

Alternative Assessment in a Relational Constructivist Mathematics Methods Course: An Illustration of Mathematics Teacher Educator Practice

Alyson E. Lischka
Middle Tennessee State University

Received: September 2025 || Accepted: May 2026

© 2026 Mathematics Education Research Group of Australasia, Inc.

For mathematics teacher educators to learn from others' practice, avenues for sharing those practices are needed. In this Illustration of Practice article, an alternative assessment model implemented with prospective teachers in a relational constructivist secondary mathematics methods course is presented. The article provides one answer to the question of how mathematics teacher educators connect theory and research to their teaching practice. Background is provided to establish the context within which an alternative grading system was implemented and examples from one strand of learning in the course are provided to demonstrate the use of the alternative assessment system. The overall grading rubric and objectives that guide the course are described and cases recounting prospective teachers' experiences with this assessment system are included. This illustration of practice contributes one example of the connection between theoretical foundations and mathematics teacher educator practices. It will support other mathematics teacher educators to consider the ways in which theoretical perspectives inform teaching practices implemented in their courses.

Keywords • mathematics teacher education research • methods courses • alternative assessment • relational constructivist teaching

Research has demonstrated the work of mathematics teacher educators (MTEs) is diverse and informed by a variety of theoretical perspectives and goals for learning (Casey et al., 2018). As such, learning from research on MTEs' work requires attention to theories serving as the foundation of teacher educators' practice and consideration of how those theories align with their teaching practices. Further, how MTE activities and practices are taken up by other MTEs is also informed by theoretical perspectives (Casey et al., 2018). Within this complexity, there is much yet to be learned about how MTEs construct practices for the teaching of mathematics teaching (Beswick & Goos, 2018; Krainer et al., 2021) and the variations of practices possible.

Assessment is one practice teacher educators implement regularly that impacts prospective teachers' (PTs') learning. My relational (Kitchen, 2005a, 2005b) constructivist (Steffe & D'Ambrosio, 1995) teacher educator practices created a tension with traditional assessment systems in which instructors evaluate PTs by assigning numerical grades to their work. In particular, my desire to teach in ways that honoured constructivist principles and supported PTs to become reflective practitioners (Dewey, 1933; Nelson et al., 2016; Schön, 1983) was at odds with the teacher educator establishing authority through assigning grades without PTs' input. Recognizing this tension as a "living contradiction" (Whitehead, 1989, p. 44) in my practice, I was prompted to explore alternative grading, sometimes referred to as *ungrading* (Blum, 2020).

To contribute to MTE knowledge of teaching practices, I conducted a self-study of my alternative assessment practice. In alignment with self-study methodology, I leverage my position as both researcher and researched to interpret and present the practice under investigation (Pinnegar & Hamilton, 2009). Presenting this work in first-person acknowledges my experiences are central to my understanding of how this practice developed. With this self-study research as the foundation This



article presents an Illustration of Practice to explicate the ways I assess PTs in a relational constructivist secondary mathematics methods course.

I address one guiding question for this special issue—"How do MTEs connect research to MTE teaching?"—by demonstrating how relational constructivist theory and research on assessment inform a particular MTE practice. Data were gathered during the self-study, as approved by the Middle Tennessee State University Institutional Review Board oversight, over several iterations of a methods course from 2018 to 2025 including: transcripts of audio recordings of class discussions, assignments completed by PTs, feedback given to PTs on those assignments, and recordings of individual assessment conferences between each PT and me. The methodological details of the research have been published elsewhere (Lischka et al., 2020; Lischka et al., 2023a, 2003b; Lischka, 2025); however, those research reports did not include depiction of how this alternative assessment model was enacted in practice.

Theoretical and Institutional Contexts of Practice

Next, I describe my theoretical perspective and situate my practice within research on assessment. Then I describe the institutional context and expectations for the course in which this alternative assessment practice has been implemented.

Relational Constructivist Teacher Education

Constructivist teaching practices are foundational in the teaching of mathematics (Davis et al., 1990) and require instructors to build on the thinking of learners, foregrounding learners' models as an instructional tool (Steffe & D'Ambrosio, 1995). Because my teacher training began as a teacher of mathematics, I transferred this perspective into my teaching of teachers. Thus, a goal for instructional activities I design in mathematics methods is to create opportunities for PTs and teacher educators to interact "in a learning space whose design is based, at least in part, on a working knowledge of teacher-learners' concepts of mathematics teaching and learning" (Kastberg, 2014, p. 352). Biggs (1996) described constructivist teaching as a perspective in which:

The learner brings an accumulation of assumptions, motives, intentions, and previous knowledge that envelopes every teaching/learning situation and determines the course and quality of the learning that may take place. The teacher may ignore or use this learner-structured framework, but the centrality of the learner is given. (p. 348)

Therefore, in my mathematics methods courses instructional activities include opportunities for PTs to share their ideas about teaching with me and their peers. These ideas are then either corroborated or challenged by the participants (both PTs and the instructor) through feedback provided orally during interactions in class or in written form. Learning occurs as PTs refine their ideas about teaching and learning mathematics from feedback received. Evidence of learning is found in PTs' reflections on their growth and is supported by observations of changes across course tasks completed. Holding a constructivist perspective on teaching means I begin with PTs' experiences and support them to move toward adopting research-based practices.

This perspective on constructivist practice requires instructors to know the PTs with whom they work to build on PTs' previous experiences and knowledge. Kitchen's (2005a, 2005b) notions of relational teacher education support teacher educators to consider ways of knowing PTs. Kitchen described relational teacher education as "a reciprocal approach to enabling teacher growth that builds from the realisation that we know in relationship to others" (2005a, p. 17). He named seven characteristics of relational teacher education, which can be described as two categories of "knowing oneself and knowing prospective teachers" (Kastberg et al., 2019, p. 70). Knowing oneself includes understanding one's personal practical knowledge, improving one's practice in teacher education, and understanding the landscape of teacher education (Kitchen, 2005a, 2005b). Knowing PTs includes, conveying respect and empathy, helping PTs face problems, and receptivity to growing in relationships



(Kitchen, 2005a, 2005b). Throughout methods course activities, I structure opportunities for PTs to share their history, ideas, fears, and questions so that I can empathise and support them to overcome problems they face.

