Differentiated Instruction to Teach Mathematics: Through the Lens of Responsive Teaching

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Preparing future teachers to be responsive to the needs of all students in their classrooms is the goal of any excellent teacher preparation program. How to prepare the preservice teachers (PTs) to be responsive to their students can be challenging. The study followed eight preservice teachers for two years and investigated their differentiation strategies and approaches for responding to their students' academic and cultural needs. Two data sources - lesson plans and reflective commentary about their lessons - were analysed through document analysis. There was an overall improvement in differentiation and responsiveness from third to fourth year. Results indicate some skill in process differentiation and responding to community culture, but more skills are necessary in the practice of teaching.

Keywords · differentiated instruction · responsive teaching · preservice teacher education · mathematical learning disabilities

There are many components that go into teaching mathematics to children. Preparing preservice teachers to learn about and use appropriate strategies and approaches is challenging. Giving the best instruction possible to every child, not just the neurotypical student performing at grade level is the goal of any reputable teacher training program. How do we equip preservice teachers with the equity disposition? Is it enough to say we value diversity culturally and academically? The researchers sought to address the issue of teaching preservice teachers how to successfully differentiate for students between the ages of 3-9 during mathematics lessons.

The National Council of Teacher of Mathematics (NCTM) position statement (2014, 2017) states teaching mathematics for equity means to ensure all students have opportunities to experience high quality mathematics instruction. Teaching mathematics to all students means providing learning opportunities for each and every student, including students identified as learning disabled. The Council for Exceptional Children (CEC) also focuses on equity in their position statement,

> An essential first step to building safe and positive school and community settings is the recognition and elimination of any inherent biases school leaders, teachers, and other school personnel may hold regarding individual students' race, culture, and other characteristics. To make this a reality, members of the school and community setting must acquire a wide knowledge base of effective practices that support human and civil rights and promote social justice for the diverse student populations in today's schools. (CEC, 2020, p. 1)

The Australian government also advocates for teachers to employ "cultural capability and sensitivity to teach Aboriginal and Torres Strait Islander students and students from Culturally and Linguistically Diverse backgrounds in culturally appropriate ways" (Australian Government, 2020 p. 27). The review of this document also advocates for better preservice teacher education that includes practice with research-based best practice (Australian Government, 2020).

With these recommendations in mind, the study sought to explore preservice teachers' understanding of teaching mathematics to students with diverse backgrounds, including students with mathematical learning difficulties. The researchers are professors in the department of education in a small midwestern university in the United States. Formative and summative assessments showed that differentiation was an area of weakness of preservice teachers in previous years. The researchers addressed the issues in their teacher education program and designed the current study to investigate the impact of the changes on preservice teachers' lesson design. The study was conducted in a 4-year teacher preparation program that licenses preservice teachers to teach PreK-3rd grade (ages 3-9). The typical program in the United States is similar to Australia in that students can be licensed to teach after completing a four-year Bachelor of Education program. Preservice teachers (PTs) in the program are exposed to culturally and academically diverse learners through their fieldwork and learned various instructional strategies to meet the needs of diverse learners through university coursework.

Theoretical Perspective and Literature Review

This study is grounded in theoretical perspectives of equity and justice in the context of school communities (Averill et al., 2009). Discussion around equity and justice often focus on inequalities in race, ethnicity, gender, and/or social status (Aronson & Laughter,2016). In this study, we extend our attention to beyond visible or inborn identity to ensure quality instruction for all students including low-performing students. Through equity of learning opportunity and culturally relevant education, we can motivate all students to engage in learning mathematics and help them relate required curriculum to their own cultures (Wlodkowski & Ginsberg, 1995). Averill et al. (2009) suggest, "teachers can use children's cultural capital to stimulate mathematics learning or ignore it and actively deplete motivation to learn, thus adding another barrier to achieve" (p. 159). Classroom environment and personal interactions can either reduce or enhance students' learning of mathematics, and students will feel more comfortable learning the content when they feel comfortable with how the teacher engages the class and discusses the material (Hackenberg, 2005; Rajagopal, 2011). Classroom environment and personal interactions can either reduce or enhance students' learning of mathematics, and students will feel more comfortable learning the content when they feel comfortable with how the teacher engages the class and discusses the material (Hackenberg, 2005; Rajagopal, 2011).

Cultural Responsiveness and Mathematical Motivation

Creating an equitable school experience for all is challenging but not insurmountable. When teachers are asked to reflect on their practice it is an excellent way to break down what it means to establish an equitable learning experience (NCTM, 2014). Reflecting about students' culture while planning and evaluating the success of the lesson after execution can lead to more student success (Limniou et al., 2018). Knowing the culture of the classroom students is a high priority, but the teacher must also address the diversity of the academic ability of the classroom.

It is also necessary for teachers to feel confident that they can broaden the participation of all students in the classroom (Chu, 2013; Moschkovich, 2013). Taking the cultural and academic

perspective of the student while crafting lesson plans and choosing materials is the foundation that equitable classrooms are built on. Successful teachers look at a lesson from the point of view of the students. A teacher that feels strongly about her ability to use appropriate strategies, plan for different academic levels, and use what she knows about students' cultures can facilitate learning at a higher level. Teacher-efficacy is a strong predictor of the commitment to teaching (Lapeniene & Dumciene, 2014). Moschkovich (2013) states that academic equity is achieved when students are supported in mathematical reasoning, conceptual understanding, and reflection. This can be overtly linked to student culture through the activities and supporting materials that the teacher chooses (Gutstein, 2003). Preservice teachers can be presented with the idea that differentiation of instruction and employing culturally responsive teaching strategies are the steps leading to an equitable experience in the mathematics classroom.

Culturally Responsive Teacher

Culturally responsive teaching (Gay, 2010, 2013) and culturally relevant pedagogy (Ladson-Billings, 1994, 1995, 2001) embrace social justice in the classroom context. Although researchers use culturally responsive teaching and culturally relevant pedagogy interchangeably, the two should be differentiated as "focusing on two separate but complementary types of outcomes: teaching affects competence and practice whereas pedagogy affects attitude and disposition" (Aronson & Laughter, 2015, p. 167). Pedagogy emphasizes teachers' planning methods that determine planning, instruction, and assessment; whereas teaching describes actual practices that respond to the culture of students (Aronson & Laughter, 2015; Dover, 2013). The pedagogy surrounding intended curricula means that the teacher has a set of objectives and determines if the time and resources will allow for the objectives to be realized. Enacted curriculum is the actual teaching where the teacher will strategize to create activities that maximize learning potential and motivate the student to engage with the material (Pak et al., 2020).

Ladson-Billings (1994) defined culturally relevant pedagogy as one "that empowers students intellectually, socially, emotionally, and politically using cultural referents to impart knowledge, skills, and attitudes" (pp. 16–17) and proposed three tenets: achieving academic success, developing cultural competence, and developing a sociopolitical consciousness (1995). The concept of culturally relevant pedagogy strives to enable all students, especially those from traditionally marginalized groups to connect their schooling and learning experiences with their cultures and communities (Ladson-Billings, 1994). Culturally relevant pedagogy can empower students emotionally, socially, politically, and intellectually by using their own culture as a frame of reference for knowledge, skills, and attitudes (Ladson-Billings, 2001).

