

Differentiating Instruction in Diverse Classrooms: A Case Study on Preservice Elementary Teachers' Math Teaching Practices during Internship

Muhammad S. Uddin

Morgan State University, United States

This qualitative case study examined how preservice elementary teachers were prepared for differentiated math instruction during internships. Data was collected through interviews, focus groups, observations, and document analysis from three preservice elementary teachers, one mentor, and one math resource teacher. Data was analyzed using a thematic analysis method. Findings indicated that while the teachers demonstrated theoretical understanding, they lacked comprehensive math content knowledge, impacting their ability to differentiate instruction effectively. Mentorship was found to be crucial in developing teaching skills, but preservice teachers struggled to implement learned strategies in real classrooms. The study emphasizes the need to strengthen content knowledge, provide effective mentorship, and offer practical training to support differentiated math instruction.

Keywords: differentiating instruction, diverse classrooms, mathematics learning, preservice elementary school teachers

Elementary education is the beginning of formal education. Elementary education helps students learn the basic knowledge of mathematics, English Language Arts (ELA), science, and social studies to prepare them to go to middle school and then step into high school and (in some cases) college. These basic areas of knowledge are the students' foundation that may ultimately guide them to graduate from college. According to Merrimack College (2018), students' academic achievement during elementary education determines their performance in later school years. Besides providing basic academic knowledge, elementary education shapes students' lives with expectations and daily routines. Elementary education creates enthusiasm and curiosity among students and motivates them to further education. This motivation is essential for the students to complete college.

Elementary education is a transition for students in many ways and a turning point for their development. This education not only gives a strong foundation of academic success, but it can also develop students' learning in other areas as well. For example, Petrilli (2021) argued that elementary education sets a foundation for students' academic, social, and emotional development. Elementary students learn and play together in a classroom. As a result, they interact with one another and develop their social and emotional skills. Jones et al. (2017) said that students who can acquire good social and emotional skills in elementary classrooms possess better mental and physical health that positively impact their educational growth and careers. Therefore, a solid elementary education can be the cornerstone of a positive future.

School Teachers' Impact on Students' Future Education

Teachers, especially elementary classroom teachers, shape their students' young minds by teaching them the purpose of education and life. Zangeneh et al. (2020) found that elementary teachers play a critical role in shaping their students' educational minds as well as their development. These teachers set the cornerstone of their students' future lives, inspiring them to succeed and become good citizens. Timm and Barth (2021) said that elementary teachers can make education sustainable in their students' minds and inspire them to complete their college education. Elementary teachers discover the strengths and weaknesses of their students and empower them through guidance and support. This empowerment is essential for elementary students to be inspired to complete their college education and contribute to their community.

Elementary classroom teachers inspire their students in many ways. Fauth et al. (2019) found that elementary classroom teachers' pedagogical content knowledge, self-efficacy, and teaching enthusiasm positively impact students' motivation for academic achievement. The authors referred to teachers' self-efficacy as their ability to create a learner-friendly classroom climate and to deal with classroom management for their students' cognitive activation (Fauth et al., 2019). When these teachers are passionate and enthusiastic about their teaching, they become more than a teacher for their students—they act as role models, guides, support, and motivators for their students' future.

The Critical Importance of Learning Elementary Mathematics

Mathematics is compulsory in the United States in elementary, middle, and high school. Students learn the basics of mathematics in the elementary classroom and then gradually learn more about mathematical concepts and content in their middle and high schools. This mathematical knowledge can help them in their college education and career. Learning mathematics is also important for the current technological world (Ojose, 2011). Mathematics is connected with all STEM-related subjects (science, technology, engineering, and mathematics), and mathematics plays a vital role in helping students earn

21st century skills to be responsible citizens (Maass et al., 2019). STEM education prepares students to be skilled workers, and they can move into many industry with that valuable skill set and help contribute to that industry's progress. Li and Schoenfeld (2019) state mathematics is a prerequisite for studying any science, engineering, and technology discipline. Good mathematical knowledge is essential for entering into STEM-related college majors; without math, students cannot succeed in STEM.

Students must learn mathematics in their elementary classroom because they need to cope with middle and high school mathematics; otherwise, they may not graduate from high school. Schaeffer et al. (2021) argued that elementary school students must have a solid mathematics foundation for long-term academic success, and Rabillas et al. (2023) found that elementary mathematics is essential for students' intellectual development. Mathematical knowledge helps students unlock their thinking skills and develop their creativity. According to Ojose (2011), mathematical knowledge enables students to interpret data, teaches them to be problem solvers and creative thinkers, and is a cornerstone to success in the current technological world. As such, learning mathematics in elementary classrooms is essential for students for their education and careers.

The Critical Importance of Differentiating Instruction

Differentiating instruction refers to tailoring teaching methods and content to meet the diverse needs of students. Teachers must first recognize that students have different learning abilities, learning styles, skill levels, and prior knowledge. Gardner's (1993) theory of multiple intelligence suggests that individuals have different strengths and abilities. Mathematics can be taught in ways that appeal to various intelligences, such as logical, visual-spatial, or kinesthetic. Differentiating instruction helps engage students based on their unique strengths, addresses each student's unique needs, and provides a more personalized learning experience. It also addresses the needs of students with special needs. In a longitudinal study, Lai et al. (2020) found that differentiating math instruction is essential for developing students' mathematics learning motivation and problem-solving skills. Varied instructional strategies can promote critical thinking and problem-solving skills. By offering diverse activities and challenges, teachers can encourage students to think critically, analyze problems from different perspectives, and develop a deeper understanding of mathematical concepts.