Taken together, a constructivist relational teacher education theoretical perspective allows me to consider variation within learning outcomes for each PT. Though there are specific course learning requirements, each PT approaches those learning goals from a different history and with different ideas for what their practice of teaching will include. My goal is to support PTs to consider their ideas against a backdrop of research-based best practices and feedback from others to shape their ideas into effective mathematics teaching practices through reflection. Encouraging PTs to become reflective practitioners (Dewey, 1933; National Council of Teachers of Mathematics [NCTM], 2014; Schön, 1983) so they can continue to grow and improve as mathematics teachers is a primary focus of this methods course.

Situating Practice in Research on Alternative Assessment

Research regarding assessment has indicated both feedback and assessment *for* learning models as influential in impacting both learning and agency among learners (Borgioli et al., 2015; Hattie & Timperley, 2007; McDowell et al., 2011). In addition, assessment models where teacher educators dominate summative assessment has been found to hinder PT learning (Mumm et al., 2016). Feedback supporting learners to understand how they are progressing and pointing to where learning will go next along with attending to the task, the processes, self-regulation, and self-reflection improve achievement (Hattie & Timperley, 2007). Coupling effective feedback with assessment for learning (Black & Wiliam, 2005) has been found to motivate learners and create positive course improvements (Borgioli et al., 2015) along with improved experiences for learners that support deeper approaches to learning (McDowell et al., 2011). Assessment for learning occurs in an environment rich in both formal and informal feedback, includes authentic opportunities to practice new skills, assists learners to develop independence and autonomy (Black et al., 2003; McDowell et al., 2011) and incorporates a variety of formative assessment practices (Mumm et al., 2016). This literature base served as the foundation for the alternative assessment model I developed for my Mathematics Methods course.

Institutional Context

The institution where I teach is a comprehensive university offering a variety of undergraduate and graduate degrees to a population of around 22,000 students. Many are first generation college students from the region surrounding the institution, encompassing both rural mountain communities and urban developments. Because of the history of the institution as a teacher college, teacher training is highly valued by the administration and continues to be supported even though numbers of students entering teacher preparation programs dwindle.

The teacher preparation program for secondary mathematics teachers is housed within the Mathematics Department and is a UTeach replicate program (Hughes et al., 2020) that includes secondary science, agriculture, and mathematics teacher preparation. Graduates earn a bachelor's degree in mathematics with a minor in teaching. PTs take courses that immerse them in K–12 classrooms throughout all four years of the program. The program uses a variety of activities to build community among the PTs including providing program shirts, hosting a study lounge, group outings, themed days with food provided (such as Taco Tuesday), and opportunities for professional development and mentoring. Because of the community building activities, PTs know each other and work together well. In most cases, PTs take a College Geometry course from me prior to this methods course. I then supervise the culminating teaching practicum for half of the PTs.

The methods course featured here is the second of two methods courses included in required mathematics courses and is taken in the final year of the program, usually one semester prior to undertaking a field placement. This course is also required for PTs in the middle grades teacher preparation program. PTs in the course had completed most requirements for their bachelor's degree in mathematics or middle grades teaching and completed the first methods course, which is focused on



Standards of Mathematical Practice (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) and student thinking in middle grades. On this foundation, the content of the course reported here focuses on Mathematics Teaching Practices (NCTM, 2014) and student thinking in secondary school. The learning objectives for this course are:

The teacher will:

1. Demonstrate mathematical knowledge for teaching secondary school mathematics across the topics of functions, algebra, geometry, trigonometry, mathematical modelling, and statistics and probability.
2. Develop unit plans that incorporate research-based best practices for teaching and learning mathematics including:
3. The Mathematics Teaching Practices;
 - a. Common Core State Standards and other curriculum documents; and
 - b. Effective use of technology for learning.
 - c. Demonstrate an understanding of appropriate assessment for and of learning, including development of appropriate mathematical questions, assessments, and ways of providing feedback to learners.
4. Demonstrate an understanding of equitable teaching practices and the role of power and privilege in mathematics education. (Lischka Syllabus, 2025)

The major assignments of the course are two unit plans (one unit for three consecutive instructional days and one unit for five consecutive instructional days), three rehearsals of teaching, and other assignments supporting unit planning. There is no field placement co-requisite with this methods course, though most PTs are enrolled in other courses with field placements during the same semester.

Assessing Growth in a Mathematics Methods Course

When I began teaching methods courses, I adopted the previous instructor's points system in which each assignment was awarded points according to related rubrics and the final grade was determined by the total points earned across all course assignments. As I progressed in the study of the alignment of my constructivist relational teacher education perspective with my teaching practices as part of a collaborative self-study (LaBoskey, 2004), I became increasingly discontented with the points-based grading system. The traditional practice of the instructor assigning points to completed work and calculating an overall grade was contradictory to my professed goal of supporting PTs to become reflective practitioners who can evaluate their growth as they progress in their careers. I struggled to see traditional grading practices as valuing PTs' ideas and respecting their knowledge of their personal growth (see Lischka et al., 2023a).

An Alternative Assessment System

I began adapting my assessment strategies in 2018 to incorporate more peer feedback and reflective assignments. I first removed points from rubrics and focused on "meeting expectations" as denoted in rubrics, with a final grade determined by the percentage of tasks on which PTs met expectations. Still experiencing a living contradiction due to the authority I was exerting to determine a final grade, I later incorporated more reflective assessments and moved to PTs determining their midterm and final course grades as described by a grading rubric (Table 1) based on Biggs' (1996) five levels of growth of competence and complexity. Throughout the semester, I discuss how each assignment provided information for PTs' growth and reflection as related to the rubric descriptors. PTs formally reflect on their progress both at midterm and at the end of the course in a written reflection, which is then discussed in a conference with me. Since 2019 I have used this rubric to guide instruction and evaluation of PTs' growth in mathematics methods.



Table 1
Methods Course Grading Rubric

Letter grade	Standard Description
A	The teacher is able to reflect on their own teaching using the language and content from the course; evaluate the decisions made about lesson planning and assessment; improve their practice; formulate a personal theory of mathematics teaching that demonstrates research-based practices; and generate new approaches to teaching based on content and principles discussed in class. The teacher attends classes and contributes productively to class discussions and activities.
B	The teacher is able to apply course content and recognise the difference between good and poor applications of teaching practice. The teacher understands that course content is used as a theory of teaching that drives action. The teacher attends most classes and contributes productively to class discussions and activities.
C	The teacher can discuss research-based practices and can demonstrate knowledge of principles and other course content but <i>does not effectively apply that knowledge to lesson planning and other teaching activities</i> . The teacher's attendance impacts their ability to contribute productively to class discussions and activities.
D	The teacher has sparse understandings of the research-based practices and principles presented in the course and shows some evidence of effort to acquire appropriate terminology. Higher levels of understanding are offset by misunderstandings . The teacher's attendance severely impacts their ability to contribute productively to class discussions and activities.
F	The teacher demonstrates fundamental misunderstandings of research-based practices and a general lack of effort or involvement in the course.