Gay (2010) defined culturally responsive teaching "as using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (p. 31). Four essential actions for implementing culturally responsive teaching include replacing deficit perspectives of students and communities; understanding the resistance to culturally responsive teaching from critics; understanding how and why culture and difference are essential ideologies; and making pedagogical connections within the context in which they are teaching (Gay, 2013).

While distinctions can be drawn between pedagogy and teaching, Gay (2010, 2013) and Ladson-Billings (1994, 2001) emphasize the importance of teachers being culturally responsive. When teachers construct curricula, environments and instructional methods that validate and reflect the identities, experiences, and diversity of all students it affirms that the educator values all students and sees multiculturalism as a benefit (Gay, 2010; Ladson-Billings, 2001). It also sends the message that educators value all students, and that multiculturalism is an asset. We use these theories to frame our view of a successfully receptive educator. Culturally responsive teachers improve achievement by teaching diverse learners from a student perspective (Driver & Powell,

2017). This includes utilizing prior experience, cultural knowledge, frames of reference and performance styles to make learning more relevant and effective for them (Gonzalez et al., 2006). This leads into the more specific arena of differentiation as it builds a bridge between home culture and school culture to empower students from diverse backgrounds to achieve an equitable school experience. Differentiation means focusing on what modifications and accommodations create access to curriculum for any student in the class. CRT research shows that when materials and assignments align with students' backgrounds than true engagement with the material can be achieved (Boone et al., 2010; Dysarz & Education Trust, 2018; Holocker, 2010).

Preservice teachers may find it challenging to engage in CRT, because it involves various strategies employed at once to become proficient. For example, student engagement is particularly important for academic success but is difficult to motivate students to engage in learning at all times. Students who are more engaged receive more attention from the teacher, and those that disconnect from the teacher and classroom gradually get less attention from the teacher (Skinner et al., 2008). The majority of classroom teachers in the United States are white females (NCES, 2020). Australia also lists females as the majority of teachers (https://www.abs.gov.au/statistics/people/education/schools/latest-release). While the teaching population is approximately 80% Caucasian, the student population of the United States is 54% nonwhite (USDE, 2020), so it is imperative that teachers need to learn about traditionally nondominant cultures in order to successfully engage students (Abacioglu et al., 2020). This differs from Australian demographics which report 1% of its teachers are from indigenous groups, but those students in the other column of ethnic groups is 15.8% (this includes Australian aboriginal students) (https://www.statista.com/statistics/260502/ethnic-groups-in-australia/).

Helping PTs achieve a positive disposition towards creating lessons that engage all students involves helping them accentuate certain qualities. Rychly and Graves (2012) identified three main teacher qualities: the ability to take their students' perspectives, developing positive attitudes about other cultures and becoming aware of their own cultural framework, and knowing about the cultures in their classroom so that they adjust their teaching. The skills required to exemplify these qualities include understanding where their students come from and where they stand in the community, so they can prepare their educational environment, and choose proper curriculum and instructional materials (Abacioglu et al., 2020; Cooper, 2004; McAllister & Irvine, 2002; Robins et al., 2006). Teachers need to examine the beliefs of other cultures but should take time to examine their own cultural frame of reference (Grant & Asimeng-Boahene, 2006; Nieto, 2004). After considering these factors, they must demonstrate knowledge of students' cultures by choosing and implementing materials that lead to equitable access (Rychly & Graves, 2012). This can include using techniques such as math stories with diverse characters, drawn from children's literature (Tucker et al., 2010). Teacher educators must overtly give assignments and experiences that allow preservice teachers opportunities to understand the individual and community backgrounds of students in their classrooms.

Differentiation

Differentiated instruction has a basis in the work of Maslow, Vygotsky, Gardner, Sternberg, and Tomlinson (Stager, 2007). Maslow's five tier hierarchy of needs suggests that students will learn if basic needs are met (Maslow, 1987). Only then will students move to higher levels. Vygotsky (2004) was a proponent that students must be challenged to attain knowledge. The theory of multiple intelligences (Gardner, 1993) and the theory of thinking styles (Sternberg, 2002) refers to the way the individual processes information and learns in different situations. Tomlinson (2003; Tomlinson & Imbeau, 2010) examined these theorists and proposed that differentiated instruction

should be responsive teaching that adjusts content, process, product, and environment for groups in the classroom.

This instructional method can be designed to meet the needs of each individual learner in a diverse classroom. There are three fundamental beliefs that make up a successful differentiated classroom (Tomlinson, 2004). First, a student's readiness level must drive how the student will be challenged and grow academically. Second, the activities provided must interest the student. Third, the learning profile of the student must match the preferred method of learning and thinking (Goddard & Kim, 2018; Tomlinson et al., 2003; Tomlinson, 2004). Presenting the view that all aspects of the students and their culture are valued leads naturally to promoting an environment where differentiation takes many forms (Tomlinson & Imbeau, 2010). Specifically, in the area of mathematics "to help students to better understand mathematics learning, the core principles of differentiated instruction with the use of multiple teaching strategies and representations must be applied" (Lai et al., 2020, p.2).

Tomlinson and Imbeau (2010) stated, "the core of the classroom practice of differentiation is the modification of four curriculum-related elements–content, process, product, and affect–which are based on three categories of student needs and variances–readiness, interest, and learning profile" (p. 15). Content is differentiated when the teacher alters the way students acquire key content. The overall knowledge and skills should be similar for all students. The typical to excelling student might research independently or talk to experts. The student with the disability may have the teacher scaffold the material based on an individualized education plan.

Process is differentiated by altering the way a student practices content. It is in understanding how the students make sense of content and giving them alternatives that make this type of differentiation successful (Tomlinson & Imbeau, 2010). Alternative grouping and speed of work required are common ways to take the student perspective in process. Creation of this type of learning environment supports success for all students.

Product is differentiated by altering the way students are assessed. An authentic assessment where students can demonstrate what they have learned works well for students with disabilities (Meagher et al., 2018). Common differentiation for product includes multiple product choices, different worksheets or lesser amounts of problems.

Affective environment is differentiated by altering the learning environment to meet social and emotional needs (Avci et al., 2009). This means understanding not just the student perspective in general, but each child's cultural background. To be responsive to how a student feels when she shares her work aloud, or how much verbal praise she needs is also important. This type of differentiation might involve physically altering the room or allowing a student to work alone, rather than a group. To be responsive to a student's environment is a natural and necessary part of culturally responsive teaching. Being responsive leads to differentiation in the learning environment.

Research Questions

This study investigated eight elementary preservice teachers' (PTs) approaches for differentiating mathematics lessons to provide equitable opportunities to their students. Eight PTs' lesson plans and self-analysis of their own practices were analysed to investigate how they applied differentiation strategies and how those strategies responded to their students' needs. The research questions that guided this study were:

1. What differentiation strategies did PTs employ for students with mathematical learning difficulties?
2. How did the differentiation practice respond to students' academic needs and cultural backgrounds?

Methods

This qualitative study was conducted through a case study research design for a deeper understanding of research questions within a particular context (Creswell, 2007; Merriam, 2009; Stake, 1995). The study explored preservice teachers' approaches for differentiating lessons and the cultural responsiveness of the differentiated lessons. By using two data sources, lesson plans and commentary, the evidence is triangulated. This study was conducted following procedures of the Institutional Review Board (IRB) for the Protection of Human Subjects.

