HOW TEACHERS DESIGN CURRICULUM UNITS: A CASE STUDY OF ALGEBRA TEACHERS' INSTRUCTIONAL DECISION-MAKING PROCESSES AND PRODUCTS

A Dissertation Submitted to the Faculty of the Graduate School University of Missouri

In Partial Fulfillment of the Requirements for the Degree

Doctor of Philosophy

by

Jaepil Han

Dr. Zandra de Araujo, Dissertation Co-Advisor

Dr. Samuel Otten, Dissertation Co-Advisor

JULY 2022

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

HOW TEACHERS DESIGN CURRICULUM UNITS: A CASE STUDY OF ALGEBRA TEACHERS' INSTRUCTIONAL DECISION-MAKING PROCESSES AND PRODUCTS

presented by Jaepil Han, a candidate for the degree of doctor of philosophy, and hereby certify that, in their opinion, it is worthy of acceptance.

_____
Dr. Zandra de Araujo, Committee Co-Chair

_____
Dr. Samuel Otten, Committee Co-Chair

_____
Dr. John Lannin, Committee Member

_____
Dr. Petros Valettas, Committee Member

_____
Dr. James Tarr, Committee Member

_____
Dr. Leslie Dietiker, Committee Member

ACKNOWLEDGEMENTS

I want to thank all the individuals who supported my academic journey in mathematics education at Mizzou. First, I want to thank my two advisors—Dr. Zandra de Araujo and Dr. Samuel Otten—for your endless support and everything you have done for me to complete my Ph.D. program. Zandra, I appreciate that you have been a great advisor who pushed me to the limit and made me think like a researcher! Sam, thank you for your support throughout the program and for agreeing to serve as a co-advisor. Without you two, I would not have been able to complete this degree. I appreciate that you gave me this opportunity to join and work with the outstanding faculty and students in the mathematics education program at Mizzou.

I also want to think the other members of my committee, Dr. James Tarr, Dr. Leslie Dietiker, Dr. Petros Valettas, and Dr. John Lannin, for your insightful feedback. Thank you, Dr. Tarr, for your encouragement and suggestions for curriculum research, and Dr. Dietiker, for your time as I kept focusing on my interests in curriculum coherence and sequencing. Thank you, Dr. Valettas, for your insight as a mathematician, and Dr. Lannin, for your acceptance of being a sixth member of my committee and expressions of interest in my dissertation work on unit planning.

Finally, my family was critical to my success. Thank you, mom and Jaewoong, my younger brother, for always believing in me and sending me all your heart and cheers. Tae-Nyun and Jaewoong, I am so grateful that you two were my best supporters and believed in me. Min, thank you for believing in me and making my life much happier and

more delightful than before. Lastly, thank you, all of my excellent fellow doctoral students in the mathematics education program, for your friendship and constructive feedback on my thinking and work. To all of you who have been with me during this journey, I am so grateful for the unconditional love and support you all showed me as I carried out this work.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

ABSTRACT

This study examined how algebra teachers plan curriculum units when they actively design their curriculum. I used a case study (Yin, 2013) of five experienced high school mathematics teachers who came from school districts of varying sizes across the nation. More specifically, I analyzed the teachers' unit planning processes and products by applying a *participatory relationship* perspective between teacher and curriculum (Remillard, 2005). I found that the teachers' unit planning was a cyclical and ongoing process, which occurred not just before the unit began but also while the unit was underway and even after the unit ended. Curriculum units were the unit of planning for most teachers. A unit schedule was the most common element of the document that the teachers created during their unit planning. The teachers examined the importance of their unit components (e.g., concepts, problems, warm-ups, reviews) and made decisions based on not only the component's importance to students' mathematics learning but also student progress towards the desired learning goals. Interestingly, time constraints did not influence the teachers' plans on assessments but only their plans on lessons and pacing. The findings from this study urge future research efforts to specify differences within each of the seven unit planning practices and investigate the relationship between them. This study also provides a valuable framework for developing preservice and in-service teachers' pedagogical design capacities.

CHAPTER 1: INTRODUCTION

Background

Curriculum has been a central focus of many reform efforts aimed at high-quality mathematics education in the United States (Schmidt et al., 2005; Tarr et al., 2013). Many institutions and organizations in the U.S. have made continuous efforts to develop and improve mathematics curricula (Tarr et al., 2008), as evidenced by *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000) and *Common Core State Standards for Mathematics* (CCSSM; NGA, 2010). Despite these efforts toward the development of quality curricula, U.S. student mathematics performance on international achievement exams (e.g., Trends in International Mathematics and Science Study) remains below high-achieving countries (e.g., Korea, Japan, Finland). However, researchers have not found significant differences in terms of coherence, focus, and rigor between the mathematics curriculum of the United States (i.e., CCSSM) and that of high achieving countries on such international comparison exams (Schmidt & Houang, 2012). In the field of mathematics education, there is some consensus that simply developing or adopting a quality curriculum is not sufficient for assuring high-quality instruction or students' high performance (Remillard et al., 2009). Rather, effective curriculum use has been centered on improving the quality of instruction and, eventually, student performance (Taylor, 2016).