Note: Bold and italicised text is as written in the course syllabus.

Unit Planning Course Activities

Instructional activities for this course are presented in an interwoven manner. Four strands of activities, one related to each major learning objective for the course (mathematical knowledge for teaching, unit planning, assessment, and equitable teaching practices) overlap each other so that each learning objective has layers of activities (see Kastberg et al., 2024) supporting PTs to move toward independence with their teaching practice by the end of the course. For this Illustration of Practice, I focus on the strand of unit planning. In prior courses, PTs have learned the structure of a single lesson plan and written one-day plans. The focus in this course is building connection across consecutive days of planning within a unit.

The unit plans PTs create were comprehensive, including a narrative of what teachers and students will do throughout the lesson, assessment components, and all instructional materials, activities, or homework assignments. PTs identify prior knowledge needed and how lessons fit into a trajectory of learning. Answer keys for all activities were required, along with potential responses students might contribute during any planned lesson discussions. PTs are given a textbook teacher's edition aligned to standards assigned. During methods class meetings, I engage PTs in activities that support lesson planning such as exploring resources, learning about accommodations for learners with diverse needs, and developing tools for supporting productive struggle. Table 2 shows primary activities included to support development of unit planning. Instructional activities focused on the other three learning strands woven among the activities listed in Table 2 and are the focus of weeks omitted from the table.



Table 2
Layers of Instructional Activities for Unit Planning

Week	Description of Task	Method of Feedback
Week 1	PTs collaboratively map the content taught in high school mathematics and explore high school standards	Oral: in-class whole group discussion
Week 2	Unit Plan 1 topic assigned; introduction to the Mathematics Teaching Practices (MTP) (NCTM, 2014)	Oral: in-class discussion of reading about MTP and early planning ideas
Week 4	Introduction to curriculum resources (PTs are provided with the teacher's edition for Unit Plan 1)	Written and oral: in-class whole group discussion and feedback from instructor on guided reflection
Week 4	Begin Rehearsal 1 (launch a lesson in their unit plan 1)	Feedback if requested by PT
Week 5	Peer, instructor feedback on draft of Unit Plan 1	Written feedback from peers and instructor
Week 6	Rehearsal 1 (launch a lesson from their unit plan)	Written and oral: in-class whole group discussion and written feedback from instructor
Week 7	Introduction to supports for language learners	Feedback if requested by PT
Week 7	Final draft of Unit Plan 1 submitted	Written feedback from instructor (inline comments along with a feedback guide)
Week 8	Unit Plan 2 topic assigned	Feedback if requested by PT
Week 8	Rehearsal 2 (implementing supports for language learners)	Written and oral: in-class whole group discussion and written feedback from instructor
Week 11	Rehearsal 3 (discussion following a technology enhanced lesson)	Written and oral: in-class whole group discussion and written feedback from instructor
Week 12	Peer, instructor feedback on draft of Unit Plan 2	Written feedback from peers and instructor
Week 14	Final draft of Unit Plan 2 submitted	Written feedback from instructor (inline comments along with a feedback guide)

Another course activity supporting lesson planning is rehearsal. In each rehearsal, PTs present a 10-minute portion of a lesson from their unit as their colleagues participate as mathematics learners. Following the rehearsal, the whole class reflects on decisions the PT made and considers the effectiveness of those decisions. Each rehearsal is focused on a distinct aspect of lessons: launching a concept, implementing supports for language learners, and leading a discussion following a technology-based exploration activity. When the methods course is small (five or fewer PTs) each PT enacts each of the three rehearsals. With larger classes, groups prepare rehearsals and one member of the group presents the rehearsal, rotating through presenters as we progress through rehearsals.

In addition to the activities in Table 2, weekly exit tickets and a journal writing activity are implemented throughout the course. PTs engage in a journal writing exchange with me throughout the semester. The first prompt is prescribed and includes discussion of their ideas about curriculum along with their goals for the course. All other prompts are generated by PTs and focus on questioning and noticing they experience related to teaching mathematics. PTs write their thoughts, and I respond to them with suggestions and/or questions to support their growth. The journal is an opportunity to attend to individual PT's concerns and to encourage development as a reflective practitioner. The journal exchange also supports my relational constructivist perspective on teaching by providing an avenue for me to learn more about PTs' ideas and concerns as they progress through the semester.



PTs meet with me individually at the midpoint and endpoint of each semester to demonstrate their growth according to the course rubric (Table 1). During each conference, PTs state their current grade and provide evidence supporting the grade assignment. Evidence can be drawn from any course assignment or interaction, including completed work, work in progress, and feedback from me or peers. If there is disagreement between me and the PT on the grade assignment, we enter into negotiation focused on evidence PTs provide to support their claim.

Stories of Developing Growth in Mathematics Methods

To help readers understand how the structure described supports PT learning and growth, I provide stories of three PTs' journeys. The stories were created from PTs' submitted work, transcripts of evaluation conferences or class sessions, my instructor journal, and other interactions with PTs. Data were chosen from the corpus of research data to illuminate this alternative grading system and the variations that can occur. I present vignettes demonstrating the range of ways this type of assessment system can work, or not work, to support PTs' growth as reflective practitioners. Anna (all names are pseudonyms) was an exceptionally strong PT from the beginning of the course, Miles entered the course with an inconsistent academic history and emerged stronger, and Sarah's progress declined throughout the course. These three PTs are representative of the categories of PTs in my data. There are varying amounts of data available to tell the individual stories due to PTs' differences in participation in required course activities.

Anna: PT initially underestimating her growth

Anna, a female in her early twenties, started Fall (September) 2023 with serious health issues impacting her ability to complete assignments according to posted deadlines. Along with my methods course, she was taking a Residency course where she spent one day each week in a school. Anna's mentor teacher for Residency provided deficit rather than asset-based feedback and had little time to work with her outside of teaching hours. Both of these factors increased Anna's stress level and exacerbated an inability to focus on tasks. Because Anna had taken College Geometry with me the previous semester, I knew of her health issues and had developed a productive relationship with her prior to starting the methods course. She started the semester willing to be open with me about the struggles she was facing. Despite these struggles, work Anna submitted was outstanding. She was thoughtful, thorough and concerned about improving as a teacher. The Fall 2023 class had only three students, so Anna was able to enact the role of teacher in each of the three rehearsals.