Context and Participants

The participants of this study were preservice teachers getting a license in early childhood education (PreK-3 United States grade level; ages 3-9). The participants attend a small midwestern university in the United States. The PTs were in placements where they taught all subjects. The criteria for selecting participants was whether they were information-rich cases (Patton, 2001), meaning if they provided enough information for the research questions. The eight preservice teachers of the study were selected because they chose mathematics as a focus subject for the university-wide assessments in both their third and fourth year of the program, which are the data sources of the study. There were 7 female and 1 male preservice teacher. Six PTs identified as Caucasians (European descent) and one identified as Southeast Asian descent. All PTs were in their early 20s.

The teacher preparation program of the study is designed to provide integrated experiences to PTs that focus on understanding students and meeting them where they are in their educational journey. These experiences include field hours over the state minimum for each level of the program, linking real life to practice during university classes and broadening lesson plans beyond a single subject (e.g., developing interdisciplinary lessons such as using quality children's literature to teach mathematics). PTs in the program were presented with research and activities that explored differentiation for any student and then more specifically what works for students with identified learning disabilities or mathematical learning difficulties. They were given opportunities in the program to write lesson plans, teach lesson plans and reflect on lesson plans. They received feedback about this process from university supervisors, cooperating classroom teachers and university instructors. For the formative assessments in the third- and fourth-year PTs were expected to gather information about their students' personal, community, and cultural backgrounds (context for learning) before developing lesson plans. Once lessons were taught, PTs engaged in analysing and reflecting on their instructional practice with written commentary concerning the effectiveness of creating an equitable classroom experience.

All PTs had at least four field placements between their first and fourth years, and at least one of those placements was an urban placement. In their third year, the majority had placements in rural settings. The majority had rural placements in the fourth year, but two had urban placements. Half of the placements were schools considered high poverty.

Data Collection

Figure 1 summarizes the data collection procedure of the study. The data comes from the university-wide assigned formative assessments in third and fourth year. Third year students completed a key assessment for the program that included developing unit lesson plans, recording themselves teaching a lesson, and reflecting on the lesson after completion. During the fourth year the students completed a comprehensive edTPA unit. edTPA is a performance-based, subject-specific assessment and support system used by teacher preparation programs (http://www.edtpa.com/PageView.aspx?f=GEN_AboutEdTPA.html) throughout the United

States to emphasize, measure and support the skills and knowledge that all teachers need from Day 1 in the classroom. In the current study, we analysed both lesson plans and reflective commentary in order to investigate their differentiation strategies and cultural responsiveness and planned practice.

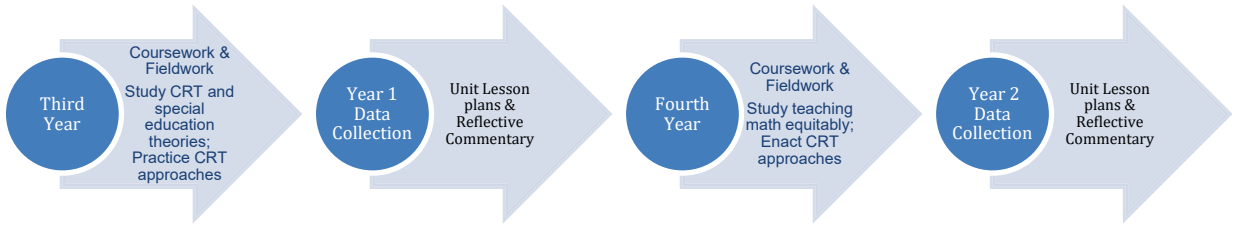

Figure 1. Data collection procedure.

Lesson plans

For both university-wide formative assessments, PTs were encouraged to use a lesson plan template that encouraged details concerning accommodations and modifications. The lesson plan included prompts along the left-hand side that included questions such as: How will you provide students with access to learning based on individual and group needs? And how will you support students with gaps in the prior knowledge that is necessary to be successful in this lesson?

PTs were then expected to respond to provided reflection prompts. The lesson plan template included items regarding students' needs and backgrounds, as well as places to state differentiation strategies, such as overtly telling the PT to state required or needed supports, accommodations, or modifications for students that will affect your instruction. They were also asked to state how they would provide access to learning based on individual and group needs. Finally, they were asked how they would address gaps in prior knowledge. Attending to the classroom context and responding to students' needs and backgrounds are essential steps for a culturally responsive teacher.

Reflective commentary

Once they completed teaching lessons planned, PTs were asked to reflect on their lesson plans and instruction. Several prompts in the reflective commentary guided PTs to revisit their classroom context and analyse how their approaches address students' needs and backgrounds. PTs were asked to discuss what they know about their students' personal, cultural, community, and developmental strengths/assets. They were asked to describe their plan for supporting specific learners' needs and justify how their plans align with their understanding of students' assets and varied learning needs.

Data Analysis

The main considerations in analysing lesson plans and reflective commentary were differentiation strategies and responsiveness of the differentiation. Table 1 summarizes data sources, focus of data analysis (categories), and codes with description. Differentiation strategies were coded based on Tomlinson and Imbeau's (2010) four elements, content, process, product, and affective support (environment). Responsiveness to cultural background was based on the

culturally responsive teaching work of Gay (2010, 2013) and the culturally relevant pedagogy work of Ladson-Billings (1994, 1995, 2001). The elements were discussed in the earlier section, Review of Literature, and a brief description for each code is stated in Table 1.

The data analysis involved exploring PTs' instructional approaches for responding to students' backgrounds. The areas were generated based on the lesson plan and reflective commentary prompts concerning students' needs and backgrounds. Students' needs and backgrounds that PTs were expected to address were, cognitive/behavioural/affective domains concerning students' learning readiness, students' cultural background, and students' community background. Based on the initial analysis, it was noted that PTs considered the needs and or backgrounds of an individual student, the whole class, or the general student population. The further specified codes are employed in the final categories and codes (Table 1). PTs' responsiveness approaches were coded in two areas, (1) how PTs' instructional approaches align with their consideration of students' backgrounds and (2) how PTs' instructional approaches were developed – did they build on their understanding of students' backgrounds?

Table 1: Categories and codes.

Focus	Categories of the Analysis	Codes and Description	Data Sources
Strategies addressing students' academic needs	*Differentiation strategies*	• Content differentiation: modifying actual curriculum • Process differentiation: modifying how the student receives information • Product differentiation: modification of assessments • Environment differentiation (Affective support): modification of classroom environment	Lesson Plans and Reflective Commentary
Approaches responding to students' cultural backgrounds	Responsive approaches	• Alignment: PTs' considering students' backgrounds guides instructional approaches • Development: PTs instructional approaches build on their understanding of students' backgrounds	Lesson Plans and Reflective Commentary

Results

The results are presented in two sections, differentiation strategies and responsiveness of the differentiation. The actual strategies that PTs used and the discussion of their strategies should state overtly how they address the needs of students. The differentiation strategy section discusses four types of differentiation, content, process, product, and environment. The responsiveness section reports PTs' approaches for responding to individual student cultural needs, community needs or a generalizable student population. Pseudonyms for student names are used when quoting directly from the PTs' work.

