Supporting Math Learning of Students with Behavioral and Academic Challenges: Case Study of a Pre-Service Teacher

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ABSTRACT:

This case study presents findings of approaches that one pre-service teacher (PST) used during practicum teaching when providing instruction for a mathematics unit with three fourth-grade students who had behavioral and/or academic challenges. The purpose of this study was to examine the planning, reflections, and decision-making of this unique PST who was able successfully to engage students as they learned about and "proved their thinking" about properties of geometric shapes. The study examined how her approaches aligned with (a) high-leverage practices for students with exceptionalities and (b) classroom conditions that promote an environment for positive student behaviors. The results suggested that this PST was able to focus on the social context of teaching—understanding her students and building a discursive community of learners—to aid students in learning the math concepts. Teacher educators can use this case to help PSTs understand the application of high-leverage practices in the classroom.

Keywords: elementary preservice teacher education, high-leverage practices, students with academic and behavioral exceptionalities, special education

INTRODUCTION

During teacher preparation programs, pre-service teachers (PSTs) learn instructional strategies in methods courses to apply their nascent pedagogical skill subsequently in practicum field experiences (Darling-Hammond, 2017). However, studies have reported that some PSTs, as novices, provide teacher-directed dissemination of information to students during practicum teaching, focusing on their own delivery rather than the student context (i.e., needs of specific students) due to their desire to follow their planned lesson and prevent behavioral disruptions (Berliner, 2004; Lloyd, 2018). PSTs' lack of experience results in their approaching teaching with less knowledge of students and their needs, less flexibility, less awareness of social situations, and less ability to recognize patterns in student understandings and behaviors in contrast with expert teachers who can focus on student needs, react intuitively to meet those needs, and effectively manage a class (Berliner, 2004).

Given that 66.2% of students with disabilities spend 80% or more of their school day learning in a general education classroom along with peers without disabilities (U. S. Department of Education, 2022), PSTs need preparation to employ instructional approaches that meet the learning needs of *all* students. Researchers in the fields of special education (McLeskey et al., 2019) and behavioral analysis (Kestner et al., 2019) have identified effective teaching practices and classroom conditions that not only promote student learning, but also create an environment for positive student behaviors.

Ball and Forzani (2010-2011) describe teaching as a complicated activity that does not come naturally; teaching involves being able to break down core competencies so they are accessible to learners as well as understand the differences between learners and their specific needs. They posited that PSTs require specific training to acquire "high-leverage teaching practices" that address how to teach complex concepts and skills while addressing the student and cultural context (p. 43). However, studies have shown that these best practices are not always used in classrooms (Wehby et al., 1998; Wilburne et al., 2018).

Therefore, it is noteworthy when an undergraduate PST shows evidence of implementing high-leverage teaching and learning practices effectively with students with both behavioral and academic exceptionalities. The purpose of this study is to examine the planning, reflections, and decision-making of one PST for practicum teaching who successfully engaged three students with special needs as they learned about and "proved their thinking" about the properties of geometric shapes in a three-lesson mathematics unit. This study addressed the following research questions: What approaches did a novice elementary PST use to facilitate the mathematical learning of three fourth-grade students with behavioral and academic challenges? How do these approaches align with high-leverage practices and classroom conditions for effective teaching and learning?

CONCEPTUAL FRAMEWORKS

The Council for Exceptional Children, an international professional organization dedicated to improving educational outcomes of individuals with exceptionalities, approved 22 high leverage practices (HLPs) for K-12 special education teachers as effective practices for teaching students with disabilities in inclusive classrooms (McLeskey et al., 2019). The practices address four key areas: collaboration, assessment, social/emotional/behavioral, and instruction. Given the three-lesson practicum examined in this study, we used 14 applicable HLPs in the latter three areas as one part of our conceptual framework (table 1).

High-Leverage Practices (HLPs)

Research studies used to identify these practices have indicated the value for student learning when teachers acquire skill with these HLPs. Regarding the *Assessment HLPs*, effective teachers of students with special needs require knowledge of how to assess students' unique learning requirements and how to use and interpret the data appropriately (McLeskey et al., 2014; Nelson et al., 2021; Vaughn & Bos, 2014). In developing the HLPs, McLeskey's team (2017) recognized that since students with disabilities are complex learners, assessment is foundational to understanding students' strengths and needs.

For the *Social/Emotional/Behavioral HLPs*, teachers need to provide respectful, organized learning conditions for students to succeed as well as opportunities for students to learn and practice social and problem-solving skills (Mikami et al., 2014). To promote student success, teachers also need to use a variety of practices to promote students' social and emotional well-being and supports to prevent behavioral challenges, such as teaching appropriate interpersonal skills with positive feedback (McLeskey et al., 2017).