Differentiating mathematics instruction is also essential for students with diverse identities. The current student population in U.S. classrooms is very diverse. In fall 2022, 49.6 million students were enrolled in K-12 schools (National Center for Education Statistics [NCES], 2024). Among them, 27.5 million students were non-White (NCES, 2024). Therefore, more than 50% of classroom students are from diverse ethnicities. These diverse students need diverse instructions to meet their needs. van Geel et al. (2019) said that one-

size-fits-all instruction is inappropriate for a diverse classroom because it cannot address every student's learning needs. Students need equitable instruction in their math classroom. The National Council of Teachers of Mathematics' (2017) strategic framework states that teaching mathematics equitably means that "each and every person has access to high-quality teaching empowered by the opportunities mathematics affords." Onyishi and Sefotho (2020) said that differentiating instruction in an inclusive classroom is a valid and essential approach for teachers so that all students can learn. In other words, elementary teachers need to customize their instructions for diverse student populations based on their learning styles or needs.

In a diverse classroom, students come from diverse cultural and linguistic backgrounds. Bobis et al. (2021) found that engaging students in learning mathematics requires teachers know their students well and then differentiate instruction. Differentiated instruction acknowledges and respects these differences, ensuring that the content is accessible and relevant to all students. It may involve incorporating diverse examples, using multiple languages, or leveraging students' cultural experiences to enhance understanding. Pozas et al. (2020) said that increased classroom diversity has created an urgent call for teachers to differentiate instructions to meet those learners' needs. Differentiating math instruction in a diverse classroom acknowledges and values the diversity among students, promoting equitable access to education and fostering an environment where all learners can thrive.

The Critical Role of Internships in Preparing Preservice Teachers

Elementary preservice teachers' internships are critical in preparing them to differentiate mathematics instruction by providing practical, hands-on experiences that bridge the gap between theory and classroom application. D'Intino and Wang (2021) said that preparing preservice elementary teachers for differentiating instructions for diverse classrooms is essential. Internships immerse preservice teachers in real classroom settings, allowing them to observe, interact, and engage with diverse groups of students. This firsthand experience helps them understand individual students' unique needs, learning styles, and abilities. Working alongside experienced mentor teachers during internships provides preservice teachers with valuable mentorship and guidance. Mentor teachers can share insights, model effective differentiation practices, and offer feedback, all of which can help preservice teachers develop a deeper understanding of how to tailor instruction to individual learners.

Mills et al. (2020) said that preparing preservice teachers for diverse classrooms through internship is critical. Internships expose preservice teachers to the diversity within classrooms, including varying abilities, backgrounds, and learning styles. This experience helps them recognize the importance of differentiation in addressing the unique needs of each student and fosters a commitment to inclusivity. Internships also expose preservice teachers to diverse cultural contexts within classrooms. This experience enhances their

cultural competence, helping them understand how cultural factors can impact students' mathematical learning. Preservice teachers can then incorporate culturally relevant examples into their differentiated instruction.

Internships also encourage preservice teachers to engage in reflective practice. By reflecting on their teaching experiences, they can identify what worked well and what could be improved in terms of differentiation. This reflective process contributes to ongoing professional development and a commitment to refining instructional practices (Mundy-Henderson et al., 2023; Uddin, 2022).

Purpose of the Study with Significance

This study intended to explore how preservice elementary teachers' internships prepare them to teach mathematics in diverse classrooms. The focus of the study was preservice teachers' practices on differentiating math instruction during their internship in order to promote teaching and learning for diverse students to help them meet their individual needs to be successful in mathematics. This study aimed to explore how the preservice elementary teachers interpret and practice differentiation of math instruction during their internships. The study also focused on how their internship experiences shaped their view of differentiating math instruction.

Theoretical Framework

In her book *How to Differentiate Instruction in Academically Diverse Classrooms*, Tomlinson (2017) provided a framework: "In a differentiated classroom, the teacher proactively plans and carries out varied approaches to content, process, and product in anticipation of and response to student differences in readiness, interest, and learning needs" (p. 10). According to Tomlinson (2017), content, process, and product in differentiating math instruction involves tailoring the material (content) to meet the needs of individual students, adjusting the methods and strategies used to teach the material (process), and varying the ways students demonstrate their understanding of the material (product) based on their readiness, interests, and learning profiles. This study used this framework to explore how preservice elementary teachers practice differentiating instruction in their math teaching.

Research Question

- How do preservice elementary teachers' internships prepare them to differentiate mathematics instruction for diverse students?

Methods

Research Setting and Background

This study aimed to explore preservice elementary teachers' teaching practices of differentiating instructions for diverse students in a mathematics

during their internship. Preservice elementary teachers practice teaching all subjects in their internships, but this study specifically focused on mathematics only. Thus, the focus of this study is very specific (i.e., differentiating math instruction), which is separated from the entire internship. The space is also specific: elementary school classrooms. The time is specific, too (i.e., only math teaching time). As such, the focused inquiry of exploring preservice elementary teachers' math instruction differentiation in a naturalistic setting (i.e., elementary school classroom) is a case or phenomenon for this study.

