

Embracing Curriculum Compacting: Teacher Candidates Supporting Differentiated Instruction in Elementary Mathematics

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ABSTRACT: This article discusses a collaborative effort to implement curriculum compacting activities with elementary students in conjunction with developing teacher candidates' abilities to teach mathematics. This endeavor included a partnership between a university and a local elementary school. All stakeholders benefited from this project: The elementary students received differentiated instruction; the teacher candidates learned from teaching high performing students, which is not the norm of their field placements; and the school-university partnership was strengthened. This article describes the development of the partnership, the benefit of the experience for teacher candidates, and the impact on student learning.

NAPDS Nine Essentials addressed: 1. A comprehensive mission that is broader in its outreach and scope than the mission of any partner and that furthers the education profession and its responsibility to advance equity within schools and, by potential extension, the broader community; 2. A school-university culture committed to the preparation of future educators that embraces their active engagement in the school community; 4. A shared commitment to innovative and reflective practice by all participants; 8. Work by college/university faculty and P-12 faculty in formal roles across institutional settings; and

To meet the challenges of classrooms composed of diverse learners and to address the content of The Common Core Standards for Mathematics (CCSSI, 2010) differentiated instruction is a necessity for effective instructional practice. This is especially true for gifted students who are often overlooked with the often laser focus on struggling students (Winebrenner, 2000). According to the National Council of Teachers of Mathematics' vision statement, "students with special interests or exceptional talent in mathematics may need enrichment programs or additional resources to keep them challenged and engaged. The talent and interest of these students must be nurtured so that they have the opportunity and guidance to excel in mathematics (2000, p.13)." This is part of NCTM's commitment to equity and high-quality mathematics instruction. But, differentiated instruction can be a daunting instructional task (Dee, 2011; Martin, 2013; Tomlinson, 1995) especially for teacher candidates.

Effective differentiation involves using both formative and summative assessment data to drive the groupings, tasks, and content for a unit of study (Winebrenner, 2000). Pre-assessments of unit content should be administered to determine students' skills, prior knowledge, and needed areas for growth. The data collection component is foundational and guides the teacher in

determining what type of differentiated instruction is needed. One option is curriculum compacting.

Curriculum compacting is an acceleration practice that bypasses content that students have previously mastered and provides them with the more complex standards and faster pace that matches these students' knowledge and abilities (Reis & Westberg, 1994). Curriculum compacting also maximizes teachers' instructional time and respects the prior knowledge of students by creating an optimal learning environment for enriching and accelerating curriculum (Reis, Burns, & Renzulli, 1992).

Teachers recognize the value of pre-assessing their students prior to a unit of study. However, challenges often arise with managing the diverse range of levels that the pre-assessments reveal. Some teachers are resistant to providing different instruction for the students who have mastered the desired content because some teachers have not had the appropriate professional development to provide this type of targeted instruction, and some teachers believe it is not necessary to focus on an expanded view of the curriculum (Winebrenner, 2000). Some of these teachers may believe that these proficient students have met the standards so now that provides them with the time to work with those less proficient. Other difficulties arise in implementing curriculum compacting. Management of

the diverse grouping is frequently cited as a reason for not trying curriculum compacting. Teachers are unsure how to manage those who have mastered the target content and are ready to go deeper within a given mathematics strand in the same classroom space as students who are at or below grade level. Teachers find themselves asking, “How do I do this?”

When teachers know a collection of strategies for curriculum compacting, their options multiply and they have ample resources to assist in planning. Instead of asking “How do I compact?” the question becomes “Who needs to compact?” When using curriculum compacting, it is optimal to collaborate with colleagues to aid in the planning and implementation of this type of differentiated instruction.

Service Learning Partnership

Here we describe a model of a partnership between the local university and a Title I elementary school to provide curriculum compacting by using teacher candidates enrolled in an elementary mathematics methods course. Teacher candidates are selected based on their class performance and volunteer their time to curriculum compact in third and fourth grade classrooms. This volunteer time is in addition to their field placement hours required by their elementary education teacher preparation program. The teacher candidates meet with the school’s gifted and talented coordinator and collaborate with their elementary mathematics methods instructor in preparation for working with students who have successfully passed the pre-assessments with a score of 90% or higher.