Differentiation Strategies

This section summarizes differentiation strategies the PTs employed in their planning and how they perceive the success of the strategies in their reflective commentary (see figure 2). Overall, the PTs were much more likely to differentiate process than the other areas. This is logical, because it is the heart of the lesson plan to describe how you will deliver content to students.

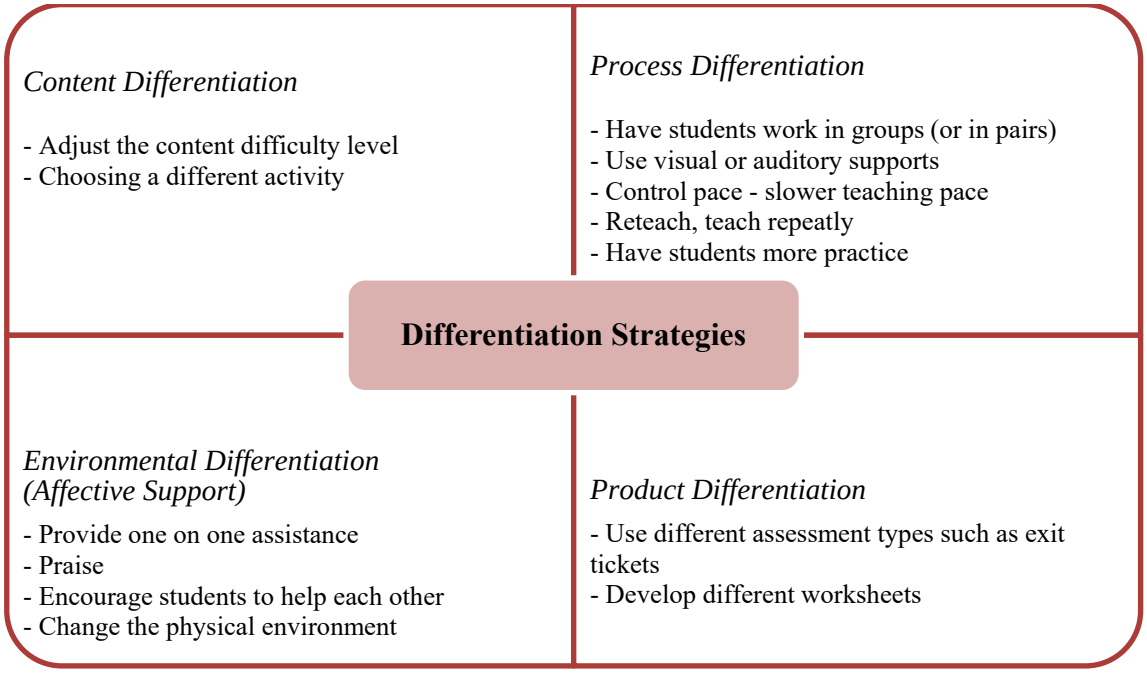

Figure 2. A summary of differentiation strategies.

Content differentiation

Half of the PTs differentiated content to address students' specific needs. This is consistent with what PTs have been taught about altering the ways students acquire content. The differentiation choices in content ranged from changing the level of difficulty in instructional materials to choosing different activities. Examples would be sorting by two colours instead of five, using smaller numbers instead of bigger number cards, or choosing 2D (two dimensional) shapes instead of 3D (three dimensional) shapes. "Students who struggle will get smaller number cards. Not all the worksheets will have the addition, subtraction, or equal sign symbols; this will depend on how well I think they understand the concepts" (Ashley, Lesson plan, Third year). Another PT, Mary, justified her plan for supporting the varied learning needs of her students,

> To support the needs of all students learning needs the strategies vary. Below level students need to identify 2 of 4 3D [three dimensional] shapes verbally and/or be given the name of the shape and asked to point to the correct visual of the shape. Addition modelling and repetition of the task may be required. On level students need to verbally produce the name of 3 of the 4 3D [three dimensional] shapes. Above level students need to verbally produce the name of all 4 3D [three dimensional] shapes.

Process differentiation

The PTs employed far more process strategies for differentiation than any other strategy. Strategies identified as process differentiation were students working in groups (or in pairs), visual and auditorial supports, controlling pace, and reteaching with more practice. The most frequently used process differentiation strategy was the group activity approach. This coincides with the research about grouping being a frequently chosen strategy (Prast et al., 2018). Regarding her group activity plan, Kim discussed, "Each member is responsible not only for learning what is taught but also helping teammates learn, creating an atmosphere of achievement" (Kim, Reflective Commentary, Fourth year). She showed a great understanding of what process differentiation means. Other frequently used process differentiation strategies took into account student learning preferences, "Students who are below level can perform this same task using hands on cubes to determine if it is a set of 6 or not a set of 6" (Mary, Lesson Plan, Third year year).

Most PTs showed growth from their third year to fourth year. In her third year Carla noted only providing more practice time to address learner needs but by fourth year she articulated, "provide visual examples and multiple strategies, allowing extra time for students to finish their work" (Carla, Commentary, Fourth year). Kim's plan represents the majority of the PTs' growth, demonstrating understanding of process differentiation and better articulating why they chose a particular process strategy in their commentary than in lesson plans,

> For students who are below level, they will have the opportunity to look at their books while putting in order the pictures. For students who need a greater challenge I will print out even more pictures for them to put in order and they will not be allowed to use book. …(For students who are below level, they) will begin with easy equations and will work up to more challenging ones. While students are writing the equations independently, I will walk around to help those who need it. … Students who struggle will be paired with students who are ahead on concepts that can help them. (Kim, Lesson Plan, Fourth year).

Kim's plan not only used process differentiation but also affective support to address students' needs. She was concerned about creating a supportive environment for students who are struggling with mathematics.

Product differentiation

Not all PTs discussed providing supports through product differentiation, but those that did showed understanding of product differentiation. Ashley offered students a different exit ticket assessment based on ability, "We will start out as a whole class, then they will split into their table groups, but each student will have their own bus and own worksheet. They also will each have their own exit ticket to answer as a form of assessment" (Ashley, Lesson Plan, Third year year). Even though he did not articulate product differentiation strategies in his lesson plan, Daniel discussed that he used a different worksheet for different students, "Students on IEP's [individualized education plan] and 504 Plans [section 504 of the Americans with Disabilities Act] will be given modified assessments with less questions, less answer choices and highlighted sections to help them" (Daniel, Planning Commentary, Third year). Mary had by far the most extensive ideas for product differentiation in her fourth-year lesson plans. She showed acceptable skills in formal and informal assessments and states how she will move her students into higher level thinking by encouraging discussion and questions, "Students will be able to look at other peer's 3D [three dimensional] shapes and will be encouraged to ask questions about the 3D [3 dimensional] shapes other students have created."

Environment differentiation: Affective support

Commonly used affective support took two forms: one on one assistance and changes to the physical environment. Differentiation in the area of affective support was through peer support

during small group work or structured and spontaneous instructor's (PT's) support. An example of peer support can be found in Hayden's reflective commentary "The students love helping their classmates, especially when it comes to reading, writing, and sounding out words. I will also be a support to my students and help them if they cannot receive help from their classmates" (Third year). While Hayden demonstrated a very narrow view in the third-year, "I will have to work with those more at school that don't get help at home," she showed improvement in the fourth year "I try to use manipulatives to keep their hands busy and make the lesson more hands on." She moved from a strong deficit mindset towards more of a student perspective mindset.