This case is bounded by focus, setting, and time. Thus, a qualitative case study approach was used. For a case study method, Creswell and Creswell (2022) defined boundedness as a separate phenomenon or case regarding time, place, or some physical boundaries. This study separated its focus from the entire internship. Flyvbjerg (2011) defined a case study as a research study that intensively analyzes individuals' development concerning the environment. This study also explored preservice elementary teachers' development of differentiating math instruction during their internship. Rashid et al. (2019) said a case study explores a complex phenomenon within a specific context. This study also focused on a specific context of mathematics instruction out of the entire internship, which was complex. Yin (2018) defined the case study approach as a qualitative research method that explores a phenomenon or case in an in-depth manner in a real-world context. This study took place in elementary classrooms for an in-depth exploration of preservice elementary teachers' math instruction differentiation practices. Ultimately, it can be concluded that a case study approach was the best fit for this study.

Participants

This study had three preservice elementary teachers, one mentor teacher, and a math resource teacher as participants. The preservice elementary teachers were from a higher education institution's elementary teacher preparation program from an eastern state in the United States. They were in the final semester of their senior year. They all were in their Phase II internship as they had completed their Phase I during the first semester of their senior year. All three preservice elementary teachers did their Phase II internship at the same elementary school and the participant mentor teacher served as a mentor to the third preservice elementary teacher. The math resource teacher was from a neighboring elementary school. The preservice elementary teachers (pseudonyms are used) were as follows:

Ahlise

Ahlise identified as a Black female. She did her internship in a third-grade class. Math was her favorite subject because students needed to understand it. She did not like social studies as she felt the third-grade curriculum was very advanced for her students. Math was her favorite subject in elementary and middle school, but in high school, she liked English

Language Arts (ELA). Science was her least favorite subject in her K-12 school. She wanted to be a teacher because she loved teaching kids.

Evelyn

Evelyn also identified as an African-American female. She was placed in a fifth-grade class. She liked social studies because it taught the past, and students could connect it with the present. Art was her least favorite subject because she was not good at it. However, math was her favorite subject in elementary school. She had no negative attitude toward math, and she shared that “math is a fun subject when you have a fun teacher who can make math fun.”

Taylor

Taylor identified as an African-American female. She was placed in a fourth-grade class during her internship. She liked teaching ELA as she liked her students to read and understand stories. Math was her least favorite subject because she used to struggle with math. She saw her students also struggle with math, which she did not like as a teacher. Math was not a scary subject for her all of the time. She said that she started to learn and enjoy math in her internship.

Data Collection

Data was collected through semi-structured interviews, focus groups, and observations, during the spring 2024 semester.

Semi-Structured Interviews

The data collection regarding the preservice elementary teachers started with individual semi-structured interviews for demographic information, including some pre-prepared questions about ethnicity, gender, why teaching profession, favorite subject to teach and why, least favorite subject to teach and why, and attitude toward teaching mathematics. A second semi-structured interview was conducted after each observation, and the questions were as follows:

1. What did you teach?
2. What were your learning objectives?
3. How did you differentiate math instruction for your students?
4. How did your mentor help you in preparing your lessons?
5. What challenges did you face in differentiating math instruction?
6. How did you overcome your challenges?
7. What were your takeaways from that teaching practice?

A mentor teacher and a math resource teacher were also interviewed after the end of the data collection from the preservice teachers. The mentor teacher was a veteran teacher with 30 years of experience and taught fifth grade. She was a White female. The questions for the mentor were as follows:

1. What are your perspectives on differentiating math instruction?
2. Do you feel it is necessary for your students?
3. What support did you get from your school and district for differentiating math instruction?
4. How did you help your intern in differentiating math instruction?
5. How did you evaluate your intern's differentiating instruction?
6. What are your suggestions for the interns for learning differentiating math instruction for diverse students?
7. What can teacher education can do to prepare better elementary teachers for differentiating math instruction?

Finally, a math resource teacher from the neighboring elementary school was interviewed. She was also a White female and had 14 years of experience in elementary classrooms, including three years as a math resource teacher. The questions asked of her included:

1. What is your perspective on differentiating math instruction?
2. Do you feel it is necessary for diverse learners?
3. How do your school and school district get support for differentiating math instruction?
4. How do you guide or coach teachers for differentiating math instruction?
5. How do you evaluate teachers' differentiating math instruction?
6. What are your suggestions for the interns for differentiating math instruction?
7. How can the teacher education department prepare preservice elementary teachers for differentiating math instruction?

Focus Groups

There were two focus group interviews with the participants. The first one was held after the individual demographic interviews, at the beginning of their Phase II internships. The questions for that focus group focused on (a) their experiences in Phase I, (b) their definitions of differentiating math instruction, (c) what support they did or did not get from their mentors for their practices of differentiating math instruction during their Phase I internship, (d) what they learned about differentiating math instruction from their math methods course, and (e) their plan for their Phase II internship.

The second focus group was held at the end of their Phase II internship. The questionnaire for this focus group was similar to the first focus group: (a) their experiences in Phase II, (b) their understanding of differentiating math instruction, (c) their practice of differentiating math instruction, (d) what support they did or did not get from their mentors for differentiating math instruction, and (e) their plan to teach mathematics in the future.