To increase the quality of mathematics instruction, what other collective efforts does the field of mathematics education need to make? One possibility is increasing the

quality of teachers' curriculum enactment. A focus on the enactment of curriculum is particularly important because a curriculum cannot be directly enacted for students. In classrooms, the curriculum runs through the teacher to the students. For effective curriculum enactment, teachers' careful and purposeful planning, resulting from interpreting and using curriculum resources, is required.

Curriculum enactment is a multifaceted process, occurring at multiple levels (Remillard & Heck, 2014). Curriculum enactment can be broken down into three parts—*what is intended* by the district/state, *what is enacted* by teachers, and *what is attained* by students (Lloyd et al., 2017). These phases relate to teachers' planning, teaching, and assessing, respectively. Planning is one of the teachers' essential roles in curriculum enactment (Roche et al., 2014), which often involves teachers' activities for preparing and designing students' learning experiences (Yinger, 1980). Teachers make numerous curriculum decisions (e.g., tasks, pedagogies, assessments) by drawing on the designated curriculum and other curriculum resources available to them. Teachers' curriculum decision-making process is called *teacher-intended curriculum*, which is teachers' interpretations and curricular decisions made to design deliberate and purposeful plans for their curriculum implementation (Remillard & Heck, 2014). Recently, the increase of open and freely-available online curriculum resources (e.g., worksheets, free online textbooks, online quizzes) and the absence of a school/district designated curriculum (i.e., official textbook) have led teachers to design a curriculum for their students by putting these curriculum resources in the form of curriculum.

Since curriculum design has been traditionally treated as curriculum developers' activities, teachers have been considered enactors of the curriculum on behalf of its

developers. However, teachers are actually *designers* of their curriculum that they plan before instruction and enact in classrooms (Ben-Peretz, 1990; Brown, 2009; Pepin et al., 2013; Remillard, 1999). Because teachers know their students, classrooms, and school better than curriculum developers, teachers make a range of curriculum decisions, such as selecting mathematical tasks or determining the content, topics, and skills to be taught to their students (Hayes, 2018; Panasuk et al., 2002). However, teachers' purposes and capacities for curriculum design differ from curriculum developers' purposes and capacities of it (Ben-Peretz, 1990). Teachers usually do not design their curriculum from scratch nor enact these pre-existing curricula as written. Rather, teachers omit some parts of the available curriculum programs and supplement the activities or lessons with ones that they created or adapted from other resources to meet their students' needs, which are often not addressed in the curriculum resources that they use (Dietiker et al., 2018; Stein & Kaufman, 2010). In this view, teachers do not just read, interpret, and use multiple curriculum programs or instructional materials but also actively design the curriculum for their students using their expertise about their students and classroom reality (Ben-Peretz, 1990; Drake & Sherin, 2009).

Teachers' planning is one of the core, high-leverage teaching practices that teachers do in everyday classroom situations (Core Practice Consortium, n.d.; National Council of Teachers of Mathematics, 2000, 2014a). Despite the complex and multi-layered nature of teachers' planning, it has traditionally been conceptualized as a goal-oriented linear process before instruction, occurring in four phases: (1) stating the objectives, (2) selecting learning tasks or activities, (3) sequencing those tasks into an appropriate order, and (4) indicating evaluation procedures. But teachers do not actually

plan this way (John, 2006; McCutcheon, 1980). Rather, teachers' planning is a more dynamic and cognizant decision-making process in order to make their instruction align with the skills and learning objectives on curriculum resources and assessments (Cohen et al., 2003; Remillard, 2005; Webel et al., 2015). Although teachers make decisions regarding their curriculum activities during and even after instruction, the aspects of teachers' planning as continuous curriculum design activities throughout their instruction have not been emphasized enough in the field of mathematics education (Sherin & Drake, 2009).