In summary, PTs felt their differentiation approaches were successful. For example, Kim stated her students were successful with grouping and teamwork and "This aligns with my personal pedagogy of facilitating, promoting and encouraging the success of others as a natural way of life" (Fourth year). Daniel also shows his readiness and flexibility with differentiation strategies, "If one of my teaching strategies is not working for some of the students, I am ready to present it another way with a different strategy" (Fourth year).

Responsive Approaches

This section summarizes the relationship between PTs' instructional approaches and their understanding of their students' needs and backgrounds. PTs' responsive approaches appeared in lesson plans and their justification in their reflective commentary showed three patterns: connecting instructional approaches to students' individual readiness and interests, a missing connection between what PTs noticed about students and how they used the information in lesson development and a narrow interpretation of students' cultural backgrounds. PTs' responsiveness was more evident in the commentary than actual lesson plans as they justified their approaches and how they would be culturally responsive in reflective commentary.

Responding to students' learning readiness and interests

Overall, PTs considered their students' readiness, prior knowledge and experience. However, there was a limited responsiveness to what they considered during planning. Five PTs considered both struggling and advanced students in planning their lessons. Ashley recognized differences in students' readiness and uses this to promote peer support.

> To support my students who may have misconceptions or misunderstandings of what it means to add, I will be walking around the room and checking on them and helping them. This booklet is allowed to be done as group work because it is practice for students, so I am encouraging my students to work together. I am hoping my students who understand addition slightly better than others may help to talk about it with the other students and in turn help the others to understand as well. (Ashley, Lesson Plan, Fourth year)

Carla held viewed the lesson from a student perspective. Her approaches for responding to different learner needs was through individualized support and content differentiation. She provided tips for students at lower levels and posed more questions to challenge students.

> For approaching level students, I will be walking around offering them support as we go through the worksheets. I will also be providing reminders of what strategies they can use such as drawing pictures visually and reminders of what phrases such as how many more are asking students to do. On level students will be working independently. To challenge students, I am asking questions throughout the worksheets. Which has the most votes, the least, can someone write our addition fact/subtraction fact, how do we know, etc. (Carla, Lesson Plan, Fourth year).

Most PTs focused on the general needs of the whole class versus telling specific strategies for those with identified disabilities. In her reflective commentary, Carla justified that she considered the students learning style when making her plans, specifically stating that she understands her

students' backgrounds and uses that in her plans. For example, Carla justified using food items that students are familiar with to create graphs connecting the math class with students' interests and cultural backgrounds.

Some students may remember that we voted on what our dojo goals should be, or how we should title a book we wrote together. Students have experience with collecting information at home such as when an adult asks what everyone wants for dinner or from the store. Someone may point out that we vote for the president. I have two girls who voted with a parent about what movie they wanted to see during their sleepover. These are examples of cultural backgrounds and practices of the students and informs me of their current interests. Many of the graphs I used in the unit involved food and I would hear many say phrases such as "I love donuts." or "Grapes are my favourite!" Some students have parents who are farmers and may tell me about the food they grow. (Carla, Commentary, Fourth year)

Limited responsiveness to students' backgrounds

Overall, most PTs attended to their students' community and home backgrounds in reflective commentary but showed a limited responsiveness to applying this knowledge to their lesson plans. PTs tried to gather information about the school community or students' home situation from their cooperating teachers and from state report cards, which list demographic data for each district in the state. PTs' efforts to learn about students show from Kim's reflection, "I passed out surveys to get to know my students better and bring their funds of knowledge into the classroom" (Kim, Reflective Commentary, Fourth year).

Students' home, community and cultural backgrounds information were used to justify PTs' choice of instructional materials rather than for sharing cultural experiences with other students. PTs usually used money, corn, pumpkins and discussing farming to connect their lessons to students' cultural backgrounds, which were largely rural communities. Their justification for using such instructional materials was that their students are familiar with these objects due to their community background. Ashley's reflection is an example of PTs' efforts to connect their students' rural communities to mathematics lessons.

> When it comes to the central focus, my goal is to ask questions and use what I know about my student's backgrounds to help them relate to the learning segment. The students in my class do not come from a wide variety of backgrounds. Most of the students live on a farm, near a farm, or have some type of family member that may have a farm. My school community is very family oriented and most people in the community know one another personally in some way or another. Keeping all of this in mind, I use lots of animal pictures or reference story problems about pigs or cows, etc. I have noticed that my students are very much animal lovers as well, most of them have multiple animals at home whether that being cats, dogs, bunnies, chickens, cows, sheep, etc. (Ashley, Commentary, Third year)

Meg's commentary from her third year is another example of surface level understanding of being responsive to students' cultural backgrounds. She assumed that middle class students would have experience with physically touching money.

> Most of my students come from working-class families. They have parents that are for the most part very involved in their education and help with practicing their skills at home. From my funds of knowledge survey, I found that majority of my families live outside of the city limits, which correlates because my school is a rural school. I thought this was great because the students can connect to the value of money and the difference between the different values that we talked about. (Meg, Commentary, Third year)

Meg showed somewhat improved responsiveness in her fourth year. She tried to build her lesson based on a specific student's case - collecting information and discussing the culture of the Marshall Islands.

> In this classroom the majority of our students are Caucasian. However, we do have one student who is Marshallese and three students who are multi-racial. About sixty percent of our class is from a low-income household and receive free or reduced lunches. However, the cultural background of my Marshallese student does influence holiday celebrations in our class. They do not celebrate Christmas and Easter, so we discuss his holiday traditions also. This creates a great learning experience for all students in this class. Although there are students of different races in this classroom, it does not affect their ability to work together. All my students are very accepting and seem to really enjoy working with one another. During lessons my students like to use manipulatives and dry erase marker to draw pictures. This is incorporated into many of my learning experiences in order to engage my students in the ways which they learn best. (Meg, Commentary, Fourth year)

Generalised, narrow or biased interpretation and responsiveness

Even though most PTs gathered information about their students' backgrounds, they were not able to develop meaningful lessons to address students' backgrounds. For example, two PTs, Hayden and Daniel demonstrated narrow interpretations of students' backgrounds and showed a bias toward two parent families and rural Christian homes. Hayden did evidence some growth between third year and fourth year but tried to link student focus to cultural background. In the third year, Hayden's approach for responding to students "who don't receive extra practice at home" was spending more time with them in the classroom without elaborating how she would do that in the context of teaching specific lessons.

> Those who don't receive extra practice at home, suffer in the classroom. Therefore, all students in my classroom have different strengths/assets. My plans reflect students' backgrounds through differentiation. For the students who don't get enough practice at home, I have to work with them more in the classroom so that they can learn basic skills like saying the alphabet and counting in sequence. That is what we hit really hard in my classroom because these are important for life use. (Hayden, Commentary, Third year)

Hayden's fourth year description about students and her understanding of learners was more specific and focused, which demonstrate some growth over the year. This was probably an attempt to overtly address the prompt that asked about linking student background to planning strategies. However, her focus was how to keep students engaged (keep their hands busy) rather than how specific math concepts of the lesson can be taught building on her understanding of students' backgrounds.