Observations

This study intended to observe each preservice elementary teacher three times during the semester, but due to schedule conflicts, only two observations

were possible for each participant. The researcher took field notes during the observations.

Research Site

The preservice elementary teachers were doing their internship at X Elementary School. According to public data, this school has a diverse student population. In the 2023-2024 school year, the school had 702 enrollments from PreK-5th grade. Among them, 48% of their students are Black, 20% are White, 8% are Latino, 16% are Asian, and 8% are from two or more races. Among 46 classroom teachers, 57% are White, 38% are Black, and 5% are from other races.

Data Analysis

Data were analyzed using the thematic data analyzing approach. First, the transcribed interviews were collected from Zoom. Then, the data from each of three preservice elementary teachers were separated to analyze. In the next step, each transcript was read carefully to identify possible themes, and each possible theme was documented in the transcripts. Then, each transcript was re-read, and the themes were adjusted with possible close meaning. Finally, the adjusted themes were reviewed to determine the final themes.

The transcripts of the mentor teacher and resource teacher interviews and the field notes were also read carefully, and possible themes were documented. However, these documents were not analyzed using the above method. They were used for triangulation with the analyzed data.

Positionality

In qualitative research, a researcher plays an instrumental role in collecting and analyzing data. Thus, the researcher's positionality is inevitable and needs to be confronted (Olukotun et al., 2021). The researcher of this study was aware of his positionality. He started his career as a high school mathematics teacher and has 29 years of experience in public education. Currently, as a faculty member of a higher education institution, the researcher teaches teacher candidates and researches on teacher development. Therefore, the researcher was fully aware of his position and used his experience as a resource in collecting and gathering data. The researcher depended on collected data, not on his experience, to avoid bias.

Results

Definition of Differentiating Math Instruction

The participant student teachers shared their understanding of differentiating math instruction throughout the interviews and focus groups (see Table 1).

Table 1*Participant Definitions of Differentiating Math Instruction*

Name	First Focus Group	Last Focus Group
Ahlise	“To me, differentiating math instructions means being versed in teaching. So, I use chart paper and a strategy that [students] are used to. I just have them come up to the board, do a lot of turns and talk, and create a discussion based on math. I said connecting math with their personal lives really helps, especially for word problems.”	“It is definitely student-centered discussion, student-led work. If they had an idea, allowing them to do the idea, giving them work to do independently, but also working in a small group. In my classroom, I use coloring chart, playing games, and so on. It’s just a different way to do it or making their own.”
Evelyn	“To me, differentiating math instruction means making math learning equitable, giving students the tools they need, or teaching them how to learn better. Right now, we are doing decimals and fractions. I explain to my students, ‘If you are not that strong at decimals, then you just convert it to a fraction, and that’s fine, or vice versa.’ So, just give them the tools they like.”	“The best way I differentiated is that I had quite few students with 504 plans. I did a lot of sentence starters. I showed them their work and then the spot where they have to write a statement. I would group my 504 students with some low scorer. I would just use my data and stuff to put them in a group together. Small grouping definitely works.”
Taylor	“Differentiating math instruction means tailoring the way that you teach through your students. In my math class, I have some students who are not as high as the rest of the other students. So, when I teach in the class, I have to change my lesson to be tailored to the needs of all of my students, like using visual aids or having my students turn and talk with their peers while they work on math problems.”	“For differentiation, we use manipulatives like anchor charts posted all over the classroom. We did a lot of small group and independent work time. We have some students [who] struggle and some of them miss important instruction. During independent work, they don’t know what to do. We definitely provide support they need because they don’t get [it] during the lesson.”

Focus group shows that Ahlise emphasized the importance of student-centered discussions and allowing students to work independently, as well as in small groups, using methods such as coloring charts and games for teaching math. Evelyn focused on making math learning equitable and providing tools for students, including those with 504 plans, through strategies like using sentence starters and grouping students based on their needs. Taylor tailored her teaching to meet the needs of all her students, using visual aids and peer

discussions, as well as providing support during independent work for students who struggle with important instructions.

Tailoring Lessons

When it comes to effective teaching strategies, the insights and experiences of mentor teachers can be invaluable. In this context, the experiences shared by Ahlise, Taylor, and Evelyn shed light on the importance of customizing instruction to meet students' diverse needs. By leveraging their wisdom and expertise, educators can gain valuable perspectives on tailoring teaching approaches to facilitate student learning and understanding. Ahlise shared:

My mentor helped me learn to piggyback on what she said about time. She said it is okay not to follow the scoping sequence that the district sets for you. It is supposed to be okay with this week, and you are supposed to do that number of lessons. She helped me with the anxiety of that. Just knowing that takes a day to re-teach, review, or pull these small groups. That's the way students can meet the lesson's objectives that day.

Taylor said:

My mentor teacher gives me different materials for different groups of students. She will give me a set of questions. We have some students with high math skills in the advanced math class. My mentor will ask me to give them these problems to challenge them. Then we have middle-level assessments, and we have those students who are not as high.

Evelyn said:

If my students do not understand fractions, my mentor talks about money. [The students] know money, and that is what they remember. She even has visuals for them. She asks students to draw pictures and gives them manipulatives. If that does not work, she tries another way.