Finally, for the *Instruction HLPs*, effective teachers need knowledge of how to decompose a concept into small, teachable components (Ball & Forzani, 2009) and how to offer a variety of pedagogical approaches to en-

Table 1. **Selected High-Leverage Practices Applicable to This Pre-Service Practicum Unit**

Assessment HLPs
HLP 4 Use multiple sources of information to develop a comprehensive understanding of a student's strengths and needs.
HLP 6 Use student assessment data, analyze instructional practices, and make necessary adjustments that improve student outcomes.
Social/Emotional/Behavioral HLPs
HLP 7 Establish a consistent, organized, and respectful learning environment.
HLP 8 Provide positive and constructive feedback to guide students' learning/behavior.
HLP 9 Teach social behaviors.
Instruction HLPs
HLP 12 Systematically design instruction toward a specific learning goal.
HLP 13 Adapt curriculum tasks and materials for specific learning goals.
HLP 14 Teach cognitive and metacognitive strategies to support learning/independence.
HLP 15 Provide scaffolded supports.
HLP 16 Use explicit instruction.
HLP 18 Use strategies to promote active student engagement.
HLP 19 Use assistive and instructional technologies.
HLP 20 Provide intensive instruction.
HLP 22 Provide positive and constructive feedback to guide students' learning/behavior.

gage students in meaningful learning (Dunlosky et al., 2013). This HLP category is aligned with the Universal Design for Learning's framework that students be provided with multiple means of engagement, representation, and action/expression (CAST, 2018; Meyer et al., 2014; Root et al., 2020). For example, Pindiprolu (2015) recommended that offering a range of content enhancement strategies/tools such as non-linguistic representations, graphic organizers, and manipulatives can enhance learning for students with high incidence disabilities.

Yet, when preparing PSTs to acquire skill with these complex practices, studies have shown that while PSTs have a positive outlook about teaching, some also hold a simplistic view (Whitbeck, 2000) that their role is merely to transmit information to students (Bolyard & Valentine, 2017). Research into elementary PSTs' perceptions of their efficacy in using *Assessment* and *Instruction HLPs* in mathematics has revealed PSTs' lack of confidence in designing lessons for specific learning goals and assessments of student learning (Lee & Dumitrascu, 2017). Though PSTs indicated high self-efficacy in leading group discussions, they had low self-efficacy in eliciting and interpreting individual student's thinking—suggesting undeveloped awareness of practices involved in orchestrating meaningful class discussion to learn about students' conceptions. To further affect PSTs' ability to elicit and interpret students' thinking, Lee and Dumitrascu reported that the PSTs struggled with diagnosing common patterns of student thinking and development in mathematics.

For the *Social/Emotional/Behavioral HLPs,* Howard et al. (2020) reported that PSTs had strong self-efficacy in building respectful relationships with students, yet the study results also indicated that the PSTs did not understand fully the skills needed to build a positive learning environment (i.e., learn about students' interests and socio-cultural realities; build trust and students' self-esteem). Furthermore, research indicates that practices promoting social bonding within groups (i.e., engaging in discourse, managing conflict and dissenting ideas) are contemporaneous with students' knowledge construction (Bellocchi, 2022). Thus, development of PSTs' practices to promote students' engagement, discussion, and social/emotional skill development are important aspects of effective teaching.

Classroom Conditions for Effective Learning and Appropriate Behavior (CCs)

Researchers in the field of Functional Behavior Assessment (Kestner et al., 2019) have identified classroom conditions correlated with effective learning outcomes and appropriate behavior in the classroom (the second el-

ement of the conceptual framework used for this study): (a) opportunity for frequent active student responding (CC-a); (b) use of appropriate curriculum (CC-b); (c) provision of positive and corrective feedback (CC-c); and (d) implementation of clear, effective instructions and transitions (CC-d).

The opportunity for a student to respond (CC-a) from teacher questioning and the rate of active student responding are variables that impact student learning and behavior (Sutherland & Wehby, 2001). Questioning is an important skill for PSTs to acquire that can scaffold students' knowledge construction in discourse (Webb et al., 2019). Higher-order questioning (Bloom et al., 1956) helps students connect prior knowledge to new math content (Koizumi, 2013), stimulates students' critical thinking and reasoning skills in mathematics (Mahmud & Mohd Drus, 2023), and helps teachers pinpoint student understandings/misconceptions (Weiland et al., 2014). Yet, for positive academic and behavioral outcomes, research has shown that the curriculum must match students' skill level (CC-b) (Anderson & St. Peter, 2013). Thus, assessment of student understanding is needed to determine if the curriculum is too easy or too difficult. Also, effective teachers give students frequent, positive, corrective feedback and behavior-specific praise (CC-c) (Cook et al., 2017). Perle (2016) suggests that feedback should be specific, immediate, and focused on student performance. Finally, the manner of teachers' requests, auditory/visual cues, and transitions (CC-d) can affect a student's ability to complete tasks (Brewer et al., 2014). Kestner et al. (2023) noted that giving students choice in routines (e.g., order of activities, materials, location, timing, duration) can improve task engagement and decrease challenging behavior while providing students with opportunities for self-determination.