> A bunch of my students are involved in sports which are very popular extracurricular activities and tends to hold most of their interest. Many attend church and practice Christianity. None of my students come from Spanish speaking families. … Young students tend to lose focus quickly. It is key to keep them engaged and entertained during their learning experiences. At this age and time in their development, they love to play or at least like to keep their hands busy. If the lesson isn't engaging and keeping them active, they tend to fidget with items in their desks. In my planning, especially in the beginning of procedures, I try to use manipulatives to keep their hands busy and make the lesson more hands on to better their understanding. (Hayden, Commentary, Fourth year)

Another PT, Daniel equates very few cultural differences and a rural community with average to above average developmental ability. While his interpretation of rural community equalling support from dedicated parents was evident in his third year and fourth year years, his instructional approaches for responding to students' backgrounds did not change. A change we did note from Daniel was that he was better able to articulate why he believes this culture contributes to his classroom in a positive way.

> I know from papers that were sent in at the beginning of the year that all of my students come from a Christian background in a rural community. They know each other from church and community activities based upon conversations I have overheard from students. Community support is very

> strong. There are several volunteers that come in and work with students needing extra help. Based upon the activities that the students sign up for, I can say that my students have similar interests. There are several after school programs that kids participate in such as soccer, basketball, football, cheerleading, and volleyball camps. They also have clubs for robotics, Legos, and destination imagination. Parents of my students have been very good at having their children complete and return homework and reinforce any behaviour issues that occur at school at home. (Daniel, Commentary, Fourth year)

This tells the researchers that while Daniel improved his ability to state where culture fits into his classroom his view of home culture is narrow and based on his own background equalling the most supportive background for students.

Mary made links to the community in her fourth-year planning commentary. While she did not consider the needs of specific students with disabilities, she was attempting to engage the class by bringing in their culture. She justified using corn to connect to students' community background (rural area) as helping to engage students in the lesson. The farming of corn is common in the Midwest portion of the United States, so students living on farms would understand its use in their daily lives.

> I also choose to use corn as my manipulatives because my students live in a small rural community where farming is happening all around them. The use of the corn for my lesson brought up great conversation about farming and their own real-world experiences. (Mary, Commentary, Fourth year)

Even though all PTs addressed the surrounding community, they did not demonstrate a deep understanding of how to respond to students' cultural backgrounds. It shows that they were responding to the prompts and the university class discussions about considering students' community background in planning lessons. Responsiveness to culture can be challenging to articulate in lesson plans. PTs are more focused on the process of facilitating a lesson and less on the back story of their production.

Discussion

The study focused on investigating preservice teachers' differentiation strategies and the responsiveness of the differentiation strategies. The ultimate goal of this study was to look closely at what the teacher preparation program is doing well and what can be improved to prepare prospective teachers to better respond to their students' needs and backgrounds. By analysing PTs' planned lessons (lesson plans) and perceived instructional approaches (reflective commentary) over two years, we found that PTs' differentiation strategies and responsiveness to their students' needs and backgrounds have improved. However, findings indicated that PTs' consideration of the classroom context did not always lead them to apply accurate educational theories or transfer this to lesson plans. We also noticed some disconnects in PTs' understanding of their classroom context, planning lessons, and reflecting on their teaching practice. It is important to note that while we feel we can generalize findings to our program and others our participant number was low due to the strict criteria we applied to choosing participants.

Need for Balanced Differentiation Strategies

When we look at the eight PTs' cases through the theory of Tomlinson and Imbeau (2010), there were some commonalities. Even though there was evidence of addressing specific needs of students with disabilities, PTs' differentiation strategies showed more focus on process modification than other elements such as mathematics content, lesson product, or supportive environment. In other words, PTs paid more attention to modifying how they would teach the

lesson in general than planning for adjusting the level of mathematics content difficulties, developing differentiated mathematics tasks or assessments, or accommodating classroom environment to be more supportive.

One of most implemented differentiation strategies was utilizing group activities. Even with group activities, PTs did not elaborate on their plan for how students with special needs would be supported or encouraged to benefit from group activities. Teachers often find ability grouping one of the easiest ways to start differentiation, because they can use assessments at hand to group by ability. In this way students of similar ability are put together in subgroups so that the teacher can focus on the needs of students in that group (Prast et al., 2018). However, those skilled at differentiation understand grouping should be flexible and that lesson delivery can vary from one-on-one, to small group, to whole-group instruction. While grouping can be by ability it should also be purposeful based on interests or talents to allow students to work with numerous classmates or to focus on specific skill development. In order to support more balanced and responsive differentiation, a deeper dive into what constitutes differentiation and more overt examples of what each type looks like should be discussed with PTs. For example, during whole group work the PT should be very explicit during the instructional phase and include guided practice, motivating activities and ongoing progress monitoring (Fuchs et al., 2008).

Need for Responsive Differentiation

Regarding PTs' approaches to the classroom context, we noticed a mismatch between what is observed by PTs and how their observation was executed in the planning or reflecting of their practice. PTs paid attention to the context of their classroom and discussed information about their students' readiness and background information as part of the planning process. However, the information PTs considered did not always transfer explicitly to responding to students. Instead, PTs referenced effective mathematics teaching approaches for young learners in general. Some PTs demonstrated somewhat limited interpretations of students' needs and backgrounds, subsequently their differentiation approach served a more general population than their own students. There were also some students who still viewed cultural background from a deficit perspective. While the researchers had presented the view that multiculturalism is a benefit (Gay, 2010; Ladson-Billings, 2001), it may take longer than a year to internalize this concept.

Findings of the study suggest that we need to pay more attention to discussing how general theories should be applied to a specific classroom and school context and spend more time practicing responding to specific students' needs and backgrounds. When the teacher enacts culturally relevant math instruction effectively, students learn how to respect other perspectives and gain a deeper understanding of mathematical content (Aronson & Laughter, 2016; Fulton, 2009; Hubert, 2013). As Fulton (2009) concluded "The results of culturally responsive teaching include not only deeper learning of content, but also, an opportunity for students' to learn to value their own and each other's differing perspectives that supports the development of stronger democratic citizenship" (p. iii). In other words, students remember mathematical knowledge and find learning mathematics more meaningful, if the instruction is connected to their cultural experiences (Gutstein, 2006; Leonard, 2008).

Good instruction requires the teacher understand their students' needs and backgrounds, in addition to comprehensive knowledge of content and pedagogy. Measures of a successful teacher include increased student motivation (Bui & Fagan, 2013; Civil & Khan, 2001; Dimick, 2012; Ensign, 2003; Hill, 2012). When teachers demonstrate their understanding and respect for students' cultural and developmental backgrounds, students will engage in lessons that increase student interest in content and motivate students to capture more subject matter (Choi, 2013; Dimick, 2012; Ensign, 2003; Martell, 2013; Robbins, 2001). Understanding students' needs and backgrounds should be the first step in the lesson design process as culturally responsive

pedagogy and culturally relevant teaching has been "demonstrated repeatedly to have positive impacts on student outcomes" (Aronson & Laughter, 2016, p. 196). A successful teacher will increase student's perception of themselves as capable learners (Robbins, 2001; Souryasack & Lee, 2007) and in their confidence when taking standardized tests (Hubert, 2013), which many people equate with a quantifiable measure of student ability.