At the start of each methods course, I ask PTs to write their description of a high-quality mathematics lesson. Anna wrote:

I think that a high-quality mathematics lesson is one that involves a teacher speaking as little as possible. If I were to observe a classroom during a high-quality mathematics lesson, I would want to hear a lot of student discussions (both in small groups) as well as the whole class. I would also want to hear students asking questions of each other and really diving into the content. (Anna, Journal Entry 1)

During class, I asked Anna to explain how she thought student discussions would start. She responded, "Really good questioning, but I know that is not easy!" (Anna, Class Recording). I knew from interactions with Anna that she was interested in improving her questioning, so I encouraged Anna to focus on questioning throughout her semester to help her focus on an aspect of her teaching she could improve despite the stresses in her life.

Anna's first rehearsal was a launch of a task involving distances related to a baseball diamond. She opened the launch by asking what the class knew about baseball. Others in the class were not interested in sports, so this question did not engage others and forced her to shift quickly. She then asked, "What do you know about squares?" (Anna, Rehearsal 1 Video) and used responses to generate a list of prior knowledge held by class members. In my feedback, I stated:



You made great choices about making sense of the problem that led to pointing out important features of the diagram. Different choices for how to start may have achieved this in other ways. Consider what might have happened if you started with the question "What do we know about squares?" – gathered all the information you can about the class's prior knowledge and then asked the question about baseball. [Anna, Rehearsal 1 Feedback Form]

Anna incorporated a variety of questions in her rehearsal, but they were "funnelling" questions (NCTM, 2014, p. 37) intended to lead students to particular responses. After the rehearsal, I provided feedback related to the Mathematics Teaching Practices (NCTM, 2014). I wrote, "Pose purposeful questions: you asked questions to get students thinking. Be careful about having a particular answer in mind. If you are trying to get students to say a particular thing it sometimes clouds the question you are asking" (Anna, Rehearsal 1 Feedback Form). This rehearsal and feedback marked the beginning of Anna's growth related to questioning.

Anna's first unit plan was better than most of the first unit plans I have reviewed. She incorporated a variety of activities for developing conceptual understanding and connected the content from one day to the next with effective activating and closing strategies. Several of Anna's conceptual development activities, however, were reduced to understanding procedures by questions and discussion points she included. Questions Anna wrote were either closed questions or questions that funnelled students toward a particular procedure. For example, she planned to ask students, "What is an equation of a parabola with vertex $(-3, -4)$ that passes through $(-5, -6)$?" (Anna, Unit Plan 1) and followed this with a conceptual question, "How can you tell if a is positive or negative before writing the equation?" (Anna, Unit Plan 1). However, Anna followed the conceptual question with plans to explain a procedure:

You can compare the y-coordinate of the vertex with the y-coordinate of the other point. If it is lower that means the parabola opens downward and a is negative, if it is greater, that means the parabola opens upward and a is positive. (Anna, Unit Plan 1).

In response to Anna's plan I wrote,

Be careful of making this too procedural. Can they plot the points and look at them and determine whether the parabola opens up or down? If so, they don't need this rule. Doing this without the rule would reinforce connections between the graph and the algebraic rule. [Anna, Unit Plan 1 Feedback]

In summary feedback on Anna's first unit plan, I pointed to improvements she could make in planning for productive questioning.

You have a really nice start on lesson planning Be careful you are not reducing conceptual understanding to a procedure. In other words, providing a set of "steps" is not always helpful unless students understand WHY those are necessary Add more opportunities for students to explain WHY and HOW they know what they know. Why are they doing the things they are doing? You need to plan to ask those types of questions or else they will not happen as part of your lesson. That is where conceptual understanding is built. You have nice opportunities for conceptual understanding to develop but you need to follow through with opportunities for students to talk about that and explain it to you. Overall, this is a really nice start. [Anna, Unit Plan 1 Feedback]

Lesson Plan 1 marked the end of the first half of the semester, at which point PTs wrote a reflection on their progress and met with me to discuss it. Anna graded herself a C and explained this by pointing out assignments that had been submitted late and her lack of reflecting in the journal (she had not submitted any journal entries beyond the first one at that point). When Anna's mid-term conference began, I asked how she was doing, and she proceeded to open up about pressures from her family due to family members' and her own health issues. She also told me these pressures along with the difficulties she had with her Residency mentor were increasing her anxiety levels to where she was working with her physician to adjust anxiety medication, which was creating issues with ability to focus. We spent much of the conference discussing strategies to help her manage both external pressures and deadlines for work. When I finally brought discussion around to her submitted work, I pointed out the positive feedback and the high quality of her lesson plan along with encouragement to



improve her questioning. By the end of this conference, Anna decided work she had submitted demonstrated A level work in many ways, but her lack of evidence of reflection reduced this to a B.

In the second half of the semester, PTs engaged in additional rehearsals and wrote a longer unit plan, encompassing at least five days and including analysis of formative and summative assessments. As Anna progressed through remaining course tasks, she improved her reflection by submitting six journal entries and she managed her schedule to meet posted deadlines. It became clear Anna was taking up feedback given on questioning when she enacted her third rehearsal. For her rehearsal of a discussion following a technology task on explicit and recursive functions, she engaged learners by listening in productive ways. In feedback I wrote, "You did a nice job of hearing what your students were saying and responding to them in positive ways." [Anna, Rehearsal 3 Feedback] In addition, regarding feedback on the Mathematics Teaching Practices I wrote,

Pose purposeful questions: You asked questions to help students make sense of the formula and the notation (which is a struggle for students). You also picked out particular examples to discuss – in particular the similarities and differences among the two methods. This was really nice! I especially liked the "why did you determine that you needed to use an exponent" question toward the end of your rehearsal – you are picking out important mathematical concepts. [Anna, Rehearsal 3 Feedback]

Through these activities, I could see Anna's growth in questioning. What remained to be seen was whether Anna could see this growth.

Anna's final unit plan was on the topic of logarithms and logarithmic functions. While she was writing the plan, Anna met with me to be sure she was understanding how to develop the content conceptually. This work paid off as her final lesson plan incorporated activities that developed conceptual understanding and used productive questioning to allow students to explain their thinking without direction from her. One notable activity used in her plan was one in which learners solved a problem independently on a sticky note and then moved into a group, each placing their sticky notes solutions on the task sheet and then discussed different ideas each brought to the group to write a group solution. The task chosen for this offered multiple solution paths and the planned group discussion allowed students to defend their reasoning and listen to each other. This marked a departure from the earlier plan in which Anna funnelled student thinking to a particular procedure.

