead to several productive strains of research including identifying key features of productive simulations and optimal use cases. For example, the authors at Woodrow Wilson Academy articulated design parameters for their simulations. They require that every simulation is focused on a situation that would be high-stakes for teacher candidates and students in real life, but low stakes when simulated. While this design principle reflected the preferences of the Woodrow Wilson design team, empirically exploring and justifying other similar parameters could be helpful for answering questions about a) when simulations are and are not beneficial, b) for making decisions about which practice opportunities should take place mixed-reality environments (especially given that mixed-reality simulations require substantial resources) or with peers and instructors in methods classrooms, and c) the degree of structure and support necessary for simulations to be beneficial.

There were also several differences between the lines of inquiry presented in each of the four papers. For example, the authors described using simulations for different purposes including assessment of candidate practice, candidate practice opportunities, a launch pad for candidate reflection, and as an opportunity for researchers to learn about candidate's emergent teaching practices. Given the dearth of measures of candidate development in teacher education, exploring simulations as a means of formative assessment seems likely to be extremely productive for teacher preparation programs, teacher candidates, and researchers alike. Before this can happen, however, researchers need to develop standardized simulations and outcome measures (the researchers at SMU have begun promising work on observation protocols) that

can be used at a wide scale. The four papers presented here had very limited samples and did not describe the degree to which there was consistency across simulations.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

- Woodrow Wilson Academy described designing simulations aligned with their broader program competencies. What are these competencies? How were they developed? Does every competency have a simulation? Is candidate development of these competencies measured in a systematic way and if so, does this involve simulations?
- Interested in SMU's work using simulation to measure effectiveness of coursework and interventions. In particular I would like to hear about a) the level of standardization they have achieved across simulations that they are using for assessment, not pedagogical, purposes; b) the level of buy in from students and faculty; c) how they use the data from their simulations; d) whether they are finding simulations as a more powerful tool for candidate learning or assessment (or equally as effective in both roles).

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Rhonda Bondie, Harvard University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Wild, A. & Karamcheti, M. (2019, February 19-21). *Design Principles and Process of Designing Mursion Scenarios with Teaching Candidates.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Simulations that approximate situations and promote practice proximal to those teachers experience daily emerged as a common goal across the four papers, Wild & Karamcheti (2019), Garrett (2019), Self (2019), and Kretschmer & Kwon (2019). However, the papers showed variance in defining simulations. Two papers referred to simulations as rehearsals with Wild and Karamcheti (2019) providing the following definition, "learning experiences where teachers rehearse for important moves they make when interacting with students and adults, and then reflecting on those rehearsals" (p. 1). While Self identified simulations as a "cycle of instructional tasks that occur each time a simulated encounter happens." It was unclear if approximations included the full complexity of teacher daily tasks or intentionally limited the complexity of a task by using a simulation to isolate an element for the participant to develop and practice.

The goal of each simulation was to approximate or provide experience in practice "proximal" to the teaching profession. To do so, each paper leveraged Mursion with goals of providing preservice and inservice teachers meaningful and authentic experiences through engaging with

the student avatars. Simulations were part of a learning, assessment, and feedback cycle achieved through a sequence of activities such as pre-readings or learning activities, digital and non-digital simulations, debriefs and coaching sessions. Common to the papers was the advantage of simulations as a means of creating safe environments for teachers to practice high leverage practices and reflect on their simulated experience either individually, one-on-on, or in a group setting. Simulations were carried out with combinations of teams and individuals. Often participants experienced the simulation multiple times in different settings, such as a class fishbowl, teams advising the teacher experiencing the simulation, and as individuals.

These papers highlight a foundation for simulations as being authentic or realistic experiences and safe environments yet the definitions and theories of action focus on outcomes relative to more general teaching practices such as questioning, promoting classroom discussions, and developing a reflexivity regarding practice or one's own positionality. Two papers focused on approximation to include the complexity or situations likely to be encountered again while the other two seemed to focus exclusively on the behaviors being promoted. Further discussion is needed to understand the extent to which and ways simulations might include aspects of both practices, communication methods, problem-solving approaches, and context common to a given field or profession.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

All four papers examined simulations focused on developing teacher practices and used the simulation as part of a sequence of learning events. Three of the papers leveraged both digital and non-digital components for teachers to acquire knowledge, practice an instructional move, and reflect on the application of the new learning to teaching practice. Two of these papers had explicit goals focused on changing teachers practice relative to teachers asking purposeful questions and promoting student discussions with goals of gaining insights to student thinking and drawing connections between students. While the third paper had a primary goal of increasing teacher reflexivity and understanding of their positionality with a secondary goal of using this self-awareness and exposure to anti-oppressive pedagogy to promote equitable practices. Interestingly only one paper, Kretschmer and Kwon (2019), identified a clear problem to be addressed, focusing on addressing shortcomings of teacher preparation programs by providing experience that serve as "approximations of practice" (p. 1).

The fourth paper highlighted the design process focusing on a five stage sign process that met seven principles of design for Mursion presented by the team: active participant of target population (1), alignment with teacher competencies (2), creating a realist (3), unique (4), and

authentic situation (5), space to practice decision making (6), and deepen understanding through a debrief (7).

The theory of action situated simulations in a sequence of learning events. The sequence included cycles of learning, applying learning to practice or acting with the learning, and feedback. The visible object or learning being measured was changes in behavior as monitored through the simulation. A possible hidden object of learning is the thinking pattern that results in the behavior and behavior change. Possibly discussed in the debriefs, but not central to the simulations, was examining the teacher thinking of how responses are determined and how teachers control their thinking to make a conscientious choice to change a behavior to apply a newly learned skill, while being actively engaged in a time bound complex iterative situation.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

The papers converged through the desire to approximate teaching practice using Mursion as part of a learning sequence including readings, activities, in-person coaching, group coaching, observations, individual reflection and/or group debriefs. The common goal was to improve teacher practice through a cycle including the acquisition of new knowledge and skills, application through rehearsal, and reflection. Our team felt that the focus of simulations as formative learning experiences for teachers is a productive route to pursue. Engaging in high-stakes situations in low-stakes settings and feedback oriented on growth and not judgment seem to be key aspects that mediate teacher respective outcomes for each intervention. Authentic and safe, supportive environments should provide the space for experimentation and a vulnerability in moments of receiving and giving feedback or reflecting on practice.

There is a concern as the three interventions seem to be resource intensive interventions with programmatic, coaching, and digital elements all needing to be designed, aligned, and maintained throughout the research project. The potential for fidelity to play a role in mediating outcomes increases as the number of moving parts increases. It would be important to see how fidelity is being promoted and assessed to rule out idiosyncrasies of the setting, support individuals, or participant/group characteristics in the case of coaching and group debrief elements. Furthermore, a comparison to or at least reference to the status quo the intervention is replacing or supplementing will be important context information. Perhaps conference attendees could share any comparisons they have explored of digital simulation versus low cost paper-based simulations impact on teacher practices. Especially in the case of Garrett whose control group in their randomized control trial should be compared to the status

quo or business as usual. Finally, it seems that the digital components are to use as materials for coaching sessions or individual and group reflections on practice. In-line with comparison to the status quo, it would also be of use to explore how the digital and non-digital components alone impact participant performance.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

Relative to Mursion, our team would like to learn more about the design process used by the other conference attendees as they relative to the four parts of Mursion as outlined by Wild and Karamcheti (2019): learning objectives; a scenario, a problem that the teaching candidates (TC) need to solve; "hits and misses," examples of effective and ineffective responses by the TC and how the avatars should respond; and debrief questions, prompts for feedback and discussion following the simulation. Additionally, insights into the engaging the interactor puppeteers through training and throughout the project.

Relative to the design and evaluation of the project, conversations around the expected dosage or repetitions teams expect teachers to undertake in order to achieve desired outcomes. Also, whether the teams have considerations to the degree to which projects are supplemental to existing training programs or professional developments or stand alone products. In the case of Wild and Karamcheti (2019), pulling back the curtain even further on the process of aligning simulations with programmatic goals and design considerations such as the context, problem, and content in order meet particular competencies. In addition, to what extent other programs have explored how student teachers and practicing teachers can set and reflect on personal goals accomplished through the simulations - so that the learning experience is aligned to a common program goal and is individualized in some aspect.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Elizabeth A. Davis, University of Michigan

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Reich, J. & Thompson, M. (2019, February 19-21). *Exploring authenticity and playfulness in designing of teacher practice spaces.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycl*e. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Ware and Wernick define simulations as "human-augmented, real time teaching and conversation interactions". They use these "mixed reality simulations" in two ways. First, they use them to assess teachers' instructional choices prior to and after engaging in professional development around supporting English learners. These simulations are with student avatars. Second, they use them during the program to support the development of skills for interacting with families of language learners. These simulations are with adult avatars.

Reich and Thompson do not provide an explicit definition, but note that their "teacher practice spaces" are focused on something more like drills than like scrimmages – they are intended to help build some of the skills teachers need.

Garrett also does not provide an explicit definition, but they (like Ware & Wernick and like Kretschmer & Kwon) are using a mixed-reality classroom simulation technology. They use them with student avatars to work on facilitating classroom discussions of mathematics.

Kretschmer and Kwon define approximations of practice using Grossman's definition ("opportunities to engage in practices that are more or less proximal to the practices of a profession"). Like others, they use the Mursion digital simulation software, which others describe as providing mixed-reality simulations. They use the simulations in elementary science to work on eliciting students' ideas about evaporation and condensation. They use them in elementary mathematics to work on eliciting students' ideas about long division.

Three of the four papers here use "mixed reality simulations" using student and/or adult avatars. Although not much detail is provided about what a mixed reality simulation is or how it works (an issue likely driven by space limitations as much as anything else), I can glean a sense of this based on my previous experiences viewing such systems. The other paper focuses on the authors' "teacher practice spaces" with an emphasis on skill-building and playfulness. Several such practice spaces are described, and through the description, we can get a sense of what these entail.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Two of the papers (Ware & Wernick and Kretschmer & Kwon) start from the premise that high-leverage practices can be taught and simulations can provide opportunities to practice in safe (low-stakes) and deliberate ways, with Ware and Wernick also emphasizing that the simulations reduce the complexity of instruction. Each of these papers focus on specific aspects of the practice(s) of focus and have designed simulations that allow participants to demonstrate those practices. They each have particular outcomes that they can watch for, to see if participants have in fact developed the intended skills or practices.

Garrett's theory of action assumes that the professional development workshop will build instructional knowledge. Then, participants experience the simulation (including a cycle of practice, feedback, and repetition). (Presumably this hinges on an interior theory of action similar to that described for the above two papers, but this is not made explicit.) The author notes that experiencing the simulation cycle in turn should lead to improvements in classroom instruction and self-efficacy (which also interact with one another).

Reich and Thompson's theory of action is quite different from the others in some ways. Like the others (implicitly or explicitly), they attend to the authenticity of complexity. Unlike the others, they also attend to the authenticity of setting, of role, and of task. They posit that all four dimensions are important to consider and that varying the level of authenticity along one or

more of these dimensions (to be less authentic) can open up "a wider design plane for teacher practice spaces with more opportunities for including playfulness."

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

For Ware & Wernick, the simulations serve as pre/post measures. They teach two versions of the class, one at a community center (treatment) and one at the university only (control). Thus far, the authors have identified a main effect for time (teachers get better across the year), but no effect for treatment/control or for preservice/inservice. This has led to some modifications of their instructional approaches. While the authors don't frame their work explicitly as design-based research, it seems that it is. DBR seems like a promising methodology for these beginning stages of the use of simulations in teacher education.

Reich and Thompson have developed three design conjectures based on their work so far. First, authenticity of task is the pre-eminent consideration. Second, other forms of authenticity can get in the way of playfulness. Third, there are different ways to embed expert practice into a design of game play. Their designs have taken a range of forms and are based on the basic premise of playfulness as a way of developing skills. Design-wise, this is the most out-of-the-box implementation among this set of papers.