Need for Planning and Reflecting Teaching Practice Guidance

While the PTs in the study showed some improvement in differentiation and responsiveness from third year to fourth year, some issues were noted from analysing the PTs' lesson plans and reflective commentary. The PTs were more apt to discuss students' needs and backgrounds in their perceived practice (reflective commentary) than overtly in the planned practice (lesson plans). While the PTs could often articulate their differentiation strategies and their responsiveness in reflective commentary, they need more guidance in the practical recording of these strategies in their plan for practice. This is to be expected because of the reflection prompts given for commentary.

Having PTs use a more elaborate lesson plan template containing students' backgrounds and needs, as well as their plans for addressing those needs can improve preservice teachers balanced and responsive differentiation strategies. Possible activities promoting balanced and responsive differentiation include peer analyzation of lesson plans where PTs are required to code each other's plans for differentiation strategies and cultural responsiveness to students, reflection on growth in these areas between third year and fourth year and hearing from guest speakers noted for their ability to exemplify culturally responsive teaching with students with disabilities.

Conclusion

The study intended to examine if our program is equipping our PTs with the knowledge, skills and disposition needed to be a responsive teacher. Improving PTs' understanding of what it means to be culturally responsive can be accomplished but enhancing their practice to respond to students' needs and backgrounds is more challenging. We have systemically introduced elements of culturally responsive teaching and differentiation in the third year and fourth years. This is not to say that it is ignored in the first years of the program, but a concentrated effort by the researchers was undertaken in third year and fourth year. The intent was not just to introduce theory, but to provide opportunities for PTs to practice and see the connection between theory and practice. While we find the PTs in the study showed evidence of knowledge and skills related to responsive teaching and specific differentiation strategies, there is room for improvement and that informs implications for future practice. This study contributes to the field because it looks into actual implementation of theories presented in university classes. It is generally easy to reiterate the instructor's view on differentiation and culturally responsive teaching during a university course. It is much more challenging to show evidence in actual practice and reflection. It presents gaps in our program that we need to address, and this can be generalized to many teacher education programs where the dominant culture is training to become teachers. We need to continue to provide opportunities for learning to be a culturally responsive teacher who can differentiate a lesson. In addition, we should connect our discussions with research that shows the positive student outcomes and specific examples associated with differentiation and culturally responsive teaching (Aronson & Laughter, 2016; Fulton, 2009; Gutstein, 2003; Hubert, 2013; Lai, 2020).

References

Abacioglu, C. S., Volman, M., & Fischer, A. H. (2020). Teachers' multicultural attitudes and perspective taking abilities as factors in culturally responsive teaching. *British Journal of Educational Psychology, 90*(3), 736–752. https://doi.org/10.1111/bjep.12328

Aronson, B., & Laughter, J. (2016). The theory and practice of culturally relevant education: A synthesis of research across content areas. *Review of Educational Research, 86*(1), 163–206. https://doi.org/10.3102/0034654315582066

Australian Government. (2020). *Disability standards for education 2005: 2020 review*. https://www.dese.gov.au/disability-standards-education-2005/resources/final-report-2020-review-disability-standards-education-2005

Avci, S., Yüksel, A., Soyer, M., & Balikçioğlu, S. (2009). The cognitive and affective changes caused by the differentiated classroom environment designed for the subject of poetry. *Educational Sciences: Theory & Practice, 9*(3), 1069–1084.

Averill, R., Anderson, D., Easton, H., Te Maro, P., Smith, D., & Hynds, A. (2009). Culturally responsive teaching of mathematics: Three models from linked studies. *Journal for Research in Mathematics Education, 40*(2), 157-186.

Boone, J., Rawson, C., & Vance, K. (2010). Getting it right: Building a bridge to literacy for adolescent African-American males. *School Library Monthly, 27*(2), 34–37.

Bui, Y. N., & Fagan, Y. M. (2013). The effects of an integrated reading comprehension strategy: A culturally responsive teaching approach for fifth-grade students' reading comprehension. *Preventing School Failure, 57*, 59–69. https://doi.org/10.1080/1045988X.2012.664581

Choi, Y. (2013). Teaching social studies for newcomer English language learners: Toward culturally relevant pedagogy. *Multicultural Perspectives, 15*, 12–18. https://doi.org/10.1080/15210960.2013.754640.

Chu, S.-Y. (2013). Teacher efficacy beliefs toward serving culturally and linguistically diverse students in special education: Implications of a pilot study. *Education and Urban Society*, *45*(3), 385–410. https://doi.org/10.1177/0013124511409401

Civil, M., & Khan, L. H. (2001). Mathematics instruction developed from a garden theme. *Teaching Children Mathematics, 7*, 400–405. https://doi.org/10.3102/0034654315582066

Cooper, B. (2004). Empathy, interaction and caring: Teachers' roles in a constrained environment. *Pastoral Care in Education, 22*(3), 12–21. https://doi.org/10.1111/j.0264-3944.2004.00299.x

Council for Exceptional Children. (2020). Ensuring a safe and positive climate in school and community settings for children and youth with disabilities. https://exceptionalchildren.org/sites/default/files/2020-11/School%20Climate%20-%202020.pdf.

Creswell, J. W. (2007). *Qualitative Enquiry and Research Design: Choosing Among Five Approaches.* SAGE Publications.

Dimick, A. S. (2012). Students' empowerment in an environmental science classroom: Toward a framework for social justice science education. *Science Education, 96*, 990–1012. https://doi.org/10.1002/sce.21035

Dover, A. G. (2013). Teaching for social justice: From conceptual frameworks to classroom practices. *Multicultural Perspectives, 15*, 3–11. https://doi.org/10.1080/15210960.2013.

Driver, M. K., & Powell, S. R. (2017). Culturally and linguistically responsive schema intervention. *Learning Disability Quarterly, 40*(1), 41–53. https://doi.org/10.1177/0731948716646730.

Dysarz, K., & Education Trust. (2018). *Checking in: Are math assignments measuring up? Equity in motion.* Education Trust. https://edtrust.org/resource/checking-in-are-math-assignments-measuring-up/

Ensign, J. (2003). Including culturally relevant math in an urban school. *Educational Studies, 34,* 414–423.

Fuchs, L. S., Fuchs, D., Powell, S. R., Seethaler, P. M., Cirino, P. T., & Fletcher, J. M. (2008). Intensive intervention for students with mathematics disabilities: Seven principles of effective practice. *Learning Disability Quarterly, 31*(2), 79–92.

Fulton, R. (2009). A case study of culturally responsive teaching in middle school mathematics (Doctoral dissertation). Available from Proquest Dissertations and Theses Database. (UMI No. 3372472)

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. Basic Books.

Gay, G. (2010). Acting on beliefs in teacher education for cultural diversity. *Journal of Teacher Education, 6*(1-2), 143-152. https://doi.org/10.1177/0022487109347320

Gay, G. (2013). Teaching to and through cultural diversity. *Curriculum Inquiry, 43*(1), 48-68. https://doi.org/10.1111/curi.12002

Goddard, Y. L., & Minjung Kim. (2018). Examining connections between teacher perceptions of collaboration, differentiated instruction, and teacher efficacy. *Teachers College Record, 120*(1), 90–103.