Teacher candidates provide student compactors with unique learning experiences that increase the complexity of the mathematics content, accelerate the pace of learning and focus on higher order thinking skills. The students participating in curriculum compacting are a fluid group, meaning that the group members change from one mathematics topic to the next depending on students’ scores on the pre-assessment. Sometimes the compacting group may be large with 10 to 15 students, or small, with 3 to 4 students. Teacher candidates must create high-level activities for these very proficient student compactors, a task that is not often addressed in initial teacher preparation.

Theoretical Framework

The theoretical framework for the project falls under the umbrella of phenomenology and community inquiry. Specifically, the “lived experience” of teacher candidates is the focus of this project in conjunction with community inquiry. “Community inquiry research focuses on people participating with others, on the lived experiences of feeling, thinking, acting, and communicating” (Bruce & Bishop, 2008, p. 703). The inclusion of community inquiry as a focus may appear to be a radical connection as it usually seen as part of the new literacies field. The argument here is there is a literacy of learning and teaching of mathematics, meaning literacy is the competence or knowledge in the field of mathematics.

This project zeroes in on two of the three themes of community inquiry: learning and lived experience and community (Bruce & Bishop, 2008). For the purposes of this work, the third theme of technology was omitted. By focusing on community inquiry, the project allowed the teacher candidates to authentically experience work with gifted and high performing students.

Through inquiry, people recognize a problem, mobilize resources, engage actively to resolve it, collaborate, and reflect on the experience. Making sense of the “lived” experience in this way, and doing so in concert with others in embodied, historical circumstances, is fundamental to learning. (Bruce & Bishop, 2008, p. 703).

Methods

The nature of the project required a qualitative approach to evaluate the “lived experiences” of the two teacher candidates. The teacher candidates kept field notes about their planning process and teaching implementation. Upon review of these notes, the teacher candidates approved the write-up and analysis of their experience. Practice was used to ensure the integrity of a phenomenology study. Using the participants’ own descriptions, words, and feelings is how Husserl (1913) described phenomenology. This study was designed in a non-invasive way for the teacher candidates; teacher candidates volunteering for the project were not burdened in time-consuming data collection. The data were derived directly from each of them with a “focus on meaning making as the essence of human experience” (Patton, 2002, p. 106). This methodology does have some limitations, including purposeful sampling and lack of triangulation. Due to the elementary setting, we did not want to interfere or influence the elementary students or the teachers. The focus was the development of the teacher candidates through their experience with proving curriculum compacting to gifted or high performing elementary students.

Participants and Setting

The participants for the project were two teacher candidate volunteers who were enrolled in Elementary Mathematics Methods. One male and one female volunteered in what was their first semester of their teacher preparation program. The project required the use of volunteers as these service hours were outside the required field hours from their program and took place at an elementary school different from their assigned field placement school.

The setting is a local elementary school that is a magnet school for high performing students in the city school system. Students from each of the system’s elementary schools are invited to apply to the magnet school and the top 7% are selected. The school does not have a specific content focus, but a general magnet for the top students in the district. At the time of

Table 1. Student Population

<i>Student Diversity</i>	<i>Percentage</i>
African American	49%
Caucasian	45%
Asian/ Asian Pacific Islander	3%
Hispanic	2%

the project, the magnet school was also working toward becoming an International Baccalaureate school; they since have obtained status. The school serves first through fifth grade and has approximately 300 students and 17 teachers. This results in a 19:1 student to teacher ratio. The school is a Title I school with a diverse student population as seen in Table 1 with approximately 36% receiving free/reduced lunch.

The Curriculum Compacting Process

The classroom teachers in the third and fourth grade gave common grade level pre-assessments for the upcoming mathematics unit of study. Students who displayed mastery of the content were identified by a score of 90% or higher. The gifted and talented coordinator then prepped and supported the teacher candidates in planning for the curriculum compacting for the two groups of students. The teacher candidates then met with their group of compactors once a week for the duration of the unit of study. At the end of unit, a pre-assessment was given for the next mathematics unit and new curriculum compactors were identified.

Results: Teacher Candidates' Lived Experience

Teacher Candidate One

This candidate provided a reflection that included his feeling of surprise about working with high performing students.