In her end of course self-evaluation, Anna noted her growth both in rehearsals and in unit planning. She wrote,

I improved my practice. I think the best thing that shows that I did this are my task rehearsals. In the first rehearsal and second rehearsal part of my feedback discussed how I didn't incorporate many purposeful questions. For my third rehearsal, my biggest goal was to improve my practice by incorporating more purposeful questions. Through my discussion with classmates as well as the feedback form from Dr. Lischka, I think my practice has definitely improved from the rehearsal one to the third rehearsal regarding purposeful questioning. On my Rehearsal 1 feedback, you mentioned that I asked some good questions but that they were very leading. Then on Rehearsal 2 you noted how I "asked a few nice questions in the opening of the lesson," but that I could think of more ways to incorporate purposeful questioning. In my rehearsal 3 feedback, you mentioned many different examples of purposeful questions I asked, such as asking students to make sense of notation and formulas, similarities and differences between methods, and then, "Why did you determine that you needed to use an exponent." [Anna, Final Self Evaluation]

Anna went on to explain how she incorporated pedagogical ideas discussed in class into her work purposefully:

I really wanted to take things we were learning in this class and try to apply them in my lesson planning and other assignments just to get experience with doing them for the first time and get better at them. ... I also tried to incorporate a lot of overarching ideas we discussed as well. One of those was open-ended questions. I incorporated those in both my lesson plan activities and unit assessment. I also tried to incorporate procedural fluency from conceptual understanding. I did this in my rehearsal and also worked really hard to do this in my lesson planning which you noted in feedback for Lesson Plan 2. I felt that with lesson plan 1, I did incorporate a lot of conceptual understanding, but I lacked procedural



fluency. I thought I did that better with Lesson Plan 2. I also incorporated a balance of different types of questioning in my assessment, such as closed, open-middle, and open-ended. I think incorporating these new evidence-based strategies helped me improve my practice as well. [Anna, Final Self Evaluation]

In her final self-evaluation conference, Anna was able to argue for how she met each of the characteristics described in the grading rubric for an A. More importantly, she was confident in her ability to reflect on her practice, improve her practice, and enact productive questioning. Not only had Anna grown in her teaching practices, but she had also learned to reflect more accurately on her teaching as aligned with research-based practices.

I served as Anna's student teaching supervisor during the next school term. During my first observation of her teaching, Anna implemented the sticky note activity from her second unit plan with struggling learners in Algebra 1 (replacing the task with an Algebra 1 task). I heard conversations about mathematical ideas and students justifying their reasoning throughout the activity. The evidence of Anna's growth as a teacher was now taking shape in a classroom with her students.

Miles: Case of required reflection supporting growth

Miles, a male in his early twenties, took my class in Fall 2022 with seven other PTs. Miles had struggled to make progress on his teacher education coursework and as a result had repeated several pedagogy courses and needed permission from me to take my methods course. He had not passed the prerequisite methods course though he took it twice. Miles requested an opportunity to take my methods course without the prerequisite in the hope of not delaying his graduation for a full year. I noted Miles was highly successful in mathematics courses and had strong mathematical content knowledge. However, he struggled to complete assignments in pedagogy courses, including writing single-day lesson plans. I permitted Miles to enrol in my course on the condition that he co-write a performance contract with me and agree to the stipulations. The contract included a requirement to submit all assignments according to the posted deadlines and to meet with me during office hours once each week.

As the semester began, I used the weekly check-ins to get to know Miles and to encourage him to be on track to submit assignments on time. I had not taught the College Geometry course the prior spring, so I had not yet developed a relationship with Miles. I quickly learned Miles graduated from a premier magnet school for academically talented students. Miles' face showed his energy and enthusiasm whenever we talked about mathematical concepts. He admitted he could spend hours searching for a solution to an interesting mathematical problem. Miles also discussed his struggles with writing lesson plans. In his first journal entry he stated, "I'm the kind of person who either wants to do something right, or not at all" (Miles, Journal Entry 1). In mathematics, he could find and justify a correct answer. Lesson planning was more nebulous. I asked Miles what he thought it meant for a lesson plan to be right or wrong to begin shifting his thinking on how to engage in writing lesson plans. In my mind, I thought simply having Miles submit a unit plan would be a win and would demonstrate progress.

Throughout the first few weeks, Miles submitted all assignments on time. He often commented on his progress at the start of his journal entries, as he did in his second entry:

Throughout the semester, I plan on using this journal, at least partially, to hold myself accountable for completing the assignments for this course. It is [W]eek 3, and there's a not small amount of irony in the fact that this very journal was the only thing I did not do last week. Overall, though, I feel pretty confident with the assignments I have already completed. I am very much looking forward to starting to work on my lesson plan *early*, which was something I have historically struggled with doing. [Miles, Journal Entry 2]

PTs were only required to submit ten journal entries across the entire semester, so he had not actually missed any deadlines at this point. The journal entries and weekly meetings served to keep Miles on track and supported reflection on his progress.

As the semester progressed and more work had been submitted (notably all on time), our weekly conversations turned more toward reflection and improvement. I focused on small pieces of feedback



that were tangible things Miles could use to improve. Because this was a larger class, groups planned teaching rehearsals that only one member presented. I purposely chose Miles to present his group's first rehearsal so I could highlight Miles's strengths while also pointing out places he could improve in feedback. Miles initiated the teaching rehearsal by giving students (i.e., his classmates) time to think about a mathematics problem and then moved into a group activity to build on that thinking. After both groups made progress in different ways, he asked both groups to share their distinct ways of approaching the task but did not connect the two methods to each other. The result of group sharing was simply a "show and tell" opportunity with little mathematical connection. After this rehearsal, I wrote:

Great job with patience and clarity in your rehearsal! You did a nice job of giving clear directions for the start of the task and getting students thinking about it. Without sharing out you then put groups to work sharing ideas of how to solve the problem. Would there have been a benefit to sharing out some of that individual thinking prior to moving on to the group work? Later, you had great patience in giving the class time to process and think and then work with each other. Well done! Consider the choices you make in group presentations – sometimes not having a group present will offer more opportunities for the rest of the class to reason. Make choices based on the mathematical opportunities rather than allowing every group to share. You allowed both groups to share – but this may have rushed toward the procedural work too quickly and not allowed the development of conceptual understanding. Sometimes spending time with the less efficient method can benefit a deeper understanding of the concept. [Miles, Rehearsal 1 Feedback]