METHODOLOGY

The method used was a single unique and exploratory case study (Yin,1989): appropriate for a single bounded system (Merriam, 1998) such as the experience of one novice PST in practicum teaching sessions. Case study methodology is particularly suitable for examining "process" in education (Merriam, 1998, p. 33) such as decision-making (Yin, 1989) and discovering emergent themes that occur in particular naturalistic contextual settings (Erlandson et al., 1993). This case study is considered unique given that the PST exhibited more advanced teaching skills than the typical novice PST; the study is also considered exploratory in that it allowed the researcher to examine and reveal the PST's thinking and reflections on her decisions when working with students with academic and behavioral challenges. The purpose of this study was not to generalize the findings to the population of all PSTs in teacher education programs (Yin, 1989), but rather to expand understanding of how this particular PST made pedagogical decisions to provide effective mathematics instruction for her students with special needs.

Participant

This IRB approved study was conducted with one PST, Bryn (pseudonym), a third-year undergraduate student double-majoring in special and elementary education. Her selection for this case study was purposeful (Patton, 2002) given her ease and effectiveness in teaching students with academic and behavioral challenges. From observations of her teaching, it was noted that she displayed professional dispositions and pedagogical competence similar to experienced teachers despite this practicum being her initial experience in teaching mathematics to students. Bryn gave consent to be interviewed and use her documentary/observational evidence for this study.

Study Context

For her mathematics practicum teaching, Bryn provided three lessons on identifying geometric shapes based on parallel/perpendicular lines and/or types of angles with three fourth-grade students. The classroom teacher informed her that two students, Carl and Josh (pseudonyms), had Individual Education Plans (IEPs) for behavioral and academic needs; their academic level was first-grade in reading and math. They learned primarily in a separate classroom for students with learning needs, but joined the general education classroom for itinerant classes and these math lessons. A third student, Justin (pseudonym), at a second-grade level in reading and math, learned in the general education classroom.

It is noteworthy that whenever Carl or Josh joined general education classes, Behavior Specialists were always present to support them. However, during these three lessons, the Behavior Specialists stood outside the classroom in case a need arose; yet, they never needed to come in and intervene because the students were engaged in the lessons and resolved any of their own conflicts within the small group.

Data Sources

The sources of qualitative data collected for this study included documents produced by Bryn related to each

lesson, an interview, and the university supervisor's observations of her teaching sessions (Merriam, 1998).

Documents

Three sources of documents included: (a) Bryn's detailed lesson plans with possible questions to pose to students during the lesson; (b) Bryn's three post-lesson reflections identifying approaches used to engage students, norms of interaction promoted during lessons, quotes from students during the lesson, and her interpretation of student understandings; and (c) Bryn's three detailed analyses of students' post-lesson assessments to pinpoint student understandings/misconceptions and her next steps for instruction. Bryn created these documents to use prior to, during, or following each lesson as part of the practicum requirements (Merriam, 1998). The information in these personal writings revealed her inner thinking about instruction, her reflections and perspectives on her decisions, and her analysis of student conceptions and/or misunderstandings.

Interview

A one-hour interview was conducted with Bryn in-person using a semi-structured format (Merriam, 1998) to gain insight into her planning, resources, and approaches used to address student needs as well as decisions made before each lesson, during lessons in-the-moment, and following each lesson to plan for next steps based on an analysis of each student's learning. In this case, the interview served to clarify as well as triangulate findings from the documents and the observations during her teaching (Patton, 2002). The interview was guided by a list of questions; however, the wording of the questions was adjusted or new questions posed based on Bryn's responses in order to explore a particular topic in more detail (Merriam, 1998). For example, Bryn had written in her reflections that her students cared for each other and worked well together. During the interview, Bryn responded to the question of how she created such as collaborative climate by discussing not only the norms of positive interaction they co-created and reinforced together, but also recalling an incident of one student becoming upset when he felt another student was telling a lie about him. This revelation prompted a follow-up question of how Bryn and the students worked through this situation together.

Observations

Field notes were completed from the university supervisor's observations during each lesson. These observational data were collected in the natural field setting (Patton, 2002), and they captured direct information of the context and interactions of Bryn and the three students as well as student interactions with each other. The data were examined to triangulate with Bryn's self-report written reflections and her retrospective interview.