The environment was much different than anything I had been exposed to during my regular interning. I was given around ten students (the number varied week to week) and told "These students have already received A's on the material they are about to learn; teach them something they don't yet know." I gradually came to understand that there was more to my job than just this. I was a math salesman, teaching the students how useful, interesting, and fun math can be in the hopes that they would continue investing their talents in it. My goal every week was to force the students to think about math and numbers in a way they hadn't before and to have them to gain a greater appreciation for math as a result.

He also documented the types of activities that he planned for his students.

I taught them how to multiply and divide with decimals and also gave them a lesson on probability and its usefulness. I gave them countless brainteasers and number problems, including a mathematical mind reading trick that a professor had taught me which the students later replicated that afternoon for the rest of their classmates. I tried to keep the environment fun and competitive – we oftentimes played games that required students to perform operations quickly and accurately.

Last, he reflected about the students' responses to working in a curriculum compacting setting. He shared, "The students greatly embraced the competitive atmosphere quickly and came to enjoy the weekly sessions with me, because it represented such a change of pace from the regular classroom."

His concluding thoughts:

Not only did I learn a lot from this experience, but also I believe I made an impact for the students and teachers at this school. The students not only got more exposure to thinking mathematically, but they also were able to grow in appreciation for a subject that I love. The teachers too benefitted, because they didn't need to over-extend themselves in order to find challenging new things for the gifted students in the classroom. And in doing so, I got even more experience as a teaching candidate, which I believe will help me to be a better, more prepared teacher when I am given my own classroom in the future. Volunteering my time in this way was an entirely positive experience for me, and I would recommend it to anyone in my position.

Teacher Candidate Two

Candidate two approached the opportunity with a focus on intentional planning. She met and planned with her mathematics methods instructor throughout the process, asking questions, obtaining resources, and clarifying her role in curriculum compacting. She wrote detailed lesson plans for each session with the compactors who had compacted out of the geometry unit. She reflected on her objective for teaching by saying, "The goal of the lessons was to get students introduced to the setting and the expectations of the compacting. This was the first time the third-grade compactors worked with someone unfamiliar." She extended the third-grade geometry with the students by applying it to the students' world. The teacher candidate shared the following reflection:

As a prospective teacher this experience taught me how to reach the needs of exceptional learners. Teaching through a math task, the students in this group each took on their math tasks in their own ways. It allowed



- The original shape is a rectangle (a door). Everyone uses a door. Even dogs use doors to go outside. I think the door as a rectangle can be a good door because it can hold a lot of things, it can be cut easily, and it has a lot of space for you to go through it. It can also be easier to measure it.
- I think a triangle should be a door because the top of the regular door can take up space that doesn't have to be used because the top of your head is not as big as your body and it will cost less money to try to buy it.

Figure 1. Student Work Sample

room for students to go above and beyond their required piece without feeling defeated or bored.

She also noted the impact on her teaching practice.

This experience influenced me to use similar practices in my own field placement classroom. Students have a weekly math task that they can demonstrate in a variety of ways. It has also influenced my teaching by leaving questioning and problems with open ends. I have been surprised by the way my students reason and reflect on their answers.

Key questions that she posed to students to expand their thinking include: Can you defend your answer? What do you know about these properties? Can you prove it? Can you create a viable alternative?

Teacher Candidates' Planned Activities

The teacher candidates met weekly with their mathematics methods instructor and the gifted and talented coordinator at the elementary school. The methods instructor provided mathematics planning support and the gifted coordinator provided school support including grade level standards and the mastered mathematics content. The gifted and talented coordinator assisted in introducing the teacher candidates to the teachers and school faculty, proofed their lesson plans, and obtained the necessary supplies for the teacher candidates' sessions. A sampling of the activities that the teacher candidates planned and implemented with their students is discussed here.

Some of the activities included a new spin on a geometry scavenger hunt. Students went on an excursion around the school to spot particular 2 D shapes and describe their function. They were to then defend why that shape was used for that function or design and suggest a shape that might work better. The final task was for students to defend a new shape that would be better in the design. The description for the activity given to students follows:

Activity. Act in the role of an engineer and explore the school looking at the function of various items. Recognize two and three-dimensional shapes in these items and draw them. Write how the shape was used and the function of the shape. Step 2: Now change the shape into a different one. Draw the new item. Write about its original purpose and how and why you would change it to this new shape. Student work is provided in Figures 1 and 2.