Garrett is conducting a randomized control field trial involving 22 teachers in the professional development group and 25 teachers in the control group. Garrett is looking at classroom video to watch for improvements (and, presumably, looking at records from the teachers' participation in the simulations themselves, although this is less clear to me). Examining teachers' classroom practice is an important component of determining the efficacy of any pedagogy of practice.

Kretschmer and Kwon have developed simulations for use in elementary science methods (toward the end of the program) and elementary math methods (toward the beginning of the program). They focus on the written reflections generated by preservice teachers after experiencing the simulations. This is helpful for getting at participants' reactions to and experiences of the simulations, but doesn't help us know as much about their actual practice and whether it's improving.

Combining classroom video, records from the simulation experiences themselves, and written reflections and/or interviews seems like an approach that would allow more robust claims to be

made. Furthermore, using design-based research to iteratively refine the nature of the simulations themselves seems like a promising approach.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.
I am interested in learning more about these authors' uses of avatar children and avatar adults (Ware and Wernick, Garrett, Kretschmer and Kwon). I'm interested in how much control the teacher educators have over the behavior of the avatars.

I liked the implicit use of DBR in thinking about how we can learn from and make quick adjustments to both our simulations and our instruction (Ware and Wernick). I also liked the inclusion of teachers' reflections as a data source (Kretschmer and Kwon), though I don't think it should be the sole data source for gauging the efficacy of the simulations. I think we need to know more about participants' experience of the simulation – how they experience the (lack of) authenticity, how "low stakes" it really feels to them, etc.

I appreciated the "scrimmages" versus "drills" metaphor (Reich and Thompson) and find this really generative for my own thinking about approximations of practice. I also enjoyed reading about the ways in which those authors (again Reich and Thompson) operationalized the work on drills in their "teacher practice spaces", which was quite different from the other papers here.

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Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Hala Ghousseini, University of Wisconsin-Madison

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Davis, E. & Arias, A.M. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Walker, J. (2019, February 19-21). *Simulations as professional apprenticeships.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

All the papers that I read involved simulations that had a standardized component (simulated student or parent/colleague). For the majority of the authors (with the exception of Walker), the simulation is defined as the act of experiencing *through role play or through live participation* a task/activity as a teacher.

In these examples, a simulation is structured around tasks/activities that were described as pertaining to "the real-world" or "what teacher have to do (such as instructional practices that are central to the work of teaching). The tasks have some level of authenticity in relation to practice : they either drew on actual work that teachers do or involved in-the-moment decision-making in response to stimuli or events that arise in the course of interactions with students. . While in some cases there were differences in the way simulations were designed, several of the authors described participation in a simulation as either part of a cycle or series of stages that involved preparation for the simulation and debriefing. For example, in the case of Walker, the preparation involved analyzing case materials and preparing for meeting with family. In the case of Arias and Davis and Shaughnessy and Boerst, the preparation involved information about student work. Debriefing/reflection and analysis of the simulated interactions are

common features between some projects. For instance in Arias and Davis project, the reflection takes place in the context of an interview that follows the simulation. In the Self project, participants reflect and make sense of the simulated interaction by watching a video record of it.

I saw a difference in definition of simulations in the work of Walker who proposes the idea of digital case studies as simulations. The case study was a simulation, according to Walker, in the way it involved vicariously experiencing the work of the teacher (taking the perspective of the teacher through the decisions that pre-service teachers have to make based on something they read or other pertinent information). I wondered based on this definition, how we would determine what is not a simulation given that many activities of teacher preparation engage pre-service teachers in taking the perspective of the teacher such as when analyzing student work.

Simulations as defined by these authors anchor it as a pedagogy in practice-based approaches to teacher education, where novice teachers are given opportunities to be responsive to students and learning environments. What is being simulated and how it is considered to be authentic has important implications for teacher learning.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

A common feature of the theory of action across projects is the aim to support teachers in learning important practices and being able to draw on their knowledge (knowledge of students or content) in making instructional decisions. The instructional decisions are co-opted in relation to particular challenges and events. Some authors referred to these challenges as "authentic" but it was not always clear what was meant by authentic.

The idea of supporting and nurturing teachers' decision making inside simulations is productive to the field. It suggests that simulations are not only a way to practice particular routines, but also to develop judgment and commitments for ambitious and justice-oriented teaching. Two of the projects (Walker and Self) referred in their theories of action to deliberate practice, suggesting that their use of simulations affords novices learning from repeated practice that is accompanied by feedback. The feedback as described in most of these projects often took place post simulation, either in the form of debriefs or interviews. I was interested in learning more about how deliberate practice as a theory of action was actually guiding the design and enactment of the simulations. Where are the opportunities for repeated practice and for

feedback from debriefings to cycle back into pre-service teachers' encounters with simulated students (or parents)?

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

There is convergence is the concern expressed in relation to ensuring that simulations provide a meaningful representation of teaching within a controlled environment and thinking about what conceptual tasks can be the focus of the simulation. There is convergence in the way the simulations are aimed to target more than particular skills (whether when used as assessments or learning tools). Many of the authors noted in their future steps attention to how programmatic structures at different universities and teacher education programs could support work on simulations. This is a productive line of inquiry for understanding the kinds of resources (conceptual and organizational) that can support work on simulations and as a consequence teacher learning.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I am intrigued by the work on equity issues that is happening within the SHIFT project. I appreciated the author's attention to considerations for the range of teacher identities engaging in the simulation and how that can affect the design of the simulation. I am also intrigued and interested in learning more about the way simulations can be adapted to particular contexts and participants. What varies, what stays the same?
I am also interested in thinking more about how we test the productivity of simulations for teacher learning (as Walker asks, "how do we know whether simulations have an effect and what they are effecting?")

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Kathleen Ingraham, University of Central Florida

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Berlin, R. & Cohen, J. (2019, February 19-21). *Using targeted feedback conversations to support mixed-reality simulations*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Davis, E. & Arias, A.M. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Across authors simulations / approximations are defined as experiences that represent a teaching interaction but differ from real teaching practice in key features. The objectives of the simulation / approximation determine the focus of the design of the simulation and the defined interaction elements that are targeted for simulation. Some authors define a simulated environment as a safe space where learners are able to explore teaching practices with the benefit of expert guidance and feedback (Berlin & Cohen, 2019; Self, 2019). Others define a simulated environment as a space where the complexities of teaching practice can be simplified and focused to target specific high leverage teaching behaviors so that learners can enact and practice specific skills with a goal toward increasing frequency of use of those skills (Arias & Davis, 2018; Boerst & Shaughnessy, 2019).

With a safe space definition of simulation, the implied primary purpose of simulation is to prevent harm to real students. Simulation design would focus on those issues seen to be most harmful to real students. These may include teacher prejudices, disruptive behavior in the classroom, content misconceptions left unaddressed by the teacher, or other teacher practices

seen as inherently harmful. Also implied in the safe space definition is the philosophy that learners in the simulation should test out, explore, or experience teaching practices before they've reached a level of mastery. There is an implied lack of consequences for learner failure meant to encourage learners to work outside of comfort zones and challenge held practices and attitudinal beliefs. The assumption is that the learner will internalize the individualized experience and apply the learning to their teaching practice. The danger is that in the feedback cycles learners may not accept coaching or may not incorporate the learning in their teaching practice.

In contrast, a targeted skill set definition of simulation implies that the primary purpose of simulation is to build key skills to improve teacher practice. Simulation design would focus on providing an opportunity to enact key teaching behaviors that can be observed and analyzed. These may include any measurable behavior that can be represented in the simulated environment. Implied in the targeted skill definition is that observational data on a defined set of skills can be used to measure and improve teaching practice. Also implied is the philosophy that separating specific skills for training focus in a simplified environment will aid learners in understanding and applying that skill. The assumption is that once learned in the simplified training environment, the learner will be able to generalize that practice in a more complex teaching environment. The danger with this approach is that the simplification process may exclude critical factors that may prevent the learner from generalizing the skill to the real classroom.

While both definitions leverage a strength of simulation, the implied purpose and value of simulation differs. When considering a definition of simulation / approximation for the entire field, there should be room for both approaches.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Across theories of action there are common beliefs that: a) there is value in learners enacting a simulated teaching interaction as a way to apply intellectual knowledge of teaching practices and b) that one can measure a learner's skill level at teaching with a simulated teaching environment. In this group of papers, theories of action can be separated into categories of purpose and nature of performance feedback.

Theories of action in this set of papers can be divided into two categories of purpose: training and assessment. Theories of action that fall into the training group (Berlin & Cohen, 2019; Self,

2019) focus on the process by which learners receive feedback on their performance and how learner growth can be measured. Theories of action that fall into the assessment group (Arias & Davis, 2019; Boerst & Shaughnessy, 2019) focus on defining assessed elements and standardizing the simulated experience.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

Across papers in this group research has been conducted to measure in some way the effectiveness of the simulated experience. Some authors used observational quantitative methods to measure learner change (Berlin & Cohen, 2019; Boerst & Shaughnessy, 2019) while others collected more qualitative descriptive data on teaching practices (Arias & Davis, 2019; Self, 2019). Each case shows the use of simulation as a way to examine teaching practice. While each case poses interesting questions and sometimes evidence to suggest that simulation may be a valuable tool for training and assessing teaching practices, results cannot be generalized outside of the case.

A major limitation in all of these cases is that simulation factors have not been separated out for analysis of effect. While we may have a general impression of the effect of the overall experience, we need to ask what factors or elements of a simulated experience make it successful or unsuccessful. We get pieces of this when different forms of feedback are examined (Berlin & Cohen, 2019), or when standardization of confederate performance are examined (Boerst & Shaughnessy, 2019), but data is insufficient to measure the impact of each simulation factor.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

One idea that I found intriguing is the goal of using a simulated experience to enact attitudinal change. It seems at once extremely complex and difficult both to design and evaluate. Also, I imagine that one would be forced to confront divergences in teaching philosophy and values. I would really like to learn how others confront these challenges in this type of simulation.

I would also like to further explore the idea of individualizing learner experiences and finding standardization principles for dynamic difficulty scaling of simulated experiences.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by David Kretschmer, CSU Northridge

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Arias, A.M. & Davis, E. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Chapman, A. & Alvarez-McHatton, P. (2019, February 19-21). *Mixed reality simulation in the preparation of secondary math and science teachers for teaching native Spanish speaking students*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Lange, E. (2019, February 19-21). *Does the teach live simulation system improve pre-service teachers self-efficacy?* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycle*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The authors view simulations/approximations as providing per-service and inservice teachers the opportunity to rehearse teaching moves and practices, teacher/student interactions, and teacher/parent interactions in a simulated yet still authentic, e,g, "real" (Lange, 2019) teaching environments. The authors also variously viewed simulations/approximations as pre-assessments of future teaching practices prior to and following formal instruction in disciplinary-specific methodology courses (Ware and Wernick, 2019; Arias and Davis, 2019); opportunities for teacher candidates to practice discipline-specific practices in low-stake environments prior to completing field experiences with children (high-stakes environments) (Chapman and Alvarez-McHatton, 2019; Arias and Davis, 2019); practice approaches to teaching specific populations of students, e.g., ELs (Ware and Wernick, 2019; Chapman and Alvarez-McHatton, 2019); demonstrate the ability to modify instruction to meet specific populations (Ware and Wernick, 2019); to provide feedback to teacher candidates and teacher educators on teaching practices and content knowledge of teachers (Arias and Davis, 2019); learn about the ideas and reasoning students demonstrate in grappling with new concepts that

are introduced in teaching (Lange, 2019); promote teacher reflection on effective practices (Lange, 2019); and increase teacher self-efficacy (Lange, 2019). Discussions about how the authors used simulations indicated differences in digital vs. non-digital simulations and the opportunities each provided teacher candidates and their instructors, the specificity of the practices teacher candidates used (teaching a specific high-leverage practice vs. leading a general discussion), how data from simulations are used in the preparation of teachers, the role of teacher candidates in preparing lessons for the simulation, the role of teacher educators in preparing for and implementing the simulation experience, attention to the validity of the simulation experience when teacher candidates participate in more than one simulation. The common elements and differences in the four papers is summarized in the following table:

Simulation Element	Arias & Davis	Chapman & Alvarez-McHatton	Lange	Ware & Wernick
Context	Undergraduate teacher preparation program	Math and science methods course	Mid-level teacher candidates in math/science methods course	Teacher education/science education
Digital vs. non-digital	Non-digital w/ teacher educator (1:1)	Digital avatars as students (1:5)	Digital avatars of students (1:5)	Digital avatars (1:5) as students (pre/post) and adult avatars during program
Targeted practices	Elementary teacher candidates in implementing high-leverage teaching practices in science	Secondary math and science teacher candidates in meeting needs of ELs	Middle-level teacher candidates in discussion of science phenomena or math task	High-leverage teaching practices for ELs in science Skills in interacting w/ families of ELs around science curriculum
Teaching practice	Design and teach lesson based on: 1. Information about the investigation 2. Learning objective of lesson 3. Prior knowledge from class discussion	1. Design 5E lesson plan for high school teaching in biology, chemistry, or algebra 2. Co-teach the lesson	Conduct a discussion with avatars around a scientific phenomena	Focused on 2 key objectives: 1. Build background knowledge 2. Elicit interactions between students

Simulation Element	Arias & Davis	Chapman & Alvarez-McHatton	Lange	Ware & Wernick
Role of the teacher candidate	Teacher candidate designs lesson and teaches 1:1 with teacher educator	1. Teacher candidate designs lesson 2. Peer observation with feedback	1. Teacher candidates generate discussion with avatars 2. No peer observation	Teacher candidate not involved in design
Role of the teacher educator	Interact as "student" with teacher candidate	Use as a tool to advise on teacher candidate preparation; Observe lesson	Provide feedback to teacher candidates; Review reflection on experience	Establishes focus on learning that occurs through program (per pre/post); Skills in interacting w/families
Issues of fidelity of the interactor	Teacher educator establishes standard protocol focused on specific skills; Conducts standard interview with TC	Not addressed	Variable; Depends on teacher candidate discussion with avatars	Adopt consistent personality profile as ELs
Purpose of the simulation	Practice high-leveraged teaching practices; Assess content knowledge in science; Assess change on skills (pre/post) teacher content knowledge	Develop competencies to meet needs of ELs; Develop reflective practices	Increase teacher self-efficacy	Impact of focused instruction based in pre-assessment simulation; Measure impact in post measure; Centered on 3 main constructs on teaching ELs
# of simulations	2 – pre/post	1	1	2 – pre/post Interactions with parents/families of ELs (ongoing)

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Bennett's (2010) conceptualization of "a theory of action" serves a useful framework for comparing different simulations/approximations across different components of a theory of action:

Theory of Action Element	Arias & Davis	Chapman & Alvarez-McHatton	Lange	Ware & Wernick
Object	Enact high-leverage teaching practices, assess teacher candidates' knowledge	Develop EL instructional practices	Approximate experience leading discussion prior to practice teaching	To pre/post-assess TC's instructional choices; practice interactions w/families
Components		Observe instruction and record and assess teacher-student interactions	Open-ended undefined discussion in math or science	Parallel lesson plan to avoid test/retest effect
Interpretive claims	Teacher candidates benefit from representing data; build on strengths, address struggles	MRS system as a tool to explore implicit bias, stereotype threat, microaggression	Simulations increase teacher self-efficacy (TSE)	
Action mechanisms	Pre-assess to inform teacher educators	Learn through observing others teach	Approximations of practice -> increase in TSE	Standardized approach to measure teacher learning
Intended effects	Focused attention on high-leverage practices and teacher knowledge base	Pre-assess TC knowledge of effective practices with ELs	Increase in TC's TSE	Pre-assess TC to focus on areas of need
Potential unintended negative effects		Discomfort in those who teach in front of peers		

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

No response.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I am interested in exploring more about many of the foci of the short papers I read. I was particularly intrigued with Arias' and Davis' (2019) article about high-leverage teaching practices. Another direction is the enactment of teaching strategies that are most effective with ELs in the science setting (Ware & Wernick, 2019; Chapman & Alvarez-McHatton, 2019), a topic that I continue to struggle with. Further, I want to explore deeper the focus of the simulation event that I have incorporated in my teaching which explores the alternative conceptions students form prior to or in spite of instruction in science.

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Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Minsung Kwon, CSU Northridge

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Bell, K. (2019, February 19-21). *Teaching math and science to avatars, oh my!* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Berlin, R. & Cohen, J. (2019, February 19-21). *Using targeted feedback conversations to support mixed-reality simulations*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Wild, A. & Karamcheti, M. (2019, February 19-21). *Design principles and process of designing Mursion scenarios with teaching candidates.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The authors viewed simulations/approximations as providing opportunities for teacher candidates to rehearse important teaching practices, moves, skills, or questioning techniques in an authentic environment. The authors also viewed that simulations have low-stakes in rehearsal (no serious consequences) but high-stake in actual practice (Wild and Karamcheti, 2019; Bell, 2019), develop teaching skills before impacting or interacting with real children (Boerst and Shaughnessy, 2019; Berlin and Cohen, 2019), are less-demanding because of interacting with a small number of students (Bell, 2019; Berlin and Cohen, 2019), purposefully suspend or standardize some elements of the situation (Boerst and Shaughnessy, 2019), avoid complexities and pitfalls in enactment and judgment (Boerst and Shaughnessy, 2019), provide opportunities to try again (Berlin and Cohen, 2019), and must be valid measures of teacher candidates' proficient performance (Boerst and Shaughnessy, 2019).

In defining simulations/approximations, there are a number of differences in terms of digital vs. non-digital simulation, the complexity or grain size of the targeted teaching practice, the demand of content knowledge for teaching, providing immediate feedback or coaching during/after simulations, teacher candidates' self-reflection, the role of teacher educator, the

role of teacher candidates (TCs), attention to the fidelity or variability of interactors/simulated students across simulations, and the number of simulations used in the course. I summarized the commonalities and differences across four papers below.

Simulation Element	Bell	Berlin and Cohen	Boerst and Shaughnessy	Wild and Karamcheti
Context	Math and science methods course	Teacher education	Math methods course	Teacher education
Digital vs. non-digital	Digital with the simulated students (avatars)	Digital with the simulated students (avatars)	Non-digital with the simulated student (teacher educator)	Digital with the simulated students (avatars)
Targeted practices	Three domains: fidelity to model, engagement of the children, and questioning techniques	Four target skills: timely, specific, succinct, or calm	One High-Leverage Practice (HLP)	Multiple competencies
Task of teaching	Two inquiry-based models: HEI for science and LES for math	Effective redirections of off-task behaviors	Routinely needed to teach math, crucial for supporting robust learning opportunities for all students, and learnable in teacher education contexts: eliciting and interpreting student thinking	Unique opportunity (not often get to practice) and high-stakes: responding to student who has accused them of racist behavior
Role of teacher educator	Observe the lesson	Provide supports either as reflections prompt (GR) or coaching (TFC)	Play a role of a simulated student	Identify the need of simulation Filter, draft, and revise the scenario

Simulation Element	Bell	Berlin and Cohen	Boerst and Shaughnessy	Wild and Karamcheti
Role of TCs (Teacher candidates)	Peer observation + feedback; No involvement of TCs in design	No peer observation + feedback; No involvement of TCs in design	No peer observation + feedback; No involvement of TCs in design	No peer observation + feedback; Involvement of TCs in design
Interactor's (simulated student) fidelity/ variability	Not addressed	Training and using fidelity checklist to ensure little variability across simulations	Using standardized protocol (controlling content and contextual factor)	Not addressed
Purpose	Fidelity of the model	Randomized experiments to compare the effect of self-reflection vs. the effect of coaching	Assess PSTs' engagement in high-leverage teaching practices	Design principles (realistic, unique opportunity, high stakes in real-life, and low-stakes in practice) and process of developing simulation scenarios
Number of simulations	2 (one for science lesson and one for math lesson)	3 (baseline, attempt 1 before intervention, attempt 2 after intervention)	3 (baseline, mid, and final)	1

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Using Bennett's (2010) conceptualization of "a theory of action," I summarized the object, interpretive claims, intended effects, and potential unintended negative effects across four papers I reviewed.

Theory of Action Element	Bell	Berlin and Cohen	Boerst and Shaughnessy	Wild and Karamcheti
Object	Examine the delivery of lessons using inquiry-based models	Explore the relative efficacy of two different support: self-reflection (in GR) vs. coaching (in TFC)	Develop performance assessment that provides information about TCs' abilities to engage in high-leverage teaching practices	Describe the key principles and process of designing a simulation scenario
Interpretative claims	The simulation supplements the clinical practice for TCs.	TCs would benefit from additional support to improve their practice from one simulation to the next.	The simulation assessment predicts TCs' performance of interviewing a child in their field placement.	The involvement of TCs in designing, testing, feedback, and revisions produce high-quality products.
Intended effects	Demonstrate their content knowledge and teaching skills. TCs find simulations beneficial, useful, and confident at the end.	TFC addresses potential limitations of the GR.	Securing the information about TC's knowledge and skills from the very beginning of the program	Provocation: TCs often practice what they will say and do in advance of the simulation. Nudges TCs away from a default of addressing problems in front of other students.

Theory of Action Element	Bell	Berlin and Cohen	Boerst and Shaughnessy	Wild and Karamcheti
otential unintended negative effects	TCs get anxious and intimidate with teaching a lesson to the avatars at the beginning while downplaying the evaluation and grading. Without the complete script (in math), TCs go back to the direct instruction model.	Not addressed	Not addressed	The platform (interacting with five avatars) limits the opportunities for TCs to practice redirecting behaviors.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

In synthesizing the four articles, I found more divergence than convergence in lines of research and development. This includes whether the research is content-specific (Bell, 2019; Boerst and Shaughnessy, 2019) or content-independent (Wild and Karamcheti, 2019; Berlin and Cohen, 2019), stage/use of simulations (Wild and Karamcheti, 2019-simulation design; Bell, 2019-fidelity and delivery of a supplied lesson; Boerst and Shaughnessy, 2019-performance assessment; and Berlin and Cohen, 2019-comparision between different support models), the role of teacher educator and teacher candidates, how the "authentic" context can be defined, the grain size/complexity of targeted teaching practice, what is provided for teacher candidates before simulations (Wild and Karamcheti, 2019-trailer but not a script; Bell, 2019-prescribed steps of the specified model; Boerst and Shaughnessy, 2019-student work on the problem), and the validity argument made.

The identified gaps or limitations might include more explicit connection to the theory of action (object, component, interpretative claims, hypothesized mechanism, intended outcomes, and unintended outcomes), correlations with content-specific knowledge of teaching, whether it

can predict the quality of actual teaching performance, how to scaffold TCs from interacting with "a small group of (simulated) students to interacting with a whole-group, and whether it can contribute to student learning outcomes.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.
I would like to explore in more depth about the process of developing content-specific scenarios/standardized protocols that are authentic to the actual teaching practices. What is the process of developing standardized protocols? Is the standardized protocol based on particular students' misconceptions, errors, and misunderstandings or uncommon students' solutions? Between the baseline assessment and final assessment, what type of experience or activities need to provide for teacher candidates to improve their targeted teaching practice? How do teacher candidates feel about interacting with a teacher educator as a simulated student? When should teacher educators provide live-coaching on simulations/rehearsals to teacher candidates? Are teacher candidates' peer observations or feedbacks helpful? Or is it better to do simulations by an individual teacher candidate? Also, I would like to learn more about how the content-specific methods course can be re-designed by using the simulations.