Data Analyses

The analysis of the qualitative data for this case study involved, first, unitizing the data into small pieces of information (Erlandson et al., 1993). A unit could consist of a sentence, a paragraph, or a section from a document, observation field note, or interview statement that was coherent in its unitary meaning. Next, using open coding, each unit was labeled with a term or phrase that conveyed its essence (Patton, 2002). The coded units were then sorted and organized into categories (Merriam, 1998). Some examples of categories included team building, student focus, student ownership, questioning to prompt student discussion, student explanations, analysis of student thinking, use of visuals, explicit clear instruction, flexibility, and synthesis of resources. To develop an explanation of what approaches Bryn used to facilitate the mathematical learning of the three students with behavioral and/or academic challenges and how these approaches aligned with high-leverage practices and classroom conditions for effective teaching/learning, both inductive and deductive analyses were used (Fereday & Muir-Cochrane, 2006). First, from a repeated review of the categorized data (Erickson, 1986) using constant comparative analysis (Miles & Huberman, 1994), themes and sub-themes emerged inductively of approaches Bryn used to facilitate students' learning in geometry. Subsequently, themes and sub-themes were examined deductively to compare Bryn's approaches with the 14 HLPs (McLeskey et al., 2019) and the four classroom conditions (Kestner et al., 2019) used as this study's conceptual framework that support students with academic and behavioral needs.

RESULTS

To report findings and increase their trustworthiness, four themes (purposeful initial pre-planning, frequent assessment to inform instruction, intentional instructional decision-making, and encouragement of student group work to share thinking) and respective sub-themes are presented in narrative form (Miles & Huberman, 1994) with thick description and participant quotations (Merriam, 1998) of Bryn's approaches and decisions to meet the learning needs of her students with behavioral/aca-

demic challenges. In addition, the alignment of Bryn's approaches to HLPs and classroom conditions supporting the learning of students with behavioral challenges/learning needs are embedded within the narrative.

Purposeful Initial Pre-Planning

Three sub-themes emerged of how Bryn initially planned to meet students' needs.

Synthesized Learning from Special Education and General Education Methods Courses

In preparation, Bryn consciously considered pedagogical approaches she learned in various methods courses (HLP 12). She explained,

> *In a special education class, we learned about HLPs. I learned about scaffolding, explicit instruction, having students assess themselves—all things I should use as a general education teacher anyways….In literacy methods, I used "Understanding by Design." I realized when planning these lessons, I can't come up with an objective that is not linked to my assessment….In math methods, I learned about questioning. With explicit instruction, people think only the teacher is talking. I did not want to be talking for more than three minutes. I wanted to implement questions throughout.*

Planned Lessons with Student Needs and Lesson Objectives in Mind

Bryn explained she wanted "to get to know her students" so she could plan for their learning needs. Bryn noted that she planned her first lesson from analyzing the math standard and designing an assessment matching her lesson objective. Then, after learning about the students, she would adjust her instructional decisions (HLP 12, 13; CC-b).

> *First, I always think about the students. My first time, I needed to get to know them. What kind of learner are they? Are they a visual or auditory learner, or somewhere in the middle? I take all that knowledge and I plan thinking about the students and what I know about them. Then, I think about the content, the standard, and the goal of what I am trying to teach them and how I can do this in accordance with their needs.*

Built a Team Culture

For the first lesson, Bryn co-created norms of positive social interaction with her students to promote a collaborative group climate for students to support each other, work together, express their ideas, listen to each, and be able to explain other's ideas (HLP 7). She noted, "In the introduction of my lesson, I spent a significant amount of time discussing and co-creating norms of interaction with my students to promote a collaborative, welcoming climate where students felt comfortable taking academic risks and discussing mathematics."

Bryn gave examples of how the students participated in generating the norms and supported each other in meeting them (HLP 9; CC-a).

> *Josh proposed giving a thumbs up to show you are ready with an answer….It was thrilling that students held each other accountable. Josh reminded Carl, "Remember, we give a thumbs-up and not shout out"….or Josh would simply model it by tapping on Carl's arm and holding a thumbs-up against his chest prompting Carl to follow.*
>
> *Justin said, "I need you all to encourage me to talk. If not, I'll fall asleep." To which Josh said, "I will help you, Justin. I'll encourage you to participate and I will listen to you with my eyes and ears."…Josh said, "We can't learn if we all don't work together as a team to talk."*

Furthermore, during the lessons when students might initially be frustrated with a novel task, Bryn would model supportive interactions by saying to students, "'Don't worry, I will help you. We are going to help each other and work through it together as a team.'"

Frequent Assessment to Inform Instruction

Bryn recognized that to be informed about how to adjust her instruction, she needed to continually assess students' learning. Three sub-themes show her use of various tools for assessment. She learned of students' struggles and successes through informal observations and in-depth analyses of each lesson's formal assessments. Also, she engaged students in self-assessment to metacognitively evaluate their own academic and interactional progress.