Traditionally, teachers' planning refers to activities for designing learning experiences before instruction. For this reason, teachers' planning often only means lesson planning using a mathematical task rather than planning a variety of curriculum chunks, such as lessons, units, or courses. Although planning individual lessons typically occurs after teachers have already established a larger sequence of lessons, how teachers plan curriculum units is an under-researched area in mathematics education (Roche et al., 2014; Sullivan et al., 2013). Because curriculum units are meaningful curriculum chunks, which are bounded by closely-related mathematical topics and concepts and assessed using unit tests, teachers' unit planning can be seen as planning a mini-curriculum. Due to the complex and continuous nature of teachers' planning, a careful examination of each curriculum level of teachers' planning (e.g., lesson planning, unit planning, course planning) is necessary for understanding teachers' planning as one of the essential teaching practices and supporting their development of curriculum design for their students.

Research Questions

Due to the substantial influence of curriculum to students learning (Stein et al., 2007; Tarr et al., 2013, 2008), researchers studied a variety of factors and components consisting curriculum enactment. From the curriculum intended by the district and state to the curriculum attained by students, the curriculum enactment process includes multiple components and is influenced by many factors, such as characteristics of mathematics curricula, teacher characteristics, and types of instructional materials (Pepin et al., 2013; Remillard & Bryans, 2004; Remillard & Heck, 2014; Tarr et al., 2013, 2008). Much of the prior research on mathematics curriculum focused on the content covered by a particular curriculum (e.g., Schmidt et al., 2005) or how the characteristics of one curriculum relate to student learning outcomes (e.g., Tarr, Grouws, et al., 2013; Tarr, Reys, et al., 2008).

Because algebra has been considered a gatekeeper to advanced mathematics (Moses & Cobb, 2001; Stein et al., 2011), algebra has been a central focus for improving the quality of mathematics instruction in the United Stated (National Mathematics Advisory Panel, 2008). Algebra I is one of the mathematics courses most commonly offered in high school (Banilower et al., 2018). However, preservice or in-service algebra teachers' teaching practices for teaching algebra have not been widely researched (Stein et al., 2011). In particular, teachers' planning process is an under-researched area of study because of its complexity as a teaching practice (Roche et al., 2014). Many details of teachers' planning exist in their minds and not often in a written format (Remillard & Heck, 2014). For this reason, many researchers have asked teachers to create written unit plans and examine what is on the written plans. However, as Roche et al. (2014)

highlighted, there are discrepancies between what teachers put on the written plans that they were asked to create for others and what they put on the actual plans (either mental or written) for themselves. In addition, much of the research focused on the products of such a design process (e.g., Roche et al., 2014), not the design process itself.

Although there are different levels of planning—yearly planning, term planning, unit planning, weekly planning, and daily planning (Yinger, 1980)—how teachers design larger levels of curriculum (e.g., units, quarters, courses) has been less examined in research on mathematics curriculum. U.S. teachers focus more on tasks and activities when they plan lessons and pay less attention to the connections between lessons or units compared to teachers in other countries (Stigler & Hiebert, 1999). Furthermore, much prior research on U.S. teachers' planning focused on how teachers plan smaller curriculum levels, such as activities or lessons. In particular, how teachers design curriculum units is under-researched compared to how teachers design individual lessons or how they implement the planned lessons (Roche et al., 2014). However, because planning individual lessons typically comes after teachers have already established a larger sequence of lessons, it is important to understand how teachers plan their instruction at larger curriculum levels (e.g., unit planning, yearly planning). For the purposes of this study, unit planning refers to how teachers prepare for teaching a unit, which includes reading through curriculum resources, establishing learning goals, designing learning lessons and assessments, and modifying and improving unit plans.

Teachers' processes for designing a curriculum are complex and multi-layered, which makes them hard to observe or document because the details of the process occur in teachers' minds (Panasuk et al., 2002; Remillard & Heck, 2014; Roche et al., 2014).

Examining how teachers design curriculum units provides a window into teachers' principles or processes of curriculum design for meaningful learning experiences at a larger scale. To be more specific, researchers and teacher educators need a better understanding of how teachers design curriculum units as they re-design their own curriculum to meet their students' needs. To this end, I wanted to explore *how* mathematics teachers design curriculum units and *what* they create during their unit planning processes. In other words, the purpose of this present study is to explore teachers' unit planning processes and products for their curricular decisions. This dissertation broadens the understanding of teachers' curriculum design by pursuing the following research questions:

1. When experienced algebra teachers actively design their curriculum, how do they design curriculum units?
2. How are the processes and products of teachers' unit planning similar between or different from one another? What aspects of the unit plan do teachers prioritize?

Significance

What teachers plan for their instruction directly influences students learning opportunities and learning experiences (Kim, 2018; Stein et al., 2007). Planning has been emphasized as one of the *core* or *high-leverage* practices that well-prepared beginning teachers need to be equipped with (Association of Mathematics Teacher Educators, 2017; Core Practice Consortium, n.d.; Teaching Works, n.d.). There is an agreement in the field of mathematics education that careful and purposeful planning is a starting point for effective mathematics instruction (National Council of Teachers of Mathematics, 2014b).