This feedback prompted more discussion in our weekly meeting, which Miles reflected on in his journal, writing:

The rehearsal gave me a little bit of an idea as to how well I can currently improvise if I get an answer I don't expect. For instance, with the first group I responded to, I expected a table, but when I was looking at their tables while doing it, it wasn't the table I expected. Despite this, I feel like I did a somewhat decent job at improvising, although I do recognize that I didn't do a great job of connecting the two responses. I didn't give the first group enough time and probably gave the second group a little too much time, the latter of which you helped me understand during our meeting last week. In any case, I think the rehearsal assignment was very informative, because it helped me understand how some of the finer details of the lesson plan will be done, as well as being a small insight into how actual teaching practice can go. [Miles, Journal Entry 5]

The rehearsal opportunity and feedback supported Miles to successfully complete and submit his first lesson plan. This was a monumental moment! In our weekly meetings and in Miles's journal entries, I could see his confidence growing. In feedback on his first lesson plan, I started to push him to make small changes to improve his written lesson plans. I wrote,

First, well done on completing your first full lesson plan! You have sufficient information included for others to follow your plan and the tasks flow nicely to build student understanding. The activities are appropriate to the standards and planned goals. Now let's think about ways to improve your plan. In each section, include detail of what will happen during each section of the lesson. What will you do? What will students do? You included this in some sections but not in all. In addition, please include solutions to each of the tasks you have chosen. This is important for you to think through the tasks and for me to see how you are thinking about the mathematics. [Miles, Feedback on Unit 1 Plan]

Miles knew the mathematics, but I was concerned he was not always thinking about it at a level that students would need him to be able to discuss. His mathematical content knowledge was strong, but often not translated to high-schooler's ways of thinking. He had also written a complete unit plan, but there were places where the actions that would take place were unclear. I encouraged him to think through these pieces more carefully as he continued to write unit plans. At midterm, Miles evaluated his work as meeting the criteria for a B, writing "I would argue that assigning myself an A at the midterms of this class would be a bit presumptuous, because I haven't really had a chance to improve my work in class" (Miles, Midterm Self Evaluation). However, he provided evidence of all of the



indicators for an A, including growth based on prior semester's work, and so his midterm grade was an A.

Miles continued to submit all assignments on time and to reflect deeply on his teaching in journals and weekly meetings. His second unit plan included clearer description of what both the teacher and students would be doing and developed the mathematical concepts attending to learner's conceptual understanding. In his final journal entry, Miles wrote:

Your feedback, your office hours, it all helped me so much in building myself up to become a better teacher. Even when I felt like I had made choices that I didn't retrospectively like, you managed to find the positives (or rather, encouraged me to find the positives in many cases), which helped keep my morale up (hey, there's that Self-level feedback in action!). [Miles, Journal Entry 10]

In his end of term evaluation, Miles effectively argued his work met the requirements for an A in the course and provided ample evidence from his work to support his case. Miles successfully completed the teacher preparation program and is teaching in a high school. He has learned to turn his overthinking, perfectionist tendencies into productive reflection that helps him continue to improve.

Sara: A PT overestimating her growth

Sara, a female PT in her early thirties, had changed her major several times before settling in the middle grades mathematics teacher preparation program and enrolling in my class of twelve PTs in Fall 2019. Her academic record prior to this course was not concerning, giving no indication that she might need additional supports like Miles. Sara participated in class but was often quiet and did not always contribute to discussions. Her submitted reflective tasks were succinct, offering little insight on her growth. I tried on several occasions both in-person and in writing to get to know Sara better, but she was not willing to share very much about herself. I was hopeful Sara would share in her journals and engage in deep reflection there.

Unfortunately, Sara did not reflect deeply even when prompted to by journal feedback. After reading an article about open-ended questions, Sara's complete entry was:

The author says teachers are supposed to be teaching for their students' futures, not for standardized tests. But if standardized tests are what's going to be in students' futures and help them get into colleges and grad schools, wouldn't it be okay to teach for those tests? [Sara, Journal Entry 2]

My constructivist perspective helped me recognise Sara's desire to focus on standardised tests as Sara's perspective from which to build. I replied with feedback encouraging her to remain concerned about the standardised tests, but to use research-based practices to support students to gain deep conceptual understanding. I wrote, "Research says that students that are able to reason with conceptual understanding do well on standardized tests" [Sara, Journal Entry 2 Feedback] and continued to encourage her to explore resources that could help her develop conceptual understanding in her lesson planning. However, Sara's lesson plans did not demonstrate work toward developing conceptual understanding. In feedback on her first unit plan, I pointed out the lack of conceptual development and asked,

Did you explore the resources available for this topic in D2L [Desire2Learn]? In the online resources there are a variety of sites that will have instructional ideas for this topic. How have you implemented the ideas that have been presented, read about, rehearsed, and explored in class? [Sara, Unit Plan 1 Feedback]

Throughout the semester, Sara used her journal entries to explain why she had not completed work rather than reflecting on the feedback she was given. Much of my feedback continued to ask questions and encourage her to reflect on feedback she was given but she did not return to prior comments. Sara was open with me in a mid-semester journal entry. She described her need for an A in the methods course. She wrote:

I am not going to lie. I had my advising appointment, and she told me I need all A's this semester. I need to apply to the teaching program as soon as final grades come out or I cannot progress. It is running through my head and I am really worried. I know we assign our own grades, and I know you



will tell me to participate more, turn in assignments on time, and do better than I have been, but do you have any [advice] for me? [Sara, Journal Entry 3]

I replied, "You don't earn As because you need them. You earn As because you have put in the effort and time and shown progress in what you have learned" [Sara, Journal Entry 3 Feedback] and once again encouraged her to reflect on and take up feedback. In this semester, I did not require PTs to submit a written mid-semester self-evaluation, so this entry is my only evidence of Sara's in-progress thoughts on self-evaluation.