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Simulations in Teacher Education Conference: Synthesis Review of Papers

Review Written by Eric J. Lange, Lamar University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Benedict-Chambers, A. (2019, February 19-21). *Learning to notice elementary students' ideas and use of science practices in tool-supported rehearsals*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Reich, J. & Thompson, M. (2019, February 19-21*). Exploring authenticity and playfulness in designing of teacher practice spaces*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycle*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The common factor for all papers is that simulation is defined as a means of practice, to better prepare those taught to more seamlessly step into their teaching position. Reich (2019) provided a great and simple explanation through a sports metaphor, stating that "simulations are like "scrimmages," that are close analogues to the complete game." Self (2019) described simulated encounters as an opportunity for the PST and an actor to interact in a prescribed manner. Ware and Wernick (2019) stated that simulations were controlled through drivers as the avatars, who can interact with PSTs in real-time. While each paper describes their use of simulation a bit different, they are describing an opportunity for practice for each PST.

It seems clear that all papers are describing simulation as a useful tool to enable PSTs to practice before teaching in the field. This highlights the importance of how we use simulation in developing PSTs. Use of simulation in practice needs to be done to closely resemble the classroom. The closer the simulated practice is, the easier it will be for the PST to connect what they learn to classroom application.

Each of those papers hit on high-leverage teaching practices (HLP). Although they do not specifically state it, it seems clear they are looking at analyzing instruction, coordinating and adjusting instruction, leading discussion and modeling content, practice and strategies. Each of these are high-leverage practices. Ware and Wernick (2019) specifically state they are looking to identify which high-leverage teaching practices can be identified, taught and internalized by PSTs and experienced teachers alike. Based on these papers, HLPs are a clear common thread.

Ware and Wernick (2019) hope to teach PST and experienced teachers to modify content while in the simulation, enabling them to "meet the needs of intermediate-level English learners." This is an example of coordinating and adjusting instruction as an HLP. Self (2019) believes that the opportunity to analyze moments in teaching will enable PSTs to hone skills in a way that eliminates oppressive education. Her research seems to hit on HLPs of discussion, practice, analyzing instruction as well as understanding student cultural, religion and family. Benedict-Chambers (2019) research focuses on rehearsals (practice) of PSTs, and how they can analyze their work to adjust teaching techniques. Each of these papers has a link to high-leverage teaching practices, further emphasizing the importance for the field of education.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Benedict-Chambers (2019) stated that tool-supported rehearsals can be utilized by the PST to self-assess their technique as a teacher. Self (2019) described a theory of action which attempts to provide PSTs with an opportunity to "make sense of moments of teaching." Being grounded in experiential learning by Dewey (1938/1997), highlights learning through doing.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

The benefits of each of these studies is identifying the best means of implementing simulation as a method of practice for PSTs. Benedict-Chambers (2019) emphasizes simulation as a means for PSTs to self-assess their technique, while Ware and Wernick (2019) want to improve the ability of PSTs to teach English learners. A focus on developing a realistic method of practice through simulation is common for all four papers and a credible focus to be productive.

One common area of limitation is the possibility that PSTs do not embrace the simulation as a useful tool for practicing teaching. Benedict-Chambers (2019) stated that PSTs may not embrace it if they do not understand the purpose of the simulation. Self (2019) also looked at

the disconnect for PSTs and learning in simulation, looking for answers when identifying what they find particularly difficult.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I look forward to speaking with Benedict-Chambers as her research seems to be similar to the research, I just took part in with Dr. Levin at the University of Maryland. I feel that it would be beneficial to discuss findings, similarities and directions for future use of simulations.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Daniel Levin, University of Maryland-College Park

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Davis, E. & Arias, A.M. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21). *Rehearsals of Teaching: A simulation of complex practice.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ingraham, K. & Russell, M. (2019, February 19-21). *Consideration in designing math and science simulations with a human in the loop.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The authors in this paper set generally view simulations as opportunities for pre-service (PSTs) or in-service teachers to "approximate" or "rehearse" (Ghousseini, 2019) particular core practices in settings that can be likened to "kayaking in calm waters" (Grossman, Hammerness, & McDonald, 2009) --i.e., allowing early attempts in engaging in challenging ambitious core practices to occur in safe and relatively controlled settings. The authors also all focus on the "standardization" afforded by the simulations; Boerst & Shaughnessy (2019) characterize simulations as "approximations of practice that place authentic, practice-based demands on teachers, *while purposefully suspending or standardizing* (emphasis mine) some elements of the situation that allow for a focus on particular teaching practices…"

The Ingraham and Russell paper is primarily a description of the TeachLivE/Mursion virtual classrooms and their affordances, although they describe the practices that have been regularly approximated using the system. All the papers focus on the simulations as opportunities to approximate particular practices in different content areas, although some are described as more general and applicable to all content (e.g., *eliciting and interpreting students' thinking*

[Boerst & Shaughnessy, 2019]; *eliciting student thinking and orienting students to each other's ideas* (Ghousseini, 2019); while being applied to particular content areas (e.g., mathematics), and others focus on disciplinary-specific practices (e.g., *engaging a student in analyzing data and constructing an evidence-based claim* [Arias & Davis, 2019]. Ghousseini distinguishes between "instructional activities", such as Choral Counting and "practices" (such as eliciting student thinking and orienting students to each other's ideas). One could see Arias & Davis' (2019) practice as a special case of eliciting, within the instructional activity of analyzing data and constructing an evidence-based claim, which may then be associated with other practices in situ, such as orienting students to each others' ideas. So there remains some ambiguity in the way we talk about "practices" across mathematics and science. I don't, however, feel that we have difficulty in understanding each other, so I wonder if it matters. It may matter for purposes of articulating the field to others.

There is general agreement across these papers that a well-prepared human "actor" is necessary--"the human in the loop" that Ingraham and Russell refer to. There are marked differences, however, in the nature of this actor. For Ingraham and Russell, this is a trained and prepared "interactor" who is anonymous behind the virtual simulation. For Boerst and Shaughnessy (2019) it is "a teacher educator whose knowledge, words, and actions are standardized to be in line with a carefully crafted profile of a student's mathematical thinking." For Ghousseini (2019) it is other novice teachers who "participate as students, exhibiting their understanding of how children think about mathematical ideas, and simulating the multiple relationships with students and content that might be in play." Finally, for Arias and Davis (2019) it is an adult acting as an upper elementary student in analyzing data and constructing an evidence-based claim regarding the conservation of mass. This "simulated student" has a protocol of behaviors, responses, and lines of thought to use in interacting with the preservice teachers.

It's my impression that the nature of the human in the loop offers constraints and affordances. The interactors Ingraham and Russell describe, for example, are not likely to have the pedagogical content knowledge that inform teacher educators or even novice teachers in enacting behaviors and articulating ideas appropriate for the students and the content. On the other hand, the anonymity of the simulation, with student avatars, is likely to make the simulation seem more "real" and thus be more likely to challenge novice teachers to develop appropriate instructional moves.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

For Ghousseini (2019), the theory of action is a theory of teacher learning as the development of adaptive performance, which guides pedagogical design of cycles of enactment in which practices are represented, rehearsed, enacted, and decomposed. The object of the theory is the development of adaptive expertise. Similarly, for Boerst and Shaughnessy (2019), practice-based teacher learning guides their simulation, but the object of their theory of action in simulations is not specifically on teacher learning, "but rather to provide a context for assessing teaching practice and teaching knowledge that can fairly and repeatedly be used with groups of PSTs".

Arias and Davis (2019) also note that the object is assessment. Their simulation "is not aimed at teacher learning, but rather, serves as a pre-assessment to give us insight into preservice teachers' strengths and struggles with the two high-leverage science teaching practices and their content knowledge for teaching science." They recognize the potential for teacher learning, however, and they note that they have investigated changes in preservice teachers' learning by comparing preservice teachers' interactions and responses in the simulations before and after learning data analysis and evidence-based claims practices.

Finally, Ingraham and Russell's theory of action (2019) associates practice-based learning theory and corresponding design considerations. The theory of action centers on the "human in the loop" and ideas about optimizing the experience to promote teacher interaction. Thus, the object of the theory in this case is design to support teacher learning.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

I agree with Boerst and Shaughnessy (2019) and Arias and Davis (2019) who recognize the opportunity for simulations to provide useful formative assessment data for teacher educators, PSTs, and teacher education programs. This would suggest the need for further study on how such assessment data can be used *formatively*, i.e., to bring such data back to the instructor, PST, or program in a way that can inform instruction or further learning.

I think continued discussion on the constraints and affordances of various models of simulations would be useful for the field. For example, it seems important to consider how to make the interactors described by Ingraham and Russell, if not as well-prepared as the teacher

educators used by Boerst and Shaughnessy (2019), then at least well-prepared enough so that the virtual simulation is realistic. Ingraham and Russell point to this as an area for future research: "[W]hile significant effort has been placed into ways of standardizing interactor/sim specialist performance for consistency, research has not yet explored the facets of interactor/sim specialist performance that may affect training effectiveness and learner perceptions of authenticity of practice"

I'm skeptical that simulations themselves, particularly expensive virtual ones, could move the needle on student outcomes in some measurable way, as Ingraham and Russell suggest. There are just too many other factors that influence student performance, and isolating teacher practices to look at measurable student outcomes seems like a return to the process-product approach of an earlier generation.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I am most intrigued by conversations about using simulations as a way to identify how to assess PSTs' approximation of certain practices, how to identify PSTs' strengths and struggles, and how to build on preservice teachers' strengths and support these teachers in their struggles. I think most of the papers address this issue. I am also interested in how others deal with the pragmatic challenges, either of having a well-trained cadre of actors, or of financing use of a virtual reality situation, such that simulations can be used repeatedly for reasonable cost.

References

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice*, *15*(2), 273-289.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Justin Reich, Massachusetts Institute of Technology

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Chapman, A. & Alvarez-McHatton, P. (2019, February 19-21). *Mixed reality simulation in the preparation of secondary math and science teachers for teaching native Spanish speaking students.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Lange, E. (2019, February 19-21). *Does the teach live simulation system improve pre-service teachers self-efficacy?* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycle*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

All four papers are about the Mursion (formerly TeachLive). Very reasonably, all four of the short papers assumed that readers would be familiar with Mursion, providing minimal descriptions of the simulation tool. The longest, from Garrett (2019), was

> A cornerstone of the PD approach is the incorporation of the Mursion/TeachLivE mixed-reality classroom simulator. Teachers from anywhere can use a computer to connect with a simulate classroom via an online video conference platform (for example, Zoom) to view and interact with a set of student avatars in a digital classroom. An "interactor" behind the scenes, who is not visible to the teacher, operates the avatar students. Interactors receive extensive training in content and pedagogy, child and adolescent development, and puppetry. The insertion of a human allows for realistic and wide-ranging teaching experiences for teachers.

All four papers describe Mursion environments as places where teachers can practice in specific teaching scenarios, receive feedback from teacher coaches/teacher educators, and incorporate improved skills and judgments into their actual classroom teaching with students.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

The four papers share similar theories of action: a novice teacher will prepare for a simulated teaching experience, then he or she will participate in a Mursion simulation, and then he or she will get coaching and feedback from peers or teacher educators. This process will repeat, and researchers will measure improvements by comparing early performances in the simulator with later ones. Some of the implicit or explicit dimensions of the theory of action include the notion that realism in a scenario should trigger feelings of both authenticity ("this feels like teaching") and authentic discomfort or challenge ("this feels like hard teaching"), and feelings of authenticity are an indicator that the simulation is effectively preparing students. A second common dimension is that the simulation experiences are insufficient alone, and that reflection and feedback from peers and coaches is an essential part of the learning process. A third element of theory, not common to all four, is that the purpose of these simulations is for teacher to practice teaching moves identified as "high leveraging teaching practices" and that authentic classroom scenarios are effective places to rehearse these practices. (Spoiler alert, in our research on teacher practice spaces, we suggest that an interesting design space for simulations opens up if you relax the assumption that feelings of authenticity and authentic contexts are important components of effective simulation design. Authenticity of task is probably essential, but we think authenticity of role and authenticity of context can be replaced with playful roles and contexts.)