Group Work Activities

The participants frequently talked about small group instruction for differentiating math instruction. Ahlise's approach of incorporating independent time followed by small group activities engaged her students and deepened their understanding of the material. Taylor and Evelyn's mentor also encouraged them to do small group instruction. As Ahlise said,

The other day, I gave my students 10 minutes of independent time for Geoboard. Then, I put them in small groups. I could tell you by walking around the group that they were very interested in and engaged with the Geoboard and making a difference in Polygon.

Evelyn said,

I started getting more confident in math [because of] my mentor. She started helping me out and talking to small groups herself. I would say she helped me in small groups, and my problem was always time management. I had to set up a timer for myself where she would help me. When all the students did not

get the lesson, she just said that that's what a small group is for. She also asked me who I wanted to put in a group.

Taylor added:

I have some students who struggle with solving math problems. I will spend more time and focus on those students, and my mentor teacher will do the same. She will pull a small group for me while I work with the rest of the whole group.

In summary, the experiences shared by Ahlise, Evelyn, and Taylor highlight the benefits of personalized and individualized instruction to meet the diverse needs of students. Ahlise's use of independent time, followed by small group activities, engaged her students and deepened their understanding of the material. Evelyn's mentor supported her in addressing time management challenges and recognized the value of small-group instruction. Taylor's dedication to spending more time with struggling students while the mentor pulled a small group demonstrates their commitment to providing tailored support to each student. Overall, these experiences underscore the importance of customized instruction to support diverse student needs.

Lack of Math Content Knowledge

The participant student teachers often shared their lack of knowledge of mathematical content. They were all placed in advanced math classes in their Phase II internship and struggled with teaching math because they lacked content knowledge. For example, Evelyn stated, "My challenge really started with the lesson. The only thing I remember is 'Liter.' I don't remember learning about the metric system. I was learning it for the first time, and these kids have learned it, too." Taylor added:

I am a little nervous about teaching math. You know that's not the subject area that I am strong. So, my mentor gave me extra time to review the materials beforehand. My mentor teacher helped me a lot with math. She made me teach math a lot because I was uncomfortable with it.

Ahlise said, "I know fraction is coming up, and that is not really my strong suit. So, my mentor will teach lessons, and I will watch." She also said, "I am now in an advanced math class. Many of my students give responses easily, and sometimes, they teach me math."

In summary, Evelyn felt challenged by the lessons and struggled to remember the material. Taylor expressed apprehension about teaching math but received help from her mentor teacher. Ahlise mentioned her discomfort with fractions and her mentor's involvement in teaching lessons. She also highlighted some of her students' proficiency in advanced math. Overall, the teachers recognized their areas of weakness and sought support from their mentors to improve their teaching skills.

Challenges in the Classroom

The participants shared the challenges they encountered in the classroom to differentiate math instruction. Each teacher faced unique difficulties, such as Ahlise's struggle with the prescribed curriculum and desire for more independence, Evelyn's challenges with differentiation and managing behavioral issues, and Taylor's struggle to adapt to teaching math in a larger and more advanced class. Ahlise said,

It is difficult to challenge your advanced students because of *Bridges* [math handbook]. You still want to challenge your students, like by advancing their discussion, but you cannot. I want to be independent in challenging them. In those moments, I almost choked up because I had to follow *Bridges*.

Evelyn said,

Many times, in the methods classes, [professors] talked about differentiation. But seeing it in real life was a little crazy. I have students who are really successful in math class and hard workers. Also, I have students who I can't tell you whether or not they understand what I am doing or they don't care. . . . [Also,] I really struggle with behavioral issues. It was hard to do small groups because many students with similar math strengths and weaknesses don't like each other. It is really hard to group them.

Taylor said,

In my Phase 1, I was in an English class and did not teach math. I had no practice in teaching math. Now, I am in an advanced math class with 32 students. They go through math problems very quickly. So, it is very chaotic there, and I need to be more comfortable in front of the class.

Discussion

The study focused on preservice elementary teachers' differentiation of math instruction practice during their internships to explore how those internships prepared them to teach math in diverse classrooms. Though these preservice elementary teachers practiced all elementary subjects in their internships, the study specifically focused on mathematics using Tomlinson's (2017) framework for differentiating instruction as a theoretical framework. The research question was, "How do preservice elementary teachers' internships prepare them to differentiate mathematics instruction for diverse students?" Using a case study approach, this study collected data from three preservice elementary teachers through individual interviews, focus groups, and observation. A mentor teacher and a math resource teacher were also interviewed to collect data and triangulation.

Tomlinson (2017) said that in a differentiated classroom, teachers strategically plan and implement a variety of instructional methods tailored to students' diverse levels of readiness, interests, and learning needs. This proactive approach helps address and accommodate the individual differences

among students, ensuring that each student's unique requirements are met effectively. Tomlinson (2017) also talked about the importance of content, process, and product in differentiating math instruction. Content refers to the specific material being taught, such as the math topic or skill. The process involves the methods and strategies used to teach and learn the content, including differentiating instruction based on students' individual needs and learning styles. Product relates to the end result of learning, such as the assignment or project that demonstrates the students' understanding of the math concept. By considering content, process, and product, educators can tailor their instruction to meet the diverse needs of students in the mathematics classroom.