This pattern continued through the semester. Sara submitted some assignments but neglected to take up feedback given. She led one rehearsal for her group but did not present the additional individual rehearsal assigned. In feedback on Sara's second unit plan I returned to earlier comments, writing,

It is not clear that you searched any of the approved resources in D2L for these lesson topics. In a quick search for One-Variable Statistics Plots on Statistics Education Web and Illustrative Math (both in D2L) I identified a variety of rich questions and tasks that will increase the cognitive demand of the activities you have in this plan if they were implemented. I would be happy to show you those if you would like. [Sara, Unit Plan 2 Feedback]

When discussing Sara's unit plans during her final evaluation conference, I said, "I didn't see where you were taking up feedback you were given on the draft and using that to make improvements." [Sara, Final Evaluation Conference Transcript] In addition to not completing two major assignments, Sara did not have evidence of growth in her work. Instead, her work did not progress during the semester. At one point, Sara claimed to have implemented the Mathematics Teaching Practices in her lesson plan. When I asked her to show me, she could not find them. I also pressed her about missing assignments: "Was there a reason you did not complete the assessment assignment?" Sara replied, "I haven't had the motivation, honestly, or focus for any of it." [Sara, Conference] Though she initially argued in her evaluation conference that she had earned an A in the course, she could not provide evidence of characteristics of an A as stated in the rubric. In the end, Sara's work was awarded a C in the course, and she was encouraged to reflect on why she did not have the motivation to complete work in a course focused on tasks she would be engaging in as a classroom teacher.

Aligning Teacher Educator Practice with Theoretical Perspectives

In this illustration of practice, I have demonstrated how an MTE's assessment practice in a mathematics methods course can be informed by relational constructivist theory (Kitchen, 2005a; Steffe & D'Ambrosio, 1995) theory and research on assessment for learning (Borgioli et al., 2015; Hattie & Timperley, 2007; McDowell et al., 2011). I have illustrated cases where this practice is effective in supporting PTs to grow both in their teaching practices and as reflective practitioners (Dewey, 1933; Nelson et al., 2016; Schön, 1983). Anna, Miles, and Sara, with varied experiences of growth required different forms of support to develop their practices.

This grading practice allows me to meet PTs wherever they are in their development. Anna was confident in her teaching but battling external pressures that caused her to struggle early in the semester. This assessment system allowed me to support her through this time while still focusing on ways she could grow as a teacher. Because Anna came into my class with pedagogical and mathematical strengths I could focus on her practice of questioning. This is not typical for most PTs at this point. Most are more like Miles or Sara, struggling to string together activities coherently to promote learning. Anna was already able to do this, so I met her at that point and pushed further. Miles, on the other hand, entered this class with strong mathematical knowledge but unsuccessful with pedagogically focused tasks. Because I was focused on learning who my PTs were and feedback to support them individually, I was able to tailor feedback to Miles that encouraged his success in unit planning by focusing on smaller moves he could change, such as who is called on to present. Although feedback on unit plans for both PTs was informed by the same feedback guide, I had the flexibility to



point out areas where growth occurred or needed rather than holding every PT to identical standards. Both Miles' and Anna's journal entries and final evaluations demonstrate their ability to effectively reflect on their teaching.

However, the grading system did not support all PTs to grow. Sara is an outlier in my experiences with this system, demonstrating a learning trajectory that differed from those of other PT's. During her final evaluation conference, I asked, "What could I have done differently to help you?" to which she replied, "I don't think anything because I mean, you did great - given me so much opportunity to correct. I obviously haven't had motivation or drive to do the work." [Sara, Final Evaluation Conference] Perhaps a contract such as Miles' would have supported her, but because I did not have knowledge that Sara needed such a tool prior to the course, that strategy was not implemented.

In most cases, I end up supporting PTs to raise their grade assessment after they have underestimated their growth (as in Anna's case). In relatively few cases do I find it necessary to press for evidence that lowers the grade initially reported by the PT, as was done in Sara's case. A common critique of alternative assessment points to grade inflation, which has not been my experience. Instead, my grade distribution has remained constant since implementing this system. A change has been noticeable in the quality of work submitted. As I encourage PTs to consider their growth, I find they make more adjustments to support the evidence of growth claimed.

I recognise any course assessment carries an authoritative role with it. As much as I try to hand over the responsibility for assessment to PTs, I am still the instructor of the course, who carries authority (Mumm et al., 2016). The assessment system implemented allows me to live my relational constructivist theoretical perspective on teaching, which I believe constitutes a productive practice for student growth driven by theory. I can get to know the PTs in my classes and guide them to grow in the areas that are important to them and aligned with research-based practices. For Anna and Miles, I built on my relationship successfully with each of them to help them construct their personal teaching practices.

A question to ask, then, is how might other MTEs take up alternative assessment or connect theory to teacher educator practice? Connecting theory to practice begins with introspection that examines both theory and personal practice. I have engaged in collaborative self-study (LaBoskey, 2004) for over 12 years investigating my enactment of relational teacher education practices in mathematics methods courses. It was through this investigation that I amended my assessment practices. Rather than immediately taking up alternative assessment as described by others (e.g., assessment systems presented in the Blum [2020] edited volume), I learned about theoretical perspectives on assessment and considered connections to my own perspective. This knowledge supported assessment changes that I now enact in most courses I teach. Connecting theory and research to practice takes introspection, learning about theory and research, and purposeful changes that move toward a goal. This account of alternative assessment practice in a secondary methods course provides one example of how an MTE can take up theory and connect to practice (Beswick & Goos, 2018; Krainer et al., 2021) and provides an account of how one MTE constructed a practice for the teaching of teaching.

Corresponding author

Alyson E. Lischka
Middle Tennessee State University
1301 E. Main Street
Box 34
Murfreesboro, TN 37132
Alyson.Lischka@mtsu.edu



Acknowledgements

This manuscript would not have been possible without the contributions of my critical friends in self-study: Signe E. Kastberg, Susan L. Hillman, Natasha Gerstenschlager, and Jennifer Webster.

Ethical approval

Ethical approval for the research was granted by Middle Tennessee State University Institutional Review Board (Protocol 22-1023), and informed consent was given by all participants for their data to be published.

Competing interests

The author declares there are no competing interests.