Used a Variety of Assessment Tools to Identify Student Understandings/Misconceptions

One tool that Bryn used to identify each student's learning style and their possible struggles was her observations of each student (HLP 6).

> *I learned that both Carl and Josh are visual-kinesthetic learners who rely heavily on physically manipulating materials and seeing pictures to understand concepts and represent their knowledge. For example, if I ask them to draw a trapezoid, they wouldn't be able to do it. However, when providing them with a set of shapes, they can identify the trapezoid quickly*

and accurately.

Throughout Bryn's lessons, she employed various tools (i.e., oral, written, visual, gestures) to assess students' understandings and inform her instruction (HLP 4). She noted, "I feel just assessing them on paper isn't fair. That's why I tried different games or so much discussion because then I can really tell what they understand." She found she needed to probe deeply to identify students' actual understandings rather than rely on students' initial responses:

> *If they are telling you the correct answer, I used to think, let's move on; but I learned that though they say the correct answer, they may not understand the concepts. If I reframe the question, I can see if they have a misconception. I just really listen to their reasoning. I think in-depth about their response because sometimes what they say doesn't mean what they really understand.*

Engaged in In-Depth Analysis of Student Work and Explanations to Plan for Next Steps

Her in-depth analysis of student work and explanations gave Bryn insight into the students' understanding so she could address their misconceptions with different approaches in her subsequent planning (HLP 6). Here is an example from one of her reflections:

> *In the Geometry Board Game, Josh was asked to circle an acute angle in a right triangle. He circled the hypotenuse and said, "This is the acute angle because this line makes the angle less than 90 degrees. I know this because when I used the tool, the line goes 'inside' the right angle." In this statement it was clear that Josh didn't understand that an angle is the space between two intersecting lines. For next week's lesson, I will help them understand that an angle is a space between two intersecting lines, not the lines themselves. I will glue popsicle sticks onto cardstock as an obtuse angle, drawing a dotted line vertically up from the vertex, showing a right angle and labeling it 90º. Then, I will draw a semicircle from one popsicle stick to the other coloring it in and writing "more than 90º-obtuse." I will follow with an acute angle.*

Engaged Students in Self-Evaluation

Bryn engaged students in self-evaluative, metacognitive thinking about their math work, active learning, and collaboration. In her lesson plan, Bryn described how she would guide students to consider their next steps in math and working with peers (HLP 14; CC-a).

> *This worksheet will help you reflect upon your performance in math thus far. 'Why do you think it's important to think about our progress in math so far, specifically the ways we participate in activities and worksheets, and work together as a team? How can this help us to improve as learners and team members? To learn math, I want to improve_____. To work better with my classmates, I want to___.*

Intentional Instructional Decision-Making

Seven sub-themes show Bryn's intentional planning for explicit instruction and modeling as well as student-centered activities, games, and question prompts to help students discuss their ideas. From observing students, she adapted instruction flexibly to meet their needs.

Focused Lesson on Key Concepts Appropriate for Students

After the first lesson, Bryn realized that expecting students to identify seven shapes based on parallel/perpendicular lines was overwhelming for students. Thus, to meet the lesson objectives, Bryn decided to limit the number of shapes so students could master the skill (HLP 20; CC-b). She explained, "They need explicit repetition. So, focusing on fewer shapes was the wisest decision I made." Later, she faced another decision about naming triangles based on both angles and length of sides. "Given the complexity of this topic, I decided once again to modify the content focusing solely on naming triangles based on their angles, eliminating the length of sides."

Created Tools for Students' Ease of Use in Learning

To help students identify shapes based on parallel/perpendicular lines or angle size, Bryn offered various tools for active learning (HLP 19; CC-d). She noted in her lesson plan,

> *I'm going to provide you with a new "tool" to use when determining whether angles are right, acute, or obtuse. Teacher presents the new index card (an index card cut into an "L" with a red dot in the vertex and a dotted line on each "leg"). Teacher models this by using her popsicle stick card with two popsicle sticks glued on it.*

She explained in her reflection how she developed another tool for students to manipulate,

"I provided students with popsicle-stick angles, a visual reinforcement they could physically manipulate as a tool to identify whether angles were acute, obtuse, and right."

Modeled Tasks Clearly with Progressive Scaffolded Steps and Explicit Instruction

Bryn modeled tasks for students so they could see the

progression of steps used to identify a shape based on angles (HLP 15; CC-d). She considered how to scaffold the learning and release the support so students could identify types of angles themselves.