The third graders also worked with “pentonimoes” within a game setting; many know “pentonimoes” as a Tetris game (See Figure 3). A pentomino is plane geometric figure formed by joining five equal squares edge to edge. Other activities included brainteasers, challenges, and appropriate competitions. One competition was designed to increase the automaticity of common calculations. Besides providing challenging, meaningful mathematics tasks, the teacher candidates wanted to instill a love of and a passion for mathematics.

Benefits of Service Learning Collaboration

The partnership benefits all stakeholders. The teachers are provided with human resources to assist them with effective differentiation and are validated with community support from the local university. Collaboration helps in educating school faculty about curriculum compacting and maximizes instructional

The original shape of a volleyball net was a big rectangle with a tessellation of squares inside it. It is used to play volleyball. I think the volleyball net is that way because that way the volleyball will not go through the net when they are playing, but still see each other while they are playing the game of volleyball. The size of the volley ball is so big to my idea because that way where ever the ball hits there is still something to block it. The new shape I made is a circular net with triangles and rectangles to seal the rest of the parts. The net has circles on the outside then it has triangles on the inside. Who would use it you ask? Well..... us humans of course we play lots of games (including volleyball).I would use circles on the outside so that way if the ball hits it will go through to the other side. I would use triangles in the middle because they are stronger and if the ball hits it will just bounce back.



Figure 2. Student Work Sample

time and resources. Curriculum compacting allows teachers to focus on a smaller group of struggling students and those on grade level. The school's gifted coordinator at the school stated:

My goal in implementing curriculum compacting was to equip and empower teachers to be effective managers of student learning and to enjoy the process. After reviewing the content standards, I decided to confine our initial efforts with compacting to mathe-

matics. I knew the biggest obstacle for classroom teachers would be the difficulty managing students who have mastered the objectives with those who were struggling. Because teachers were already aware of the wide range of mathematic abilities, they were open to strategies to assist in differentiation.

The gifted coordinator had previously provided professional development on the power of using pre-assessments and

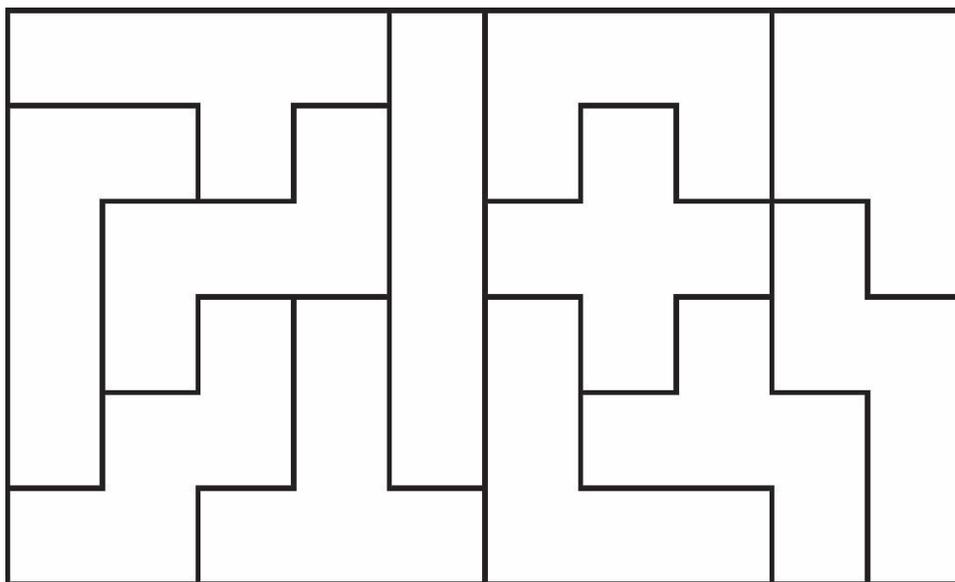


Figure 3. Pentominoes Pieces

differentiated instruction to the teachers, including compacting. For the first year, the faculty provided the compacting instruction. The next year they reached out to find mathematics mentors for the elementary students. Using undergraduate teacher candidates as math mentors took place in year three. The gifted and talented coordinator described the curriculum compacting's impact below:

Curriculum compacting has had a positive effect on our students and has become an integral part of our enrichment program. Our teachers have shared their enthusiasm for compacting and this influenced other schools in the district to use this strategy. Our students' math scores are in the top 10 of schools in our state, but most importantly students' attitudes toward math learning is enthusiastic!