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

One area where the papers diverge is in the outcomes analyzed. One paper uses teacher self-reports, two papers use observation rubrics of participant performance within simulations (evaluating change in practice using pre-post design), and one paper follows up simulation PD with pre-post evaluation of actual teaching practice. This latter approach should be the bar to aim for; all of practice-based teacher education right now suffers from limited evidence of efficacy on teacher practice. This work is incredibly hard to do (kudos to AIR for pursuing field observations), but will be essential for developing effective simulation-based teacher PD and pre-service training, and convincing the field to adopt evidence-based approaches.

The one limitation that I might highlight is that in each of the four papers, the research framing felt somewhat like a new starting point, rather than advancing specific lines of inquiry in a more developed field. This may be a function of the short length of the papers, but it felt like each was testing the question "Does participation in Mursion scenarios improve teacher quality?" rather than some more specific question or set of questions based on a research base that included some agreed-upon fundamental principles or established findings and a set of open questions that had provoked interest from multiple researchers or labs. Given how long TeachLive and Mursion have been commercially available, I would have perhaps expected more papers to address open questions that results from previous research. Perhaps one of the goals of the NSF SITE meeting can be to identify some of these shared questions.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

Drawing from the above, I hope we can ask three kinds of questions together.

1. Are there any findings from simulation-based teacher PD so well established that we can consider them givens, and turn our attention to more specific questions about what works, for whom, under what conditions? Can we develop some consensus on the kinds of questions that are most important to answer?

2. How do we support and encourage research that follows the impact of simulation-based teacher learning as far as possible—beyond simulation performance, into teacher classroom performance, and ultimately into student outcomes?

3. What might practice-based teacher education look like if we relaxed the assumption that authenticity was a necessary pre-requisite for effective practice? Stage actors use improv games to prepare for performances; athletes use drills like keep-away to prepare for more structured competition settings; what might it look like for teachers to develop authentic teaching skills in rehearsal settings that were more playful in nature?

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Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Morgan Russell, Mursion

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Benedict-Chambers, A. (2019, February 19-21). *Learning to notice elementary students' ideas and use of science practices in tool-supported rehearsals*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Berlin, R. & Cohen, J. (2019, February 19-21). *Using targeted feedback conversations to support mixed-reality simulations.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Walker, J. (2019, February 19-21). *Simulations as professional apprenticeships.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The four papers reviewed represent research being conducted primarily in U.S. university settings from coast to coast. The authors of all four papers explore considerations for approximation of teacher practice using rehearsal. Two involve digital simulation to simulate a classroom experience, one uses live role play with instructor and peers and one incorporates a combination of exemplar videos made with a live actor and live simulated interactions with a live actor. Three papers focus on teaching math and/or science. Walker (2019) is dedicated to approximating parent-teacher conferences. Benedict-Chambers (2019); Walker (2019); and Berlin and Cohen (2019) involve a multi-step process and framework for engagement in the rehearsal. Each structures the practice with specific materials with varying degrees of numbers of practice opportunities and scaffolding those rehearsals. All authors overtly or inadvertently imply the need for the simulation or role-play to be "real time" and immediately responsive to the learner's moves. Based on these four papers, the following definitions of activities could be used to define the delivery of the approximation:

1. Augmented Reality Simulation or Mixed Reality Simulation to define the use of a software platform that allows for live interaction between the learner and virtual students or guardians in a 2-D or 3-D environment.
2. Live Actor Simulation where professional actors portray a character and situation to provide practice interactions.
3. Structured Role Play for scenarios that are enacted with peers providing guided interactions based on learning objectives.

The ability to solidify terms commonly used for these different types of approximations and supplemental guidelines of best practices for each would support not only wider use of these practices to improve pre-service and in service teachers, but it could lead to more effective research, shared learning and use of these strategies. All authors call for the development of flexible, user-friendly, high quality simulations.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

The theories of action through all four papers explore use of rehearsal to practice complex relational skills. The common outcomes being studied are effectiveness of the practice and learner engagement in the use of simulation. Additionally, one paper is focusing on the efficacy of the type of feedback given. Berlin and Cohen (2019) uses simulation to practice redirecting off-task student behavior. The goal is for the teacher candidate to practice ambitious mathematics, which requires supporting a safe and productive learning environment. Using Responsive classroom framework, which is being used in the coursework, the simulation provides the opportunity to redirect off-task behavior in a timely, specific, succinct, and calm manner. The action is a research study with a 5 min baseline simulation and survey at the beginning of the semester followed by a 20-minute session at the end of the semester that includes a similar simulation, reflection or targeted feedback as randomly assigned, and a final practice opportunity.

Walker (2019) uses two phases of applied learning to build and practice family engagement skills. The first phase is observing a series and taking quizzes on video exemplars, the second is directly participating in live standardized simulations with a live actor portraying a parent. The theory of action is providing ethical, challenging opportunities to practice complex interactions with a guiding framework. Employing both immediate expert feedback and later self-reflection based on observing a recording of the live interaction, both forms of feedback are used to set goals for future interactions.

Benedict-Chambers' (2019) theory is providing tools to attend student thinking in science discussions and opportunities to practice using those skills prior to working with actual students. The candidates work together with the instructor to role-play alternate student thinking and representation of work to hone the skills of listening and looking for patterns. They then teach the same lesson with a class of real students and compare and analyze the experiences. The goal is to build the capacity to understand and maximize each student's thinking.

Kretschmer and Kwon (2019) are using simulation to practice the High Leverage Practice of eliciting student thinking in pre-service teachers in math and science. The science PSTs engage in teaching a lesson that they are concurrently teaching in field assignments. Math PSTs practice a lesson before any actual classroom placements. Both groups receive immediate peer and coach feedback. The object is to enable the PSTs to make better instructional decisions.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

Common themes and objectives were observed in all four papers reviewed, including: interest in speeding up the process of mastering teaching practices, using simulation or rehearsal as an ethical and effective way to practice, structuring the practice in alignment with coursework or a theoretical framework, and questions of carry over of skills attained to the actual classroom. Three of the papers include audacious teaching as a model to practice in simulation. All focused on the social context of learning, whether in eliciting student thinking, conducting an effective family conference or attending, listening, effective questioning and anticipating student's thinking. All use cases employ immediate feedback, however there are different approaches or experimentation with self-reflection, peer feedback or targeted feedback from a coach.

The primary distinctions are the approximation delivery formats and the targeted application. It's interesting to note that Walker (2019) and Benedict-Chambers (2019) also involve more time with the simulated practice. Benedict-Chambers (2019) discusses some learners' initial reluctance to fully participate in the role-play. Conversely, while more engagement and "buy in" was reported in those using augmented reality simulation or live actor simulation, a concern for standardization and training was raised.

Limitations of the current research and questions yet to be answered include:

What are the benefits and limitations of the mode of approximation (delivery method)? What is the right dosage for maximum effectiveness and does it vary by learner? How is transference to ongoing practice in the real world measured and how is it affecting real students and families? What is the dynamic between needs for the simulation to be standardized and the ability for the simulation to respond authentically to the learner?

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

The following are ideas that I found intriguing and hope to explore in more depth during the Simulation in Teacher Education conference:

- Studying transference of learning outcomes in the actual classroom or with real family conferences. Are there long-term benefits of continued simulated practice?
- The UVA initial findings indicate that providing Targeted Feedback Conversations were more effective than Guided Reflection with novice teachers. A follow up question is to test this with veteran or even master teachers. Does the fact that the learner is engaged in the "moment" of the simulation make it more difficult for effective, guided self-reflection and analysis of "what to do differently" in the future. Would observing a recording of the interaction for reflection (as done in Walker's, 2019 study) be more productive? Is Self Reflection and redirection a skill to be practiced and developed as well?
- Missouri State University's study uses multiple rehearsals and well articulated, research based tools for the teacher practice to facilitate conversations in math and science AND well articulated, research based tools for the portrayal of student thinking. Using these materials in augmented simulation could provide a rich, engaging immersive learning opportunity. It could also be interesting for organizations with simulation systems to experiment with the teacher candidates either developing the academic profiles for the students to portray or even step in as the interactor. Would this provide an opportunity to empathetically understand the student's experience?
- It would also be interesting to create a series of tools that incorporate both academic profiles and the behavioral challenges used in the UVA work that could be practiced discretely and coupled. Building skills to engage students in math and science is not only about understanding content, but also personalities and preference. Opportunity to practice attending students who may be introverted or afraid to contribute is a nuanced form of eliciting student thinking.
- The discussion topic of using simulation to develop and practice inclusion, connection and meaningful communication with and for diverse populations is extremely

interesting to me. How do we design ethical, authentic, valid, useful, and consistent simulations? What are the implications for facilitator and interactor training?

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Elizabeth A. Self, Vanderbilt University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Benedict-Chambers, A. (2019, February 19-21). *Learning to notice elementary students' ideas and use of science practices in tool-supported rehearsals*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Bondie, R., Jack, J., and Dede, C. (2019, February 19-21*). Agile thinking: Deciding to teach every student*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21*). Rehearsals of teaching: A simulation of complex practice*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

The authors in this set of papers consistently defined simulations and approximations in ways that included:

1. preservice teachers (PSTs) in the role of "the teacher"
2. doing interactional work as the teacher; and
3. with opportunities to revisit, reconsider, or reinterpret that work

At least one article considered other forms of approximation (i.e., a game that had teachers think through instructional decisions but without the interaction) but used simulations according to these points elsewhere in their work. Simulations seemed to be commonly used in connection with decomposition of practice, providing teachers opportunities to slow down the work and make their thinking visible. All provided a space in which PSTs had to act, according to their current understandings, rather than simply think through a scenario without having to commit to action. In addition, the situations in which PSTs were placed were consistently described as everyday scenarios in teaching that PSTs would likely see again, but with particular attention to the demands or dilemmas in teaching.

Within this similar definition, however, there were important differences. In these four papers, the interactional work happened with live actors brought in from outside the university course, with members of the course playing the role of students/parents/coworkers, and with avatars. With this variation came similar differences in how much was standardized (ex. ways of communicating current understandings of a scientific phenomenon) and how much of reality was suspended (ex. the age of the actor compared to the role they were playing). All authors acknowledged, though, that a level of standardization or suspension was necessary in some elements of the situation in order to focus on other elements for the purposes of the simulation. Some authors were explicitly attending to teachers' decision-making, while others were focused on the enactment of high-leverage practice or the replication (contextually) of an instructional task. The authors also varied in whether they used the simulations in tandem with other pedagogical tools or more stand-alone and whether they engaged in eliciting teachers' thinking and providing feedback after or throughout the simulation interaction.

Given this, it seems important that the field defines *simulations* in ways that emphasize the interactional work of teaching (teachers directly in interaction with another person, whether a live actor or avatar). *Approximations*, rather, seem more focused on other, less interactional parts of the work that might include written cases only or game-like experiences that approximate the thinking but do not simulate the interactional part of the work. In addition, given this definition for simulation, it seems important that the extent to which standardization or suspension of reality is engaged is named in work with simulations in order to acknowledge this component. Finally, especially as work around simulations scales up, it may be valuable to use the term in ways that encompasses both the *action* (interaction) as well as the *sensemaking* that follows, in whatever form each of these takes. This would underscore the role that simulations serve for making thinking visible, but only if it is actively supported.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

The authors in this set of papers commonly talked about their theories of actions in ways that seek to replace current ways of doing or being as teachers with a new ways. They all function as a theory of change. In some instances, this was related to shifting teachers to more current ambitious pedagogies in science and mathematics (i.e., related to mathematical knowledge for teaching), to engaging in practices like eliciting student thinking, or in making decisions that would reduce bias and lead to more equitable pedagogy. In general, authors used the simulations to tune teachers in to students' thinking or current understandings, which was then used as a basis for shifting their own practice. Some pursued this more through trial and error

(run and revisit what the teacher did), others through repeated uses of a simulation in the vein of adaptive practice. In a sense, some authors were helping PSTs see what not to do and understand why, while others were seeking to help teachers "practice" their way out of unproductive practices.