The findings of this study showed that preservice elementary teachers had a theoretical understanding of differentiating math instruction. They shared some understanding of differentiating math instruction in their first focus group. As Ahlise said, "To me, differentiating math instructions means being versed in teaching." In the last focus group, she defined differentiating math instruction as a student-centered learning environment where students could lead discussions and work to solve math problems. She also focused on giving students autonomy to advance their ideas for math. Similarly, in the first focus group, Taylor defined differentiating math instruction as tailoring teaching to meet each student's needs. In the last focus group, she shared that she used manipulatives and small group instructions. Consequently, it can be seen that the preservice teacher understood the process and product well.

However, the mentor's understanding of differentiating math instruction differed from that of the interns. The mentor focused on the product, saying, "Differentiating math instruction, I feel like we need to start with a common goal. Whatever the standard is, we need to make sure that we focus on the end goal." According to the mentor teacher, when differentiating math instruction, beginning with a shared objective is important. Regardless of the standard being taught, ensuring that the ultimate goal is the focal point of instruction is crucial. Because of this focus, the mentor emphasized the report card, not math learning. However, the math resource teacher shared another view. She defined differentiated instruction as "knowing the students, planning ahead, and using a variety of instructional approaches to get the same standard." The resource teacher said that developing all students' math proficiency is essential. Therefore, while the interns' and math resource teacher's views of differentiating math instruction were similar as they all focused on various instruction, the mentor's definition differed as she focused on product, not process.

The findings of this study also showed that the participant interns lacked knowledge of math content. As Taylor said, "I am a little nervous about teaching math. You know that's not the subject area [where] I am strong." Even Ahlise, who said that math was her favorite subject, also lacked content knowledge as she said, "I know fraction is coming up, and that is not really my strong suit. So, my mentor will teach lessons, and I will watch." Evelyn, who was practicing

math in an advanced fifth grade class, also lacked math content knowledge. She said, “My challenge really started with the lesson. The only thing I remember is ‘Liter.’ I don’t remember learning about the metric system. I was learning it for the first time [along with the students].”

Teachers’ knowledge of mathematical content is essential for teaching mathematics (Uddin, 2021). Similarly, content knowledge is essential in differentiating math instruction because it forms the foundation of what students need to learn. Understanding the specific material being taught allows educators to tailor their instruction to meet the diverse needs of students in the mathematics classroom. Kazemi et al. (2019) said math teachers’ content and pedagogical knowledge are closely connected to teaching. Teachers can effectively adapt their teaching methods and strategies to accommodate different learning styles and individual needs if they deeply understand the math topic or skill. This ensures that all students have access to the necessary content in a way that best supports their learning. Consequently, teachers’ lack of math content knowledge is a challenge in differentiating math instruction.

Additionally, mentors play a crucial role in developing an intern’s math teaching skills. They provide guidance, support, and feedback essential for an intern’s growth as an educator. Mentors can share their expertise and offer valuable insights into effective teaching practices, classroom management, and ways to differentiate instruction. The findings also showed that the interns learned how to differentiate math instruction from their mentors. Ahlise said, “[my mentor] helped me with the anxiety of that. Just knowing that takes a day to re-teach, review, or pull these small groups. That’s the way students can meet the lesson’s objectives that day.” Similarly, Taylor said, “My mentor teacher gives me different materials for different groups of students.”

The participant interns emphasized implementing small group activities in differentiating math instruction. As Ahlise said, “I could tell you by walking around the group that they were very interested in and engaged with the Geoboard and making a difference in Polygon.” The researcher witnessed Ahlise engaging her students in group work during her math teaching. Evelyn also talked about group work, saying, “When all the students did not get the lesson, [my mentor] just said that’s what a small group is for.” The researcher observed two of Evelyn’s classes and found that some students struggled, but there were no group work activities. Her teaching was lecture-based, and she asked some questions of the students. Similarly, Taylor talked about group work several times, but the researcher did not see any group activity during observation.

The findings also showed that preservice interns struggled in their classrooms during their internships. Though they learned some strategies in their math methods classes in college, they could not implement them. As Evelyn said, “Many times, in the methods classes, [professors] talked about differentiation. But seeing it in real life was a little crazy.” She also talked about students’ behavioral issues, which was another challenge for her. However,

Taylor had a different experience in her internship. In Phase I, she practiced teaching English Language Art only, and in Phase II, she got some math classes. Ahlise said that she faced challenges in prescribed math lessons that the school districts provided to the teachers.

The findings revealed that the preservice teachers had a theoretical understanding of differentiated instruction, particularly in terms of process and product. However, they struggled with a lack of content knowledge in math, which is crucial for effective differentiation. Mentors were found to play a significant role in helping interns develop their math teaching skills and in providing guidance and support in implementing differentiated instruction. The interns emphasized small group activities as a key strategy for differentiation, but they encountered challenges in implementing learned methods due to factors such as prescribed lesson plans and behavioral issues among students.

Conclusion

This study investigated the preparation of preservice elementary teachers for differentiated math instruction during their internships using Tomlinson's (2017) framework as a theoretical basis. The research aimed to understand how preservice teachers' internship experiences equipped them to tailor math instruction to diverse students. Data was collected through individual interviews, focus groups, and observations of three preservice teachers, as well as interviews with a mentor teacher and a math resource teacher, to ensure comprehensive data triangulation.