References

- Beswick, K., & Goos, M. (2018). Mathematics teacher educator knowledge: What do we know and where to from here? *Journal of Mathematics Teacher Education*, 21(5), 417–427. <https://doi.org/10.1007/s10857-018-9416-4>
- Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education*, 32(3), 347–364. <https://doi.org/10.1007/bf00138871>
- Black, P., Harrison, C., & Lee, C. (2003). *Assessment for learning: Putting it into practice*. McGraw-Hill Education (UK).
- Black, P. and Wiliam, D. (2005) The formative purpose: Assessment must first promote learning. *Yearbook of the National Society for the Study of Education*, 103, 20-50. <http://dx.doi.org/10.1111/j.1744-7984.2004.tb00047.x>
- Blum, S. D. (2020). *UNgrading: Why rating students undermines learning (and what to do instead)*. West Virginia University Press.
- Borgioli, G. M., Ociepka, A., & Coker, K. (2015). A playbill: Rethinking assessment in teacher education. *Journal of the Scholarship of Teaching and Learning*, 15(3), 68–84. <https://doi.org/10.14434/josotl.v15i3.13306>
- Casey, S., Fox, R., & Lischka, A. E. (2018). Interpretations and uses of classroom video in teacher education: Comparisons across three perspectives. In S. Kastberg, A. Tyminski, A. E. Lischka, & W. B. Sanchez (Eds.) *Building support for scholarly practices in Mathematics Methods* (pp. 297–310). Information Age Publishing.
- Davis, R. B., Maher, C. A., & Noddings, N. (1990). Introduction. *Journal for Research in Mathematics Education. Monograph*, 4, National Council of Teachers of Mathematics. <https://www.jstor.org/stable/749908>
- Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Heath.
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81–112. <https://doi.org/10.3102/003465430298487>
- Hughes, K. K., Welch, A. R., & Moreland, A. L. (2020). The UTeach instructional program, elements, and courses. In J. E. Goodell & S. Koc (Eds.), *Preparing STEM teachers: The UTeach replication model* (pp. 163–174). Information Age Publishing. <https://doi.org/10.1108/978-1-64802-168-820251015>
- Kastberg, S. E. (2014). The power of what we know: Further directions for exploring constructivist model building. *Constructivist Foundations*, 9(3), 352–254. <https://constructivist.info/9/3/352.kastberg>
- Kastberg, S. E., Lischka, A. E., & Hillman, S. L. (2019). Exploring mathematics teacher educator questioning as a relational practice: Acknowledging imbalances. *Studying Teacher Education: A Journal of Self-study of Teacher Education Practices*, 15(1), 67–81. <https://doi.org/10.1080/17425964.2018.1541278>
- Kastberg, S. E., Lischka, A. E., & Hillman, S. L. (2024). Mathematics teacher educators' discussion practice. *Journal of Mathematics Teacher Education*, 28, 399–421. <https://doi.org/10.1007/s10857-024-09666-y>



- Kitchen, J. (2005a). Looking backward, moving forward: Understanding my narrative as a teacher educator. *Studying Teacher Education: A Journal of Self-study of Teacher Education Practices* 1(1), 17–30. <https://doi.org/10.1080/17425960500039835>
- Kitchen, J. (2005b). Conveying respect and empathy: Becoming a relational teacher educator. *Studying Teacher Education: A Journal of Self-study of Teacher Education Practices* 1(2), 195–207. <https://doi.org/10.1080/17425960500288374>
- Krainer, K., Even, R., Rogers, M. P., & Berry, A. (2021). Research on learners and teachers of mathematics and science: Forerunners to a focus on teacher educator professional growth. *International Journal of Science and Mathematics Education* 19 (Suppl. 1), 1–19. <https://doi.org/10.1007/s10763-021-10189-8>
- LaBoskey, V. K. (2004). The methodology of self-study and its theoretical underpinnings. In J. Loughran, M. L. Hamilton, V. K. LaBoskey, & T. Russell (Eds.), *International handbook of self-study of teaching and teacher education practices* (pp. 817–869). Springer. https://doi.org/10.1007/978-1-4020-6545-3_21
- Lischka, A. E. (2025). Understanding faith as a foundation for grading practices in mathematics teacher preparation. In E. Suazo Flores, S. E. Kastberg, M. Grant, & O. Chapman (Eds.), *Mathematics teacher educators' intimate scholarship: Being, knowing, and ethics* (pp. 6785). Emerald Publishing. <https://doi.org/10.1108/S1479-368720250000049005>
- Lischka, A. E., Gerstenschlager, N., & Seat, J. (2020). A journey toward course assessment as a relational practice in mathematics methods. In C. Edge, A. Standerford, & B. Bergh (Eds.), *Textiles and tapestries: Self-study for envisioning new ways of knowing* (pp. 46–54). EdTech Books. https://equitypress.org/textiles_tapestries_self_study
- Lischka, A. E., Gerstenschlager, N. & Webster, J. (2023a). Interrogating grading practices in mathematics methods. In A. Cameron-Standerford, B. Bergh, & C.U. Edge (Eds.), *Pausing at the threshold: Opportunity through, with, and for self-study of teacher education practices* (pp. 341–349). Equity Press. <https://dx.doi.org/10.59668/558>
- Lischka, A. E., Gerstenschlager, N., & Webster, J. (2023b). Dismantling traditional structures of assessment practice: Self-study as a path to understanding alternative assessment systems. *Philosophy of Mathematics Education*, 40, 1–20. <https://www.exeter.ac.uk/research/groups/education/pmej/pome40/index.html>
- McDowell, L., Wakelin, D., Montgomery, C., & King, S. (2011). Does assessment for learning make a difference? The development of a questionnaire to explore the student response. *Assessment & Evaluation in Higher Education*, 36(7), 749–765. <https://doi.org/10.1080/02602938.2010.488792>
- Mumm, K., Karm, M., & Remmik, M. (2016). Assessment for learning: Why assessment does not always support student teachers' learning. *Journal of Further and Higher Education*, 40(6), 780–803. <https://doi.org/10.1080/0309877X.2015.1062847>
- National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*.
- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards*.
- Nelson, F. L., Miller, L. R., & Yun, C. (2016). “It’s OK to feel totally confused”: Reflection without practice by preservice teachers in an introductory education course. *Reflective Practice*, 17(5), 648–661. <https://doi.org/10.1080/14623943.2016.1197113>
- Pinnegar, S., & Hamilton, M. L. (2009). *Self-study of practice as a genre of qualitative research: Theory, methodology, and practice* (Vol. 8). Springer Science & Business Media.
- Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books. <https://doi.org/10.4324/9781315237473>
- Steffe, L., & D’Ambrosio, B. (1995). Toward a working model of constructivist teaching: A reaction to Simon. *Journal for Research in Mathematics Education*, 26(2), 146–159. <http://dx.doi.org/10.2307/749206>
- Vanassche, E. & Berry, A. (2020). Teacher educator knowledge, practice, and S-STTEP research. In J. Kitchen, A. Berry, S. M. Bulloch, A. M. Crowe, M. Taylor, H. Guðjónsdóttir, & L. Thomas (Eds.), *International handbook of self-study of teaching and teacher education practices* (pp. 177–213). Springer. https://doi.org/10.1007/978-981-13-6880-6_6
- Whitehead, J. (1989). Creating a living educational theory from questions of the kind, “How do I improve my practice?” *Cambridge Journal of Education*, 19(1), 41–52. <https://doi.org/10.1080/0305764890190106>