This set of papers did not have a consistent object of their theories. None had highly specified contexts, though a few referenced that the scenarios had been written specific to their programs. Some used simulations to support learning, others as formative assessment to feed future learning, and at least one as a summative assessment on a discrete practice.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

One common point among the lines of research and development exemplified in this set of papers was a focus on feedback loops. While the timing, form, and focus of the feedback varied, all of the author focused on when and how to provide effective feedback to PSTs and whether or how to provide immediate opportunities to apply that. A consideration of when and how to provide feedback to PSTs (or teacher educators), at what grain size, and at what level (individual, group, etc.) seems like a productive line of inquiry in that it further presses the question – what are the simulations being used for, and given that, what kind of feedback is timely and appropriate. This also connects to ideas around trajectories of learning (i.e., would a first-year undergraduate receive similar feedback to a PST in their professional year).

A consistent gap in the lines of research and development exemplified in these four papers is longitudinal work that would help us see how these EPP-based simulations show up (or not) once teachers leave the program and become more prone to the "washout effect" (Zeicher, 1981). All of the authors acknowledged this limitation of their current work, and at least one group noted plans to make this happen, but none were yet able to report on this.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

Two questions that consistently came up among this set of papers included:
- What is the appropriate timeline in thinking about teachers' learning through action? Several authors noted that PSTs' learning from the simulations seemed to unfurl slowly over time, which speaks to their usefulness and strength as a pedagogy. However, it is not necessarily in line with the typical timescales of teacher preparation or easy to capture in traditional research modes in EPPs.

- How can we write about simulations in ways that help them travel across disciplines and EPPs in ways that are manageable and valid?

One question that was not brought up directly in any of these papers but seemed important is when it is appropriate and useful to generalize (learning a practice without specifying the condition under which the practice is being learned) and when simulations should be specific to a place, a person, etc.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Meredith Thompson, Massachusetts Institute of Technology

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Arias, A.M. & Davis, E. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21*). Rehearsals of teaching: A simulation of complex practice.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ingraham, K. & Russell, M. (2019, February 19-21). *Consideration in designing math and science simulations with a human in the loop.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Each of the four papers describes an interaction between individuals based with a specified domain of teaching to practice.

Two of the papers focus on approximation between a "teacher" and a group of "students". In Ingraham and Russell (2019) the simulation is an interaction is between a teacher candidate (TC) and a human actor mediated through an immersive virtual reality system. Teacher candidates approximate teaching practice by interacting with student avatars, authenticity of experience is attributed to the human element of the avatars, that are directed by a specially trained actor. In article Ghousseini (2019) groups of novice teachers learn and practice through cycles of observing a video, approximating the practice with "student" peers and a teacher educator (TE) who concurrently role plays a "student" and offers guidance and advice to the "teacher". The TC then uses the skills developed through these cycles of rehearsal during interactions with actual students. The authors focus on developing TCs' adaptive expertise through examination of the video and rehearsal of teaching practice during the simulation of teaching with other TCs as students. After rehearsal and feedback from a TE, the TC implements

what they have learned through interaction with an elementary student. The TC videorecords this interaction for additional feedback and reflection.

Two of the papers describe approximations of one on one interactions between a "teacher" and a "student". Boerst and Shaughnessy (2019) describes a one on one interaction with a Teacher Educator (TE) role playing a student and a teacher candidate (TC) role playing a student. During this role play the TC "teacher" approximates the practice of eliciting and interpreting student knowledge by engaging in a conversation with a TE "student" around a students' written work for a mathematics problem. Arias & Davis (2019) illustrate a one on one interaction between a "teacher" TC and a "student" TE in a science based exploration of conservation of mass. The "teacher" TC must assimilate data gathered from groups of students in the class and their conversation with the "student" TE to resolve the "students" confusion about the topic.

Simulation is a central theme in these four studies, and the criteria for assessing quality in a simulation are embedded within the study descriptions. Successful simulations establish a degree of authenticity for the participant to prompt an approximation of specific skills. Simulations allow for a standardization of experience that facilitates sharing ideas with others, both teacher educators and peers. Simulations also must be both high quality and manageable in order to be sustainable parts of the teacher educators' experience.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

Ingraham and Russell (2019) propose that a simulated classroom allows teacher candidates (TCs) to practice the discrete skills of teaching such as facilitating discussion and enabling higher order thinking by interacting with a trained actor through a virtual environment. Boerst and Shaughnessy (2019) suggest that simulations enable teacher candidates to directly engage with the work of teaching by both "enacting skills" and "providing assessment of skill development". Ghousseini (2019) theorizes that different types of simulations (watching videos, rehearsing skills with peers) allow novices to develop skills and adapt them in different situations. Arias & Davis (2019) describe a simulation that requires the TC participant to demonstrate their ability to engage students in analyzing data and helping students use evidence to support claims during a one on one conversation with a student. The teacher candidate needs to assimilate groups of students' work during a scientific activity to a one on one conversation with an individual student about a specific topic.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

Ingraham and Russell (2019) shared learnings from a three year study of the Mursion platform. These learnings include the importance of clear learning objectives, of well trained interaction/ simulation specialists, and the means of sharing observations of TCs during the simulation. All of these findings reinforce current best practices in learning activities, but some of the findings will be especially useful in technology-based simulation. For example, teacher educators were more likely to trust a report of TC behavior that appeared as a graph on screen during the virtual simulation than a human generated report, even though both reports were generated from the same source (a coach). The TEs did not trust that a human can be a reliable observer of those behaviors, yet both the platform and the data recording are human powered. Future research could explore how teacher educators understand technology based platforms and the data that result from their use.

Boerst and Shaughnessy (2019) have multiple lines of research around their simulation. To determine the quality of their assessment, they compared the simulated conversation with a TE role playing a student to an actual conversation between the TC and a student to see if the simulation prompted the TCs to exhibit similar skills. The researchers found that the student profile provides sufficient information for a TE to play a student during a simulation, but concluded that a live "student" was still needed for a successful simulation. These multiple methods of investigating simulations as tools will be useful to establish validity and reliability for future research.

Ghousseini (2019) studied both the demonstration of mathematical knowledge for teaching (MKT) of the TCs and also how the TEs use the simulation as a way to prompt TCs to demonstrate those skills. This study is the only one that specifically mentioned quantitative data collection and analysis; and it would be useful to better understand how those data were gathered and analyzed.

The research plan for Arias & Davis' study (2019) focuses on how to use the simulation as an assessment of TC knowledge. The current study is qualitative and focuses on TC demonstration of specific skills through observation of specific behaviors (using representations to analyze data, constructing evidence-based claims, demonstrating understanding of science content). The rubric-like table used to present findings could be a useful tool to help TEs assess students during simulations, and also to have TCs engage in self-assessment of their performance.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

We are excited to ba a part of a group of researchers who are thinking about simulations as tools for learning. The workshop could be an excellent opportunity to further our understanding of how people learn from simulations, drawing upon current research in technology-based simulations (including but not limited to VR), clinical simulations (such as Dotger and Self's work), and in-person role playing within teacher education. In particular, we are interested in investigating the variables involved in creating effective simulations. Some of the themes have already surfaced in the papers we have read, including authenticity, presence, and engagement. Each of these areas could be unpacked in ways that could be useful for designers and what does it mean for a simulation to be authentic? What factors contribute to a sense of presence within the simulation for a participant? How can participants' attention and engagement be captured by the simulation? What level of complexity is needed in order to create an effective simulation? We are also interested in best practices in role play – an ongoing staple of teacher education programs, yet one that we have not found much research around.

Simulations can be expensive and labor intensive to develop - whether they are immersive virtual environments or comprehensive guiding scripts for teacher educators to role play students. We recognize that teacher candidates have very different experiences during field work, and simulations provide a shared experience that can be helpful for facilitation and discussion among peers and mentors. However, the benefit of standardization can also be a drawback. We acknowledge that our students are different and have varied needs and learning goals, how might we enable teacher educators and novice teachers to develop and implement simulations that respond to issues they face in their local contexts?

What impact do experiences with simulations have on teacher candidates' awareness, beliefs, intentions to act, and actions in teaching? How might we gather evidence of those impacts in the short, medium, and long term? How might we establish validity and reliability among simulations and protocols so they can serve as assessments of understanding or pedagogical skills?

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Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Joan Walker, Pace University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Chapman, A. & Alvarez-McHatton, P. (2019, February 19-21). *Mixed reality simulation in the preparation of secondary math and science teachers for teaching native Spanish speaking students.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ghousseini, H. (2019, February 19-21). *Rehearsals of teaching: A simulation of complex practice.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Defining simulations:
None of the papers explicitly defined the term 'simulation.' Instead, they wrote about what simulations afford, which is essentially, a safe, controlled form of experiential learning. Across the papers, the following terms were used:

- Active learning, Authentic experience, Deliberate practice, Guided participation, Opportunity to practice, experiment and experience instructive failure, Pedagogy of rehearsal, and Practice-based education

Commonalities/differences:
I organized the authors' simulations according to the roles they required and the learning outcomes/specific professional practices they targeted:

- Roles adopted:

- o Candidate roles included actor (assuming the role of teacher), analytical observer and learning partner (assuming a role other than teacher in a simulation; source of feedback to others)
      - o Instructor roles included coach, guide/scaffold, source of feedback (evaluative and directive), simulation 'partner' and facilitator of reflection/discussion
- Learning targets/Decompositions of practice:
      - o Across the papers, simulations focused on candidates' ability to plan, use discipline-specific and general instructional strategies (e.g., questioning, facilitating discourse) and reflect on practice.
      - o The simulations involved candidates hoping to teach at the elementary, middle and high school levels. One paper targeted secondary math and science teachers' capacity to work with native Spanish-speaking students. This paper makes claims about the simulations' ability to reveal candidates' implicit bias; however, the research design does not support the authors' inferences.

Implications:

The terms used in these papers are not new in educational parlance; however, I worry that their relation to simulation pedagogy lacks precision. For example, the term "pedagogy of rehearsal" means something very specific in terms of practice, whereas terms like "guided participation" and "deliberate practice" are larger conceptual terms that describe how and why a simulation (including the pedagogy of rehearsal) works. These two levels—conceptual and practical—operate in tandem and we need to distinguish them in order to begin to tease apart what candidates learn from varied kinds of simulation pedagogies.

To chart a course for the future, we need to map the current landscape. I drew from Grossman et al. (2009) to create a visual representation that distinguishes between kinds of simulation pedagogies and the learning experiences that they afford.

In this visual representation, the X axis arrays a spectrum of approximations of practice or roles that candidates can experience during their professional preparation. Psychologically and behaviorally, the spectrum ranges from reliance on simple observational learning to meaningfully structured observational learning, to planning/anticipating action (e.g., "If I were the teacher in this situation I would……") and finally, to enacting planned intentions in real time. Inherent to this array of roles is the candidate's relative position of psychological safety and risk.