Gonzalez, N., Moll, L. & Amanti, C. (2006). *Funds of knowledge: Theorizing practices in households, communities, and classrooms*. Taylor and Francis.

Grant, R. A., & Asimeng-Boahene, L. (2006). Culturally responsive pedagogy in citizenship education: Using African proverbs as tools for teaching in urban schools. *Multicultural Perspectives, 8*(4), 17–24. https://doi.org/10.1207/s15327892mcp0804_4.

Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education, 34*, 37–73.

Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. Routledge.

Hackenberg, A. (2005). A model of mathematics classroom and caring relations. *For the Learning of Mathematics, 25*(1), 45.

Hill, A. L. (2012). Culturally responsive teaching: An investigation of effective practices for African American learners (Doctoral dissertation). Available from Proquest Dissertations and Theses Database. (UMI No. 3549438).

Holocker, A. Y. (2010). A mixed methods study of culturally responsive teaching in science and math classrooms [ProQuest LLC]. In ProQuest LLC.

Hubert, T. L. (2013). Learners of mathematics: High school students' perspectives of culturally relevant mathematics pedagogy. *Journal of African American Studies, 18*, 324–336. https://doi.org/10.1007/s12111-013-9273-2

Ladson-Billings, G. (1994). *The dream keepers: Successful teachers of African American Children*. Jossey-Bass.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465 -491.

Ladson-Billings, G. (2001). *Crossing over to Canaan: The journey of new teachers in diverse classrooms*. Jossey-Bass.

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 & Personality: An International Journal, 48*(6), 1–13. https://doi.org/10.2224/sbp.9094

Lapeniene, D., & Dumciene, A. (2014). Teachers' creativity: Different approaches and similar results. *Procedia Social and Behavioral Sciences, 116*, 279-284. https://doi.org/10.1016/j.sbspro.2014.01.208

Leonard, J. (2008). C*ulturally specific pedagogy in the mathematics classroom: Strategies for teachers and students*. Routledge.

Limniou, M., Schermbrucker, I., & Lyons, M. (2018). Traditional and flipped classroom approaches delivered by two different teachers: The student perspective. *Education and Information Technologies, 23*(2), 797–817. https://doi.org/10.1007/s10639-017-9636-8

Martell, C. C. (2013). Race and histories: Examining culturally relevant teaching in the U.S. history classroom. *Theory & Research in Social Education, 41*, 65–88.

Maslow, A. H. (1987). *Motivation and personality (3rd ed.)*. Pearson Education. https://doi.org/10.1080/00933104.2013.755745

McAllister, G., & Irvine, J. J. (2002). The role of empathy in teaching culturally diverse students: A qualitative study of teachers' beliefs. *Journal of Teacher Education, 53,* 433–443. https://doi.org/10.1177/002248702237397

Meagher, M. S., Edwards, M. T., & Ozgun-Koca, A. (2018). Pre-Service teacher design of activities through collaboration and authentic enactment. *Psychology of Mathematics & Education of North America*, 775–778.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation* (2nd ed.). Jossey-Bass.

Moschkovich, J. (2013). Principles and guidelines for equitable mathematics teaching practices and materials for English language learners. *Journal of Urban Mathematics Education*, *6*(1), 45–57.

National Center for Education Statistics. (2020). *Characteristics of public-school teachers*. https://nces.ed.gov/programs/coe/indicator_clr.asp#:~:text=In%202017%E2%80%9318%2C%20about%2079,1%20percent%20of%20public%20school.

National Council of Teachers of Mathematics. (2014). *Teaching mathematics to English language learners: A position of the National Council of Teachers of Mathematics*. https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/English%20Language%20Learners2.pdf

National Council of Teachers of Mathematics. (2017). *Mission statement*. https://www.nctm.org/about/.
Nieto, S. M. (2004). *Affirming diversity: The sociopolitical context of multicultural education*. Pearson Allyn & Bacon.
Pak, K., Polikoff, M. S., Desimone, L. M., & Saldívar García, E. (2020). The adaptive challenges of curriculum implementation: Insights for educational leaders driving standards-based reform. *AERA Open*, *6*(2). https://doi.org/10.1177/2332858420932828
Patton, M. (2002). *Qualitative research and evaluation methods (3rd ed.*). SAGE Publications.
Prast, E. J., Van de Weijer-Bergsma, E., Kroesbergen, E. H., & Van Luit, J. E. H. (2018). Differentiated instruction in primary mathematics: Effects of teacher professional development on student achievement. *Learning & Instruction, 54*, 22–34. https://doi.org/10.1016/j.learninstruc.2018.01.009
Rajagopai, K. (2011). *Create success! Unlocking the potential of urban students*. ASCD. http://www.ascd.org/publications/books/111022/chapters/Culturally-Responsive-Instruction.aspx
Robbins, C. (2001). "Por que soy tonto?" Exposing "invisible" interactions in a(n) multiracial (American) classroom. *Radical Teacher, 60,* 22–26.
Robins, K. N., Lindsey, R., Lindsey, D., & Terrell, R. (2006). *Culturally proficient instruction: A guide for people who teach* (2nd ed.). Corwin Press
Rychly, L., & Graves, E. (2012). Teacher characteristics for culturally responsive pedagogy. *Multicultural Perspectives, 14*(1), 44–49. https://doi.org/10.1080/15210960.2012.646853
Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic? *Journal of Educational Psychology, 100*(4), 765–781. https://doi.org/10.1037/a0012840
Souryasack, R., & Lee, J. L. (2007). Drawing on students' experiences, cultures, and languages to develop English language writing: Perspectives from these Lao heritage middle school students. *Heritage Language Journal, 5*, 79–97.
Stager, A. (2007). *Differentiated Instruction in Mathematics*. (Master's thesis). Available from Proquest Dissertations and Theses Database. (UMI No. 1443733)
Stake, R. E. (1995). *The art of case study research*. SAGE Publications.
Sternberg, R. (2002). Raising the achievement of all students: Teaching for successful intelligence. *Educational Psychology Review,14*(4), 383-393. https://doi.org/10.1023/A:1020601027773
Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. *Journal for the Education of the Gifted*, *27*(2–3), 119–145.
Tomlinson, C. A. (2004). Sharing responsibility for differentiating instruction. *Roeper Review*, *26*(4), 188.
Tomlinson, C. A., & Imbeau, M. B. (2010). *Leading and managing a differentiated classroom.* ASCD.
Tucker, C., Boggan, M., & Harper, S. (2010). Using children's literature to teach measurement. *Reading Improvement, 47*(3), 154–161.
U.S. Department of Education, National Center for Education Statistics, Common Core of Data . (2020). *State Nonfiscal Survey of Public Elementary and Secondary Education, 1995–96 through 2017–18; and National Elementary and Secondary Enrollment by Race/Ethnicity Projection Model, 1972 through 2029.* https://nces.ed.gov/fastfacts/display.asp?id=372#PK12_enrollment
Vygotsky, L (2004). Imagination and creativity in childhood, *Journal of Russian & East European Psychology*, 42:1, 7-97. https://doi.org/10.1080/10610405.2004.11059210.
Wlodkowski, R. J., & Ginsberg, M. B. (1995). A framework for culturally responsive teaching. *Educational Leadership, 53*(1), 17 – 21.

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