> *I planned for students to line up the right angle and obtuse/acute angles to notice the difference in size. Then I planned to scaffold instruction by modeling how to "test" two angles and having students do it with me for the last two angles. Then, I planned to assign each student one angle to test, identify, and explain, releasing support.*

She also explains her planning and questioning to help Josh understand how to identify if a triangle has an acute angle using the L-shaped tool.

> *Josh needs explicit instruction on how to identify acute angles in shapes. So, I preplanned higher-order questions to prompt students to remember to count the angles and use the tool on every angle to determine whether each is acute, obtuse, or right. I will draw a trapezoid asking him, "How many angles does it have? Circle them. How many 'tests' should you perform to identify each angle? Why do you think so?" I will model how to "test" using the right-angle tool. I will line up the red dot with the angle's vertex, and one leg of the tool with a leg of the angle. With a blue marker, I will trace the tool and remove it so Josh can see the smaller shape of the acute angle.*

Provided Reinforcement through Student-Centered Activities, Visuals, and Games

Bryn recognized the value of explicit instruction, but she also wanted students to be engaged actively in their learning (HLP 16; CC-d). She explains her thinking, "I planned to pair direct instruction with completing the 'Shapes Sort' work, but I wanted it to be student-driven focused on steps to classify shapes." As Bryn worked with her students, she discovered they were successful with visuals, physically engaging activities, and games to reinforce their learning (HLP 18; CC-d).

> *I provided students with a laminated "Shapes Sort" worksheet where they could Velcro shapes into the appropriate categories working together without my support. This was essential. Without this physical manipulation, Josh and Carl wouldn't be able to maintain attention or absorb content since they require visual support.*

From observing which activities posed struggles for her students, Bryn revamped her instruction to reinforce their learning using student-centered approaches (HLP 13).

> *Their participation increased significantly when I presented the content differently. For example, I presented the "Geometry Board Game-Angles," requiring students to identify angles within a drawn shape. Also, students were given a claim to "prove" right or wrong with reasoning and evidence using their tool to test each angle to agree or disagree with the claim. Interestingly, presenting this challenging task in this manner yielded positive results as students were truly engaged, answering higher-order questions accurately while holding their peers to the same standard. This was shocking. When using a geoboard, Josh and Carl were confused about where to place the tool, how to classify angles, and what to write on the worksheet. However, this changed when the shape was presented as a visual on a card instead of on the geoboard.*

Promoted Learning through Questioning and Student Discussion

Questioning was a prominent approach that Bryn used to gain awareness of student understanding (HLP 14; CC-a). She explained, "Through questioning, I would ask them to show their understanding. 'What do you notice? How does that compare to what [another student] said?' They would answer and then I say, 'How do you know?'" (HLP 18; CC-a).

> *When Carl stated a claim, I asked him, "How do you know?" He picked up the tool, conducted the "test" and stated, "Look at the tool leg. It goes straight up. The angle's leg is sideways. It fits inside of the tool because it is smaller. Pairing this oral explanation with modeling, he also did the hand motion introduced earlier in this lesson, forming an acute angle to show it is smaller than a right angle.*

Furthermore, Bryn used approaches to encourage students to respond to and explain a peer's ideas in order to promote students' active listening and discussion.

> *I asked part of the question, let one student answer it, then, I posed another question to the whole group. After one student gave a response, I asked, "Why do you think he thinks this? What evidence can you provide to support his answer," thus, reducing the cognitive load on one student while maintaining a "math talk," prompting others to participate by explaining the ideas of others.*

Identified and Clarified Misconceptions with Students

By listening to student responses and watching their actions, Bryn identified and clarified misconceptions with students (HLP 22). She explains how she noticed Justin's

difficulty and then helped him identify angles regardless of the positioning of the shape.

> *One area that presented Justin with difficulty was when triangles were manipulated. I challenged the students by having them test a right triangle. Then, I manipulated it placing the right angle on top instead of the right-hand corner. Justin said, "It is an acute triangle. I know this because there are 3 acute angles." After discussion, Justin finally used his tool, appropriately identifying that the triangle was a right triangle.*

After analyzing student work, she consistently planned how to address misconceptions.

> *I will clarify their misconceptions regarding parallel/perpendicular lines by using two markers. I will use shapes with multiple sets of parallel and/or perpendicular lines and trace one set in blue and the other in red, emphasizing that shapes can have more than one set of parallel/perpendicular sides.*

Maintained Flexibility during Lessons to Meet Student Needs In-the-Moment

Bryn adapted each lesson in-the-moment based on student confusion, emerging needs of students, and what worked (HLP 13; CC-b). She explained,

> *I meticulously plan out every step, but I am willing to adapt to the students…. I always tell myself I need to feed off what the kids are showing me. It's my job to stop….I think on my toes when I know we can't go on….the lesson plan is not set in stone. I need them to lead me. I need to listen to what they say, then I'm confident of what I'm teaching, but I need them to show me what they're ready to learn.*

She noted, "Now I know how to analyze their thinking in order to be flexible."