The Y axis arrays representations of practice according to how richly and realistically they represent practice. These representations range from 'low res' modalities such as text-based

scenarios/situational judgment tests and case studies, to visually stimulating experiences such as animated renderings and video cases, to 'high res' contexts including virtual and mixed reality, and face-to-face interactions such as standardized simulations or rehearsal. The continuum ends with The Real World of PK-12 classrooms.
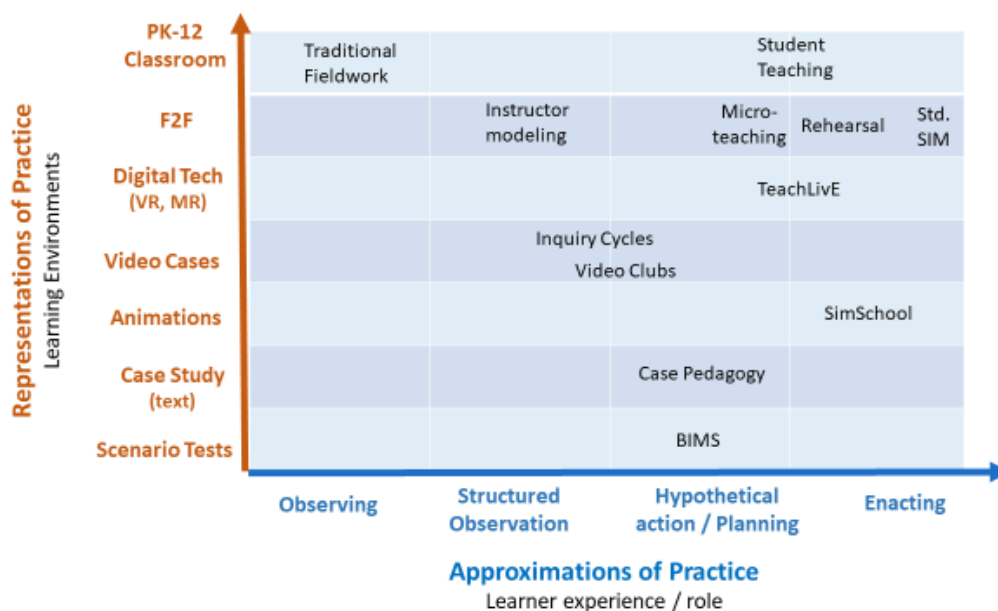
Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

None of the papers explicitly claim a theory of action; their theoretical home is implied by the constructs that are invoked and assessed, and in the organization of the learners' experiences.

- *Constructs or objects of the 'theory of action'* included the following facets of learning:
  - Multi-faceted: Adaptive performance, Transfer
  - Affective/non-cognitive: Self-efficacy, Perceptions/disposition (e.g., of students' capacities, anticipating student thinking)
  - Behavioral: Instructional skill (including planning/lesson design and use of specific practices)
  - Cognitive: Knowledge (content and PCK)
  - Metacognitive: Reflection/Critical thinking (including instructional decision-making)
- *Mechanisms of change* included: PLCs/group practice, Individual practice, Coaching/ practice with feedback, Cycles of enactment and investigation, Deliberate practice of specific practices both in isolation and in concert (progression from simple to complex)

Taken as a whole, the array of constructs and mechanisms are consistent with the larger theoretical homes of Social Cognitive Theory, Cognitive Apprenticeship and Constructivism. All are theories of how professional expertise develops.

The figure below repeats the figure above; however, instead of methodology, it overlays the 3rd aspect of professional education, decomposition of practice. This allows us to see 'at-a-glance' the professional knowledge, skills and dispositions that teacher educators are targeting in varied simulation kinds. For example, I created a list of the learning targets included in the 4 papers that I was asked to synthesize.

TeachLivE was used by 3 of the 4 papers. The 4th used rehearsal. The specific practices targeted by these two methods are plotted as X-Y 'coordinates.'
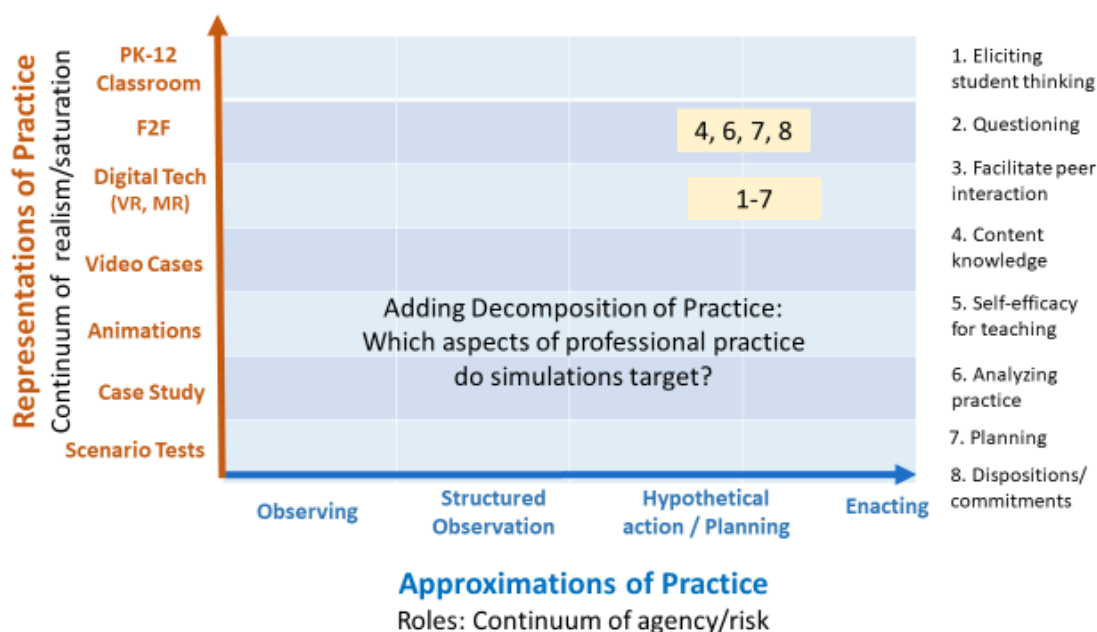
Another layer that could be added as a curriculum mapping exercise are categories of simulated practice used in medical education. These include day-to-day routines or prevalent practices, common crises (e.g., disruptive student behavior) and "never events" (e.g., extreme situations such as physical violence, sudden illness, ethical dilemmas).

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

- *Convergence/divergence*: There is more convergence than divergence in the lines of inquiry. All of the papers are positioned to contribute to theories of learning that attempt to account for the role of experience and guided participation.
- *Potentially productive lines*: This group of papers share a focus on the role of simulation in specific instructional skill development. It seems likely that shared effort/pursuit of common learning objectives across multiple simulation kinds/representations of practice are more likely to bear fruit than efforts that focus on a diverse array of instructional skills.
- *Gaps/limitations*: Although the papers have a common focus on specific instructional skills, particularly questioning and facilitating discourse, they do have share a focus on understanding advances in skills alongside other aspects of practice including non-cognitive constructs and content knowledge. Another facet that I find intriguing, but that is not addressed across all of the papers, is the exploration of development differences. Only one paper examined the role of simulation across two groups with differing levels of content knowledge/clinical experience. Practically, this is a troubling gap in that it speaks to the piecemeal, rather than comprehensive, use of simulations within individual teacher education programs. Theoretically, this gap prohibits our ability to understand the development of teaching expertise and the role that practice/simulation can play in that learning progression.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

a. How can we support teacher educators' capacity and willingness to adopt any form of simulation pedagogy?
   i. Why do some teacher educators implement simulation pedagogies while others do not? What institutional and psychological barriers and incentives are in place within individual institutions? Across institutions?
   ii. In this vein of psychological barriers to adopting simulation pedagogies: How are teacher educators learning to manage candidates' emotional reactions to simulation experiences? This is touched on in only one of the papers yet anxiety about performance tasks is widely acknowledged. Candidates aren't the only ones who fear performance tasks. Direct instruction is safer than coaching.
b. What are the advantages/rewards and complications/challenges of varied simulation models? Why do teacher educators adopt one model vs others? For example, what does

solo vs. collaborative use of a simulation involve? What is learned (and not learned) from various approaches to simulation training?

c. Some of the papers discussed outcomes that were not explicitly assessed. I am concerned that some investigators are making assumptions about the impact of their simulation training without hard evidence.

d. I would like to discuss/know more about learning progressions including aspects of dosage, 'bite-size', etc.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Paige Ware, Southern Methodist University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Berlin, R. & Cohen, J. (2019, February 19-21). *Using targeted feedback conversations to support mixed-reality simulations.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Lange, E. (2019, February 19-21). *Does the teach live simulation system improve pre-service teachers self-efficacy?* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Wild, A. & Karamcheti, M. (2019, February 19-21). *Design principles and process of designing Mursion scenarios with teaching candidates.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Authors defined *simulations* and *approximations* with different levels of specificity and with different degrees of overlap between the two terms. In general, the most helpful way to distinguish between how they were operationalized would be to define the *simulations* as the tool that provides for the experience of teaching inside (or enacting practices within) the mixed reality space. *Approximations*, on the other hand, could be characterized as the overarching experiences that teacher educators create for their participants, which would include the full cycle of preparation, simulation, and reflection/feedback.

Commonalities in how approximations took place in the four different projects included an emphasis across all to include some form of preparation and reflection/feedback to bookend the experience in the simulator. Additionally, all four papers emphasized the importance of the stability of the simulated students and the need for the simulation specialists to be well informed of and guided in the different ways the simulated students needed to respond to achieve the specified instructional objectives. Differences in how approximations were defined were closely tied to the theory of action (and therefore anticipate some of the answer to the

next question). For example, for some researchers, approximations were perceived as spaces where teachers could "suspend" or "freeze" some of the highly contextualized aspects of teaching (establishing rapport, transitioning to the next phase of the lesson, handling unexpected behavior, etc.) in order to focus specifically on a particular strategy or a particular way to teach content. This framing of the simulation space as a way to put specified practices under the microscope for rehearsal and refinement was mostly shared across the papers; however, at least one paper positioned the simulator as a space that recreates reality "as if" teachers were in a real classroom.

The implications that analyzing these similarities and differences could have on the field would be the development of a shared "vocabulary" for sharing ideas and generating a robust research agenda for the field. For example, since approximations highlight the need for both preparatory and reflective work, then researchers can work toward operationalizing *within* those different domains, since the papers share a desire to understand the full framed experience. For example, researchers who see value in the simulation space as a way to *suspend* aspects of teaching in order foreground specific practices might engage in conversations about *which* practices are high-leverage in this space and *which types* of reflection or feedback protocols are most impactful. There would be generalizable aspects for researchers to study as overarching "problems of practice" that stitch projects together, even when the specific aspects of a given study are focused on different domains (content, grade level, learner type, teaching practice, etc.). By contrast, if the simulator is seen as reproducing reality rather than as a way to suspend aspects of reality, then researchers coming from those two different traditions might be talking at cross-purposes.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

There were several commonalities in theories of action across papers, particularly in terms of two main themes. First, all papers positioned the experience in the simulator as a solution to the perceived problem of engaging (often preservice) teachers in the "doing" of teaching, rather than just in the learning "about" teaching. Most of the papers could be described as taking a cognitivist orientation, in that teachers were positioned with respect as thoughtful, reflective individuals who could learn by practicing and then by reflecting on that practice. The cycle of preparing-teaching-reflecting that grounded all of the papers underscores this approach. A theory of action that did not appear, for example, was to simply use the simulator as a way to practice preconceived routines to mastery as captured by specified measures of fidelity. Also, at least three of the papers shared the underlying premise that the simulator

allowed for both "identical or standardized" practices to co-exist with the idea that the simulator could also be tailored in flexible ways to achieve high levels of specificity in supporting targeted practices. Finally, all of the papers shared the view that practicing in the lab should, theoretically, lead to stronger, more confident performance in authentic teaching contexts, where multiple teaching practices would need to be coordinated in real time in converging ways.

Some differences in the theories of action were located in the degree of specificity in which the constructs were operationalized. For example, some of the papers reflected a highly layered approach, in which each aspect of the problem of practice was operationalized. Practices were viewed as "decompositions" into specific components that could be scrutinized and improved, and the feedback/reflection component was also broken down in one paper, for example, into different types of feedback and the outcomes of that particular type of feedback. In contrast, one of the papers situated teachers' "feelings of confidence" as the primary target and used self-report through a written reflection as the primary indicator.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

The convergences and divergences in the lines of research and development will be used as illustrations in response to the questions about productive lines of inquiry and possible gaps/limitations. Several lines of inquiry already have bubbled up from this set of papers, as there was quite a bit of convergence. First, researchers agreed upon a need to learn more about how (and whether) teachers can generalize from the more isolated practice within the simulator to the authentic contexts of classrooms—that is, how can practicing within the "suspension" of specific elements of practice translate into the highly contextualized practices required in a classroom, when teachers have to coordinate multiple skills?