This school has become a model for other schools on the use of curriculum compacting as part of effective mathematics instruction. Several of the school's teachers serve as mathematics trainers for other schools in the district and throughout the state as part of a statewide initiative in effective mathematics instruction. They present workshops on best practices in mathematics instruction and teachers statewide make visits to the school to observe the effective strategies. Due to feedback received from teacher reflections from the professional development, the state initiative has added curriculum compacting to their state training presentations. Now these teachers are introducing curriculum compacting and the use of mathematics mentors within their professional development sessions in addition to the state's training endeavors.

The university-school partnership is strengthened as a result of the mutual support and the resulting effect on student achievement. The teacher candidates are given an opportunity that is typically not provided within the normal experiences of their teacher preparation program and therefore exposes them to the benefits of differentiated instruction and formative assessment. Curriculum compacting provided a unique opportunity for teacher candidates to work with gifted students versus the more common circumstance of supporting struggling students. These teacher candidates received specialized preparation in the teaching of learning mathematics with a focus on differentiated instruction.

The coordinator described the most important benefit is the impact on the gifted students' learning:

The implementation of curriculum compacting has created a challenging learning environment for our students that allows them to expand learning beyond the confines of grade level curriculum. It creates opportunities for enrichment, acceleration, and an increase in the complexity of content, creativity, and original products. Curriculum compacting also provides time for classroom teachers to give focused instruction to smaller groups of students who may need

extra help. This enhances remediation for those students and helps to close achievement gaps.

The elementary students who compacted out of normal instruction experienced challenging materials, work on a level commensurate with their aptitude, and advance their love of math by pursuing engaging activities provided by the teacher candidates. Differentiated instruction helps prevent students from becoming underachievers, a pitfall encountered by many gifted and talented students when faced with content that is below their academic threshold. The gifted students are celebrated as they participate in curriculum compacting; their time, knowledge, and abilities are respected and applied.

Discussion and Implications

Differentiated instruction is challenging to implement, especially with the numerous demands that teachers are experiencing with high stakes accountability. Teachers need assistance and collaboration from partners. By using the university teacher preparation program as a resource and ally in the education of the students, opportunities for all participants are advanced. The teachers are supported, the elementary students are respected, and the teacher candidates are given a rare opportunity to work with high achieving students. The gifted and talented coordinator was able to facilitate the curriculum compacting efforts effectively in collaboration with the local university.

This project and the voices of the participants clearly point to the power of collaborative efforts of teacher preparation and local schools. For one, the project demonstrates the benefits and need for engaging curriculum at the appropriate level for elementary students who exhibit a mastery of grade level content. "It is vitally important that gifted, talented, and creative students...work with curriculum that is challenging and concepts that are enduring (Tieso, 2005, p. 82)." There are appropriate times where gifted, talented, and high performing students get to work together (Kulik & Kulik, 1990; Rogers, 2002; Slavin, 1987) on challenging tasks. The key to the project was providing the teacher candidates with an opportunity to work with students who were above grade level.

The curriculum compacting project provided an invaluable experience for the teacher candidates, as it was outside the customary emphasis of remediation found in their field placements. It is difficult for teacher candidates and beginning teachers to focus on high achievers due to lack of knowledge and beliefs about using these students to support the below grade level students (Borland, 1978). So, by providing unique service projects, the preparation of teacher candidates is expanded to include instruction for high achieving students. Teacher candidates became more confident in their teaching of mathematics in their assigned placements and were more diligent in meeting the needs of gifted and high achieving students. The teacher candidates shared their service project with their mentor teachers, thus planting the seeds for curriculum compacting.

Despite the limitations, the project proved to benefit all involved. Additional research on the impact of collaborative partners providing differentiated instruction is needed as the mathematics teaching becomes more rigorous. A mixed methods examination would strengthen the findings by providing triangulation of the data.

Concluding Remarks

The two teacher candidates benefited from this collaborative service learning opportunity. They were able to increase their positive beliefs about teaching mathematics, develop a community partnership between the university and the local school, and increase their strategies for teaching mathematics to all learners. This project involved a comprehensive learning experience for the community involved, which consisted of the teacher candidates, elementary students, and the school and university faculty. The benefits have also expanded outside the collaboration to other teachers, schools, and districts through professional development that includes the pros and possibilities of curriculum compacting. ^{SUP}

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