Encouragement of Student Group Work to Share Thinking

As evidenced from five sub-themes, Bryn purposefully prepared and encouraged students to work together and share their mathematical thinking. To promote discourse, she gave students opportunities to serve as the teacher. Using both questioning and positive feedback to reinforce their supportive interactions with each other, Bryn provided a safe space for students to take ownership in resolving their conflicts and behavioral challenges.

Provided Clear Expectations for Students' Verbal Explanations/Visual Representations

To support her students' explanation-making, Bryn modeled how to engage in mathematical discourse—making a claim with reasoning/evidence—or showing their thinking visually (HLP 14, 18; CC-d): "Since my students were struggling with explaining their evidence and reasoning, I modeled, 'I know this because___' after each claim." Also, she involved students in discussing the value of explaining or showing their thinking: "Why do you think it is important to explain your strategy with words and visuals? How can this help you learn?" Carl said, 'I think we need to show each other how we did it.'"

Furthermore, Bryn would present an ineffective example of discursive interaction to prompt students to notice her omission and reinforce explanation construction.

> *Today I decided to play the game with them. However, intentionally, I stated claims without explanations. Josh quickly caught me and said, "How do you know? You can't just say things and not prove it because you are the teacher!" This was so fascinating because it shows that my students value the norms and held themselves, one another, and myself accountable for following such within our "math talks."*

Elicited Student Thinking to "Prove" their Ideas to Each Other

Bryn used questioning to elicit student's thinking and prompt students to use tools to "prove" their ideas (HLP 14, 18; CC-a). This approach not only helped her identify students' conceptions, but also engaged students in evaluating each other's claims. She notes,

> *Carl used the tool to "prove" that a shape has a particular angle….Carl stated his claim, "The angle is smaller than a right angle," but Josh quickly jumped in and said, "That isn't saying the type of angle that a triangle has. It is only describing the angle. I think that what Carl means is that the angle is acute because it is less than 90 degrees and is smaller than a right angle."*

Promoted the Students' Role as Teachers of Each Other

To further engage students in their learning, Bryn provided opportunities for them to teach each other (HLP 9, 18; CC-a). The students eagerly showed each other how they solved problems. This approach resulted in students' talking with each other…rather than directing their responses to Bryn as the teacher.

> *Justin had difficulty using the tool to test the top two angles of the trapezoid on his Geoboard. When seeing Justin struggle, Carl said, "I think we should test it when it is upside down because it might be easier to compare."*

Bryn also found that students adopted her approach of questioning: "Students would say to each other, 'How do you know?' before it even came out of my mouth."

Provided Positive Feedback to Reinforce Supportive Interactions in the Group

Bryn noted her efforts to provide positive feedback as a means to reinforce students' collaborative interactions (HLP 8; CC-c). "I know you worked really hard today [after a morning of state testing]. I am so proud of you. We're going to continue learning while having fun. However, it is important that you participate in our discussions and encourage your peers to do so as well."

Gave Opportunities for Students to Resolve Conflicts

When a conflict arose, Bryn facilitated discussion among the students to give them ownership in solving the problem (HLP 7; CC-a). Bryn explained that "since they do have behavioral challenges, they did get upset sometimes. Then the other student would catch it and say, 'That's OK, I know how you feel, but you know we can work together." Deciding who would go first in a game was one potential source of conflict:

> *In terms of the game, if a student asks to go first, and the other students in the group give reasons for someone else to go first, I ask, "Why do you think that?" Instead of stopping and saying "No, we're not going to argue about this" or "You need a break," I have them think about their choices by a simple question….I prompted them to make that decision on their own and that's where I really saw progress.*

During one lesson, Bryn experienced a more intense confrontation between students and relayed how she and the students dealt with it.

> *One student with behavior challenges realized he made the other student upset and said, "I think I need to apologize to him."….By talking about how that student felt and how the other student noticed he was angry showed how we as a team can approach conflicts. It helped them become a team and, therefore, helped them with math. My stopping and validating their feelings was a good move.*

Bryn recognized that "by building that foundation in the first lesson, they trusted me, and they interacted with each other."

DISCUSSION

The results of this study present decisions that a novice PST implemented to support the mathematics learning of three students with academic and behavioral challenges. Typically, novice teachers in training rely, simplistically and rigidly, on teaching strategies they learned in methods courses, and they tend to struggle to implement these strategies with flexibility during practicum teaching (Berliner, 2004; Fowlkes et al., 2009). More integrated knowledge needed to teach and respond effectively to learning and behavioral challenges of students comes with more extensive experience in teaching (Ericsson & Towne, 2010).