Second, within this overarching goal of understanding the nature of—and impact of—generalization from the simulator to the classroom are sub-sets of questions. For example, many researchers are attempting to identify which practices are the most high-leverage for their particular field of study, their particular teacher candidates, their particular institutional context, and their particular research trajectories as individual researchers. They are also asking questions about which reflection/debriefing protocols work best to support teachers through guided inquiry. They are asking about how broad and narrow the scenarios should be (in some cases presenting teachers with the full complexity of 10 minutes in the classroom and in other cases focusing on very specific skills that prior research has determined are high-leverage

practices). Questions, therefore, about granularity in the size and scope of learning objectives, scenarios, and anticipated outcomes would be productive lines of inquiry. One paper that presented a strong RCT design also pointed out the importance of developing empirically grounded recommendations for the field (in this paper's case, they found that just repeating practice on one's own does not give the full benefit of the simulation, in contrast to the impact made by high-quality coaching coupled together with the simulation experience).

Some gaps to be filled in the research, as identified by several papers, are in part also issues about logistics. Resourcing mixed reality labs can be costly and time-intensive. The design and development of protocols and scenarios can also be task-intensive. Even conducting small pilot projects as proof-of-concept requires a large team and the coordination of multiple resources. Another gap to fill is the need for solid and reliable measures that can move the field toward the possibility of replicating studies and taking projects to scale. Some of the papers, for example, had highly specified outcome goals with scoring rubrics with clearly articulated criteria and a clear vision of what the targeted teaching practices should be.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I am very interested in the tension between time in the simulator as "scripted" vs. as more open-ended, as I think there is value in each when researchers are asking different types of questions. Also, the importance placed on the different types of reflection and feedback protocols as part of the larger design process (along with the inclusion of the teacher candidates in the design) would be of interest to explore. I'm also curious about the ways in which the post-simulation experience can be used for enriching conversations and for unanticipated directions (one paper, for example, had an intriguing idea of the simulator as a design/experimental space to try things out (they used as an example having teachers try out being "pushy, deferential, reactive, compassionate" as ways to move out of comfort zones. I am intrigued by the idea that the simulator can be a space where we are not driving, necessarily, toward a single "right" answer or an established set of agreed-upon practices, but also as a way to enrich the conversation, perhaps among teacher educators themselves who might have converging (and at times diverging) views of practices.

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Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Andrew Wild, Woodrow Wilson Academy of Teaching and Learning

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Bondie, R., Jack, J., & Dede, C. (2019, February 19-21). *Agile thinking: Deciding to teach every student*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Garrett, R. (2019, February 19-21). *Simulated instruction in mathematics professional development (SIM PD) study.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Kretschmer, D. & Kwon, M. (2019, February 19-21). *Approximation of eliciting student thinking in elementary science and mathematics methods courses*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

Garrett (2019) emphasizes the feature of authenticity of teaching in introduction to the project. Bondie, Jack, and Dede (2019) describe a simulation as an "approximation of a task done by teachers." Kretschmer and Kwon (2019) also conceptualize of simulations as approximations and quote Grossman et al. (2009) who define approximations, "opportunities to engage in practices that are more or less proximal to the practices of a profession" (p. 2058). The three projects described by these authors "go beyond" the decisions and moves that teachers make during an encounter by, for example, discussing the approximation afterwards, but it seems that they define simulations as solely the approximation. Self's (2019) definition of "simulation" is broader since it includes the preparation for the approximation of practice and the debrief afterwards, as described by Dotger (2013). It is helpful for teacher educators, researchers, and simulation developers to have a common conceptualization of a simulation as including an approximation of a task done by teachers since the shared meaning enables communication and can facilitate design. However, the inconsistency and lack of clarity in the inclusion of pre- and post-encounter thinking and interactions may present communication challenges and

variability in design and implementation (e.g., whether there are pre- and/or post-approximation activities).

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

A commonality in the theories of action (implicit in some papers) is that prior to the simulated encounter, teachers develop or activate their prior knowledge. All authors seek to improve teachers' responses, but they emphasize action as an outcome to varying degrees. Kretschmer and Kwon (2019) focus on the outcomes of asking questions and content knowledge. Garret's (2019) theory of action is unique is that it explicitly describes mechanisms (self-efficacy and instructional capacity) through which encounters and feedback impact classroom practice. In contrast, Self's primary goal is for the teachers to understand where their responses come from, especially in terms of oppressive forces (e.g., Whiteness), positionality and identities, and the impacts of their (often unintended) actions on students. Another commonality is that reflection and/or feedback on the approximation improves practice and/or understanding. Two papers theorize components of teachers' in-the-moment responses. Self (2019) theorizes that cognition, behavior, and affect come together to shape a teacher's response during the approximation. Bondie et al. (2019) describe equitable classroom pedagogy as coordinating self and cultural awareness and pedagogical content knowledge.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

The projects vary in their emphasis on teachers' responses/actions during encounters. Garrett (2019) is conducting a randomized-control trial in schools, which will offer insight into the effects of the Mursion simulation and accompanying professional development on classroom practice. Kretschmer and Kwon (2019) describe patterns in pre-service teachers questioning and their reflections on their learning from the simulation. Similarly, Self (2019) analyzed teacher discourse and how teachers narrated their learning (i.e., what they thought they had learned). Bondie et al. (2019) piloted a survey targeting several constructs (e.g., self-reported instructional practices, agile instructional thinking). Two projects (Bondie et al., 2019; Self, 2019) mention feedback on and/or iteration of their simulations and I am eager to learn more about their process. All the projects advance the understanding of simulations by investigating impacts on teachers (e.g., their responses during the encounters, perceived learning). However, there was not an expectation for the authors to specify a research question or methods, which makes it difficult to evaluate the quality of the research. Further systematic inquiry into the

relationship between the features of simulations (including the pre- and post-encounter) and teacher learning would benefit teacher educators and simulation designers.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

Kretschmer and Kwon's (2019) learning that several pre-service teachers (PSTs) repeated similar questions to different avatars makes me wonder how teachers' responses change over TCs and "rounds" of simulations. Specifically, would discussion and planning to say/ask something specific in between each round impact subsequent teachers' responses, and if so, how?

Self's (2019) point about safe and supportive communities in light of the goal of developing a stance of pedagogical responsibility piques my curiosity about the role of teachers' emotions in simulations. How might teachers' emotions be used as some indication of a simulation's authenticity of the simulation and/or supportiveness of the community? How do teachers deal with the emotions that arise when they recognize that some of their actions perpetuate the status quo or existing inequities?

Our organization is attempting to improve the alignment of our programs and I am curious how the simulation fit within the "bigger picture" of the teacher education programs. Are there frameworks (e.g., theoretical, pedagogical) that underly the simulation design and/or implementation? Relatedly, I would like the opportunity to discuss ideas and theories about the transfer of the simulations to interactions with real people.

Simulations in Teacher Education Conference:
Synthesis Review of Papers

Review Written by Christine Wilson, East Carolina University

This paper represents the author's synthesis of the following short conference papers and was structured around a set of four guiding questions.

- Boerst, T. & Shaughnessy, M. (2019, February 19-21). *Assessing teaching practice: Eliciting and interpreting students' mathematical thinking*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Davis, E. & Arias, A.M. (2019, February 19-21). *Simulated student interviews for preservice elementary science teaching*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Self, E. (2019, February 19-21). *SHIFTing horizons in future teachers with simulated encounters*. Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.
- Ware, P. & Wernick, A.M. (2019, February 19-21). *Simulating English learner instruction: Assessing teacher growth using a pre-/post-teaching cycle.* Paper presented at the Simulations in Teacher Education Conference, Louisville, KY.

Question 1: Discuss commonalities and differences in how these authors define simulations. What are the implications for how the field defines the work?

A major commonality is how all simulations are meant to be as realistic a scenario as possible as well as PSTs are given time as well as background knowledge on what they are about to do. Each author begins by giving the PST some sort of packet or seminar that includes background information on what they are to do in the simulation, such as teach a lesson on a certain topic. They are given a time window to prepare materials and gather their thoughts on how to handle the situation before they begin. The teacher or actor meant to play the role of the student is trained as well as given guidelines on how to respond to the teacher so they can portray a realistic student in a classroom.

A distinct difference is the avenue taken to perform the simulation. 3 of the 4 authors used real-life interactors, usually a teacher trained on how to act like the needed student, while the fourth author used a virtual reality program called Mursion for the student roles.

Such implications can sway how the PST reacts. With a live person, perhaps an individual the PST already knows, the PST may be more relaxed when they go through the interaction or even

become more nervous in having to treat an adult like an elementary student. Talking to child avatars on a screen may be more daunting as this is an action many do not partake in during a normal day. The PST's comfort level may be the unseen factor that sways the outcome of the simulation. For example, in (Davis & Arias, 2019) simulated student interviews on preservice elementary science teachers, they noted how one student agreed with the student's inaccurate claim as if it was true and also became confused as the scenario went on. This could be due to the PST feeling out of their element because of not understanding content or feeling uncomfortable with the live actor portraying a student.

Question 2: Discuss commonalities and differences about the theories of action suggested across the set of papers. What is the theory of action a theory of? What is the object of the theory of action?

The theories all speak of a desire for the PST to think of their skills and actions in the moment as well as reflect afterwards on why they responded the way did as well as how they could incorporate better skills into the situation next time. Also, the PSTs can be given insight into how students process information and what scaffolding would be needed to assist with that. One difference to note is that 3 of the 4 authors see the simulation as a type of assessment, whether it started out as an assessment tool as stated by Ware and Wernick (2019) or is used to do actually assessing. Dr. Self in her SHIFT Project study (2019) states that the simulated encounters are never used for assessing participants because they want to create safe, supported opportunities for PSTs to make sense of their decisions without harming real students and their families.

The theory of action in each case is a theory of how PSTs will act when shown their teaching in the scenario. They want these future educators to understand why a wrong reaction is wrong and what steps are needed to correct it. The object is to create a better understanding of the standards used in the context of the given scenario. We want teachers who can assist English Language Learners, who can explain data collecting as well as how to interpret said data, and who understand a child's reasoning in math as well as how to scaffold so the child can reach greater heights of understanding.

Question 3: Discuss convergences and divergences in lines of research and development exemplified across the set of papers. What lines of inquiry are likely to be productive? What gaps or limitations can be identified?

Two of the authors wish to find out more about how to use the simulations as assessments of PSTs' skills as well as creating valid characterizations of preservice teachers' performances. Differences include finding any moral and/or ethical concerns about using live interactors along

with making sure there is consistency across interviewers as students as well as integrating other curriculums into the study and even using different yet effective reflection protocols. What I can see as being productive is investing in how to use the simulations as assessments of the participants' skills as well as finding better ways for PSTs to reflect as well as receive feedback to better their skills. Also, the impact on using virtual interactors or real life ones is an aspect that should be delved deeper into. A limitation could be seen with Ware and Wernick (2019) as they work to integrate STEM curriculum in their research. It will be grounded in project-based learning, yet the jump from working with English language instruction in Science to pure STEM might be a challenge. Teaching a beginning unit in a simulation is one thing, but including project-based learning with simulated students is another. Participants will need more preparation time as well as background information. Interactors will need specific training to reach the goals intended.

Question 4: Describe any ideas or project features that intrigued you across the set of papers and that you would like the opportunity to explore in more depth during the conference.

I would like to explore more on how researchers prepped PSTs on background knowledge of the simulation as well as what measures were taken to make sure the PST was a comfortable as possible during the process. I was also intrigued by how Dr. Self incorporated her 5 steps in her simulation as well as the trained actors. How long were the actors trained for as well as how were the standards decided on for this undertaking.

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