The findings of the study indicate that preservice elementary teachers demonstrated a theoretical understanding of differentiated math instruction. This was evident from their discussions in the focus groups, where they articulated the concept of tailoring math instruction to meet diverse student needs. The preservice teachers emphasized creating a student-centered learning environment, utilizing small group instruction, and providing students with autonomy to advance their ideas in math. However, their understanding differed from that of the mentor teacher, who emphasized starting with a common goal and focusing on the end objective. The math resource teacher highlighted the importance of knowing students, planning ahead, and using a variety of instructional approaches to achieve the same standard.

Notably, the study revealed that the participant interns lacked comprehensive knowledge of math content, which posed a challenge in effectively differentiating math instruction. This lack of content knowledge was acknowledged by the interns themselves, indicating a need for further support and training in this area. Teachers' content knowledge is crucial in differentiating math instruction, as it forms the foundation for tailored instruction to meet diverse student needs.

The role of mentors in developing interns' teaching skills was emphasized in the study. Mentors were seen as essential in providing guidance,

support, and feedback necessary for the interns' growth as educators. The interns expressed learning how to differentiate math instruction from their mentors, indicating the significant impact of mentorship in their professional development. Additionally, the study observed that preservice interns struggled to implement the strategies learned in their college math methods classes. Despite their theoretical understanding, they encountered challenges in implementing differentiation in real classroom settings. Some interns also faced difficulties with prescribed math lessons provided by school districts, highlighting the need for further support and practical training in applying differentiation strategies effectively.

In conclusion, the study underscores the importance of strengthening preservice teachers' content knowledge, providing effective mentorship, and offering practical training to support the implementation of differentiated math instruction in real classroom settings. These findings can inform the development of targeted interventions and support systems to enhance preservice teachers' preparation for differentiated math instruction during their internships.

Limitations

This study has several limitations. First of all, only one mentor teacher out of three was interviewed. All three mentors' interviews could have enriched the data. Second, more observation could have provided more detailed insight of interns' teaching and differentiating math instructions. Finally, collecting student work on math would be rich documents to evaluate their learning outcomes based on the differentiating math instructions.

Scope for Future Studies

Future studies could further investigate the strategies and interventions that can effectively bridge the gap in preservice teachers' mathematics content knowledge. Additionally, exploring the impact of practical training and hands-on experience in real classroom settings on the interns' ability to implement differentiated math instruction would be valuable. Research focusing on developing mentorship programs specifically targeting enhancing preservice teachers' skills in differentiating math instruction could also be beneficial.

Moreover, future studies could delve into the potential role of ongoing professional development for both preservice teachers and mentor teachers in strengthening their understanding and application of differentiated math instruction, which could provide valuable insights for improving their preparation during internships. Furthermore, exploring the impact of cultural competence and diversity training on preservice teachers' ability to differentiate math instruction for diverse student populations effectively would be pertinent. Understanding how factors such as student demographics, classroom dynamics, and resource availability impact the implementation of differentiated math instruction could also be an area of interest for future research.

Overall, future studies should aim to provide targeted and practical recommendations for enhancing the preparation of preservice teachers for differentiated math instruction during their internships, ultimately contributing to improving mathematics education and student learning outcomes.

References

- Bobis, J., Russo, J., Downton, A., Feng, M., Livy, S., McCormick, M., & Sullivan, P. (2021). Instructional moves that increase chances of engaging all students in learning mathematics. *Mathematics*, 9(6), 1–19. <https://doi.org/10.3390/math9060582>
- Creswell, J. W., & Creswell, J. D. (2022). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). Sage.
- D'Intino, J. S., & Wang, L. (2021). Differentiating instruction: A review of teacher education practices for Canadian pre-service elementary school teachers. *Journal of Education for Teaching*, 47(5), 668–681. <https://doi.org/10.1080/02607476.2021.1951603>
- Fauth, B., Decristan, J., Decker, A. T., Büttner, G., Hardy, I., Klieme, E., & Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teaching and Teacher Education*, 86, 102882. <https://doi.org/10.1016/j.tate.2019.102882>
- Flyvbjerg, B. (2011). Case study. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (4th ed., pp. 301–316). Sage. https://www.researchgate.net/profile/Bent-Flyvbjerg/publication/235953309_Case_Study/links/00463514b20a55cf69000000/Case-Study.pdf
- Gardner, H. (1993). *Multiple intelligences: The theory in practice*. Basic Books.
- Jones, S. M., Barnes, S. P., Bailey, R., & Doolittle, E. J. (2017). Promoting social and emotional competencies in elementary school. *The Future of Children*, 27(1), 49–72. <https://files.eric.ed.gov/fulltext/EJ1144815.pdf>
- Kazemi, F., Rafiepour, A., & Fadaie, M. R. (2019). Investigate content knowledge and pedagogy content knowledge of the primary school teachers and its relation with the students' problem-solving ability at mathematical fractions. *Research in Curriculum Planning*, 16(60), 104–120. https://journals.iau.ir/article_546264_e32bd294d87b204a328a311c061d9af3.pdf
- Lai, C. P., Zhang, W., & Chang, Y. L. (2020). Differentiated instruction enhances sixth-grade students' mathematics self-efficacy, learning motives, and problem-solving skills. *Social Behavior and Personality: An international journal*, 48(6), 1–13. <https://doi.org/10.2224/sbp.9094>