Therefore, it is noteworthy that this PST, who was still taking methods courses, was able to apply HLPs and classroom conditions with fidelity when working with students with special needs. The evidence indicated that Bryn made conscious efforts in her teaching to incorporate the 14 HLPs to promote student learning (McLeskey et al., 2019) and four classroom conditions to reduce behavioral challenges (Kestner et al., 2019).

Of particular interest is that, similar to expert teachers who focus on the context of their work—the students (Berliner, 2004), Bryn felt that to be an effective teacher, she needed to know her students, their learning styles, and their conceptions (HLP 4). Furthermore, her first focus was on building a community of learners (HLP 7, 9) (McLeskey et al., 2017; Mikami et al., 2014). These decisions centered on the social aspects of lesson planning involving the student context for learning—an important element not typically addressed by novices; novice teachers tend to concentrate their efforts on their own lesson delivery (Berliner, 2004).

As noted by Bellocchi (2022), social bonding is important in student learning since it is contemporaneous with knowledge construction. For example, motivation to learn can increase through positive relationships, which in turn can increase academic achievement (Kindermann & Skinner, 2012). Bryn's emphasis on building students' capacity to engage together in discourse through collaborative norms of interaction allowed students not only to learn content and address their misconceptions together, but also resolve conflicts or disagreements: a decision consistent with one of the four classroom conditions to reduce disruptive behavior—opportunities for frequent student responding (CC-a) (Kestner et al., 2019). This finding is significant given reports that in-service teachers less frequently elicit evidence of student thinking to maintain classroom management (Wilburne et al., 2018). Furthermore, PSTs tend to perceive that they have higher competence on practices involving social interactions (i.e., leading a discussion, building productive relationships with students) than is viewed by their

mathematics teacher educators since PSTs may still have limited understanding of the scope of practices involved in facilitating productive discursive interactions (Lee & Dumitrascu, 2017). Engaging students in sharing their thinking with peers involves practices such as encouraging collaborative problem-solving, student generation of strategies, and explanation of reasoning (Cavanagh & McMaster, 2017)

Bryn also displayed effective use of a variety of assessment tools (i.e., student responses, student gestures, formal work) to inform and revise her instructional decisions (HLP 4), even in-the-moment of lessons. She was able to identify each student's learning styles, interests, misconceptions, and areas of confusion in order to adapt her teaching purposefully to meet each student's needs through a wide range of engaging and appropriate approaches (i.e., modeling, visuals, manipulative tools, games, hand movements) that met the learning goal (HLPs 12, 13, 15, 16, 18, 19, 20; CC-b, d); this approach is consistent with the tenets of Universal Design for Learning for multiple means of engagement, representation, and action/expression (CAST, 2018; Meyer et al., 2014; Root et al., 2020).

In addition, her effective use of assessment as well as questioning helped her to probe more deeply in order to understand her students' thinking rather than assume students' comprehension from their initial brief response (HLPs 6, 18), thus, allowing her to engage in HLPs and create conditions to provide both positive and corrective follow-up feedback (HLP 8, 22; CC-c). Bryn's effective implementation of the HLPs is in contrast to PSTs' tendency to engage in the "shallow teaching syndrome" (Stacey, 2003) whereby PSTs focus on students' rote learning of mathematical procedures (Bolyard & Valentine, 2017) and ask low-level questions when interacting with elementary students (Aguilar & Flores, 2022) rather than promote students' conceptual understanding. Therefore, Bryn's effort to assess student understanding by asking higher-order questions was noteworthy for a novice PST. PSTs commonly view assessment as a means to determine if students "get it or don't" (Otero, 2006), and they often struggle to interpret assessment results accurately (Maclellan, 2004). This naïve view of formative and summative assessment, as well as PSTs' limited skill in understanding the results of assessment, can impact PSTs' ability to make informed instructional decisions. Yet, Bryn's self-proclaimed characteristics of "perseverance" and determination "to do anything possible to help students learn" may have aided her to adopt and integrate these complex HLPs of using student assessment to shape effective instruction.

CONCLUSION

The results of this study provide a unique case of one PST who was able to synthesize her learning to apply HLPs (McLeskey et al., 2019) and establish positive classroom conditions (Kestner et al., 2019) with fidelity to meet the needs of students with academic and behavioral challenges. Teacher educators can use this case to help PSTs visualize the application of different HLPs in a real-world setting. We recommend that this case study can be used as a model of effective decision-making in conjunction with a range of approaches such as rehearsal with peers, video analysis of in-service teachers, simulation teaching, peer observation/coaching, lesson studies, and field experiences, since research has shown that PSTs can begin to develop their skill with HLPs and provide positive classroom conditions for student learning during their teacher training by receiving repeated scaffolded practice opportunities (Aguilar & Flores, 2022; Brownell et al., 2019).

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