- Li, Y., & Schoenfeld, A. H. (2019). Problematizing teaching and learning mathematics as “given” in STEM education. *International Journal of STEM Education*, 6. <https://doi.org/10.1186/s40594-019-0197-9>
- Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The role of mathematics in interdisciplinary STEM education. *ZDM—Mathematics Education*, 51, 869–884. <https://doi.org/10.1007/s11858-019-01100-5>
- Merrimack College. (2018). Why is elementary education so important? <https://online.merrimack.edu/why-is-elementary-education-so-important/>
- Mills, T., Villegas, A. M., & Cochran-Smith, M. (2020). Research on preparing preservice mainstream teachers for linguistically diverse classrooms. *Teacher Education Quarterly*, 47(4), 35–53. <https://www.jstor.org/stable/26977529>
- Mundy-Henderson, C. A., Gierhart, A., & Maarouf, S. (2023). Supporting preservice elementary preservice teachers’ design of differentiated instruction with a transparent lesson plan template. *Perspectives in Learning*, 20(2), 12–24. <https://csuepress.columbusstate.edu/cgi/viewcontent.cgi?article=1207&context=pil>
- National Center for Education Statistics [NCES]. (2024, May). Racial/ethnic enrollment in public schools. <https://nces.ed.gov/programs/coe/indicator/cge/racial-ethnic-enrollment>
- National Council of Teachers of Mathematics. (2017). Mission statement. <https://www.nctm.org/about/>
- Ojose, B. (2011). Mathematics literacy: Are we able to put the mathematics we learn into everyday use? *Journal of Mathematics Education*, 4(1), 89–100. https://educationforatoz.com/images/8.Bobby_Ojose_-_Mathematics_Literacy_Are_We_Able_To_Put_The_Mathematics_We_Learn_Into_Everyday_Use.pdf
- Olukotun, O., Mkandawire, E., Antilla, J., Alfaifa, F., Weitzel, J., Scheer, V., ... & Mkandawire-Valhmu, L. (2021). An analysis of reflections on researcher positionality. *The Qualitative Report*, 26(5), 1411–1426. <https://doi.org/10.46743/2160-3715/2021.4613>
- Onyishi, C. N., & Sefotho, M. M. (2020). Teachers’ perspectives on the use of differentiated instruction in inclusive classrooms: Implication for teacher education. *International Journal of Higher Education*, 9(6), 136–150. <https://doi.org/10.5430/ijhe.v9n6p136>
- Petrilli, M. J. (2021). An ode to elementary schools. *Education Next*. <https://www.educationnext.org/ode-to-elementary-schools-greatest-potential-impact-academic-social-emotional-progress/>
- Pozas, M., Letzel, V., & Schneider, C. (2020). Teachers and differentiated instruction: Exploring differentiation practices to address student

- diversity. *Journal of Research in Special Educational Needs*, 20(3), 217–230. <https://doi.org/10.1111/1471-3802.12481>
- Rabillas, A., Kilag, O. K., Cañete, N., Trazona, M., Calope, M. L., & Kilag, J. (2023). Elementary math learning through Piaget's cognitive development stage. *Excellencia: International Multi-Disciplinary Journal of Education (2994-9521)*, 1(4), 128–142. <https://risejournals.org/index.php/imjrise/article/view/678>
- Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case study method: A step-by-step guide for business researchers. *International Journal of Qualitative Methods*, 18, 1–13. <https://journals.sagepub.com/doi/pdf/10.1177/1609406919862424>
- Schaeffer, M. W., Rozek, C. S., Maloney, E. A., Berkowitz, T., Levine, S. C., & Beilock, S. L. (2021). Elementary school teachers' math anxiety and students' math learning: A large-scale replication. *Developmental Science*, 24(4). <https://doi.org/10.1111/desc.13080>
- Timm, J. M., & Barth, M. (2021). Making education for sustainable development happen in elementary schools: The role of teachers. *Environmental Education Research*, 27(1), 50–66. <https://doi.org/10.1080/13504622.2020.1813256>
- Tomlinson, C. A. (2017). *How to differentiate instruction in academically diverse classrooms*. ASCD.
- Uddin, M.S. (2022). Exploring the effect of student-teaching on elementary student-teachers' math anxiety. *International Electronic Journal of Mathematics Education*, 17(4), em0708. <https://doi.org/10.29333/iejme/12316>
- Uddin, M. S. (2021). *A mini ethnography on virtual elementary student teaching during the COVID-19 pandemic with a focus on the subject of mathematics* (Publication No. 2021. 28772556) [Doctoral dissertation, Morgan State University]. ProQuest Dissertation and Theses.
- van Geel, M., Keuning, T., Frèrejean, J., Dolmans, D., van Merriënboer, J., & Visscher, A. J. (2019). Capturing the complexity of differentiated instruction. *School Effectiveness and School Improvement*, 30(1), 51–67. <https://doi.org/10.1080/09243453.2018.1539013>
- Yin, R. K. (2018). *Case study research and application: Design and methods* (6th ed.). Sage.
- Zangeneh, H., Kavousi, A., & Bahrami, Z. (2020). Teachers' attitudes toward teaching-learning methods of entrepreneurship education in elementary education. *Education Strategies in Medical Sciences*, 12(6), 1–7. <https://www.sid.ir/FileServer/JF/26313980601>

Authors

Muhammad S. Uddin

Morgan State University, United States

Email: muhammad.uddin@morgan.edu