In particular, teachers' planning of curriculum is an important part of a teacher's practice and students' learning.

To better understand how teachers make such curriculum decisions, it is important to explore their planning processes and products. It includes an examination of both *what* teachers consider and *how* they consider each of the factors, resources, or contexts that they encounter. Due to the impact that teachers' planning has on students' opportunities to learn, several studies have examined teachers' planning of lessons and units (e.g., Kim, 2018; McCrory et al., 2016). Without a better understanding of teachers' unit planning processes, researchers and educators cannot fully picture the nature of teachers' curriculum design processes, which is one of the most important aspects of teachers' curriculum design.

This study extends the literature regarding the design of curriculum units. As the demands of design aspects of teachers' curriculum planning increase, teachers are responsible for finding and executing curriculum designs that aid their students. Understanding the processes (e.g., teaching practices, common approaches) of teachers' unit planning and the products that teachers create as a result of the unit planning processes is an important first step in providing coherent, focused, and rigorous mathematics learning experiences for students.

In 2020, the COVID-19 pandemic made curriculum design, including unit planning, more important than before as teachers and students worked remotely, and teachers' typical and usual planning processes and products changed due to the space and time restrictions of the pandemic—change of content delivery methods or change of types of tasks used for learning. My dissertation also includes whether there are any

changes in teachers' unit planning processes or products due to the interruptions of the global pandemic.

In the chapters that follow, I discuss my research in more detail. Given the study's focus on teachers' unit planning processes and products, Chapter 2 begins with an overview of the curriculum enactment process, followed by a review of research focused on teachers' planning. In Chapter 3, I provide an overview of my research methods, beginning with a recruitment process of participants. Then, after providing an overview of data sources and collection procedures, I describe my data analysis processes. In Chapter 4, I begin by detailing the teachers' unit planning processes. Then, I examine the products of their unit planning process. I close the chapter with a discussion of the aspects they prioritized in their unit plans. In Chapter 5, I discuss the main findings—the processes of unit planning, products of unit planning, and influencing factors of unit planning—along with their implications for future studies, teacher education, and K–12 schooling, and the conclusion of the study.

CHAPTER 2: LITERATURE REVIEW

In this chapter, I review relevant studies from two separate bodies of literature related to the focus of my study. First, I examine the literature related to mathematics curricula and curriculum enactment. I then review literature related to teachers' curriculum design. I seek to provide an overview of what researchers have learned about mathematics teachers' unit planning processes and products. I end the chapter with the theoretical framework I have woven together from several sources to bridge these literature bodies and answer this study's research questions.

Curriculum and Teacher-Intended Curriculum

Curriculum has been a central focus of many reform efforts aimed at high-quality mathematics education because different curricula cover different students' learning experiences (Schmidt et al., 2005; Tarr et al., 2013). Due to the increase in online curriculum resources, teachers live in an era with greater amounts of curriculum resources now than ever in the history of school mathematics. Because teachers interact with a wide variety of curriculum recourses to design students' learning experiences, I focused my study on the way teachers design curriculum to enhance students' opportunities to learn mathematics. In particular, I examined how teachers plan curriculum units when they actively design a curriculum for their students. In this section, I discuss the literature related to teachers' planning as part of the curriculum enactment process. I begin with a look at some curriculum definitions, and then I move to a discussion of different components of curriculum enactment.

Defining Curriculum

Curriculum often means all the written documents (e.g., textbooks, state standards, pacing guides) that are expected to be used by teachers for teaching (Stein et al., 2007). These documents list mathematical topics, content standards, or learning objectives for teaching specific courses or grade levels. In the field of educational research, curriculum has been defined differently researcher by researcher, depending on the purposes of the studies. Although the term *curriculum* is defined in many different ways in the literature, these definitions can be categorized into three strands: a) the content, b) classroom activities or experiences, and c) a plan for instruction (Portelli, 1987). For example, Stein et al. (2007) defined curriculum as "the substance or content of teaching and learning—the 'what' of teaching and learning" (p. 321). This definition limits the meaning of curriculum to the *content* of teaching and learning and focuses on what is to be covered in each specific course and grade level. Under this curriculum definition, the concept of curriculum often ends up listing what needs to be taught (e.g., objectives, standards) but not how these can be taught (e.g., methods, pedagogies).

Although some people think of curriculum as simply a set of learning objectives and activities, curriculum is actually made up of many elements. Furthermore, curriculum needs to be coherent and focused on important mathematics skills to challenge students and enhance their understanding of mathematics (National Council of Teachers of Mathematics, 2014). According to NCTM (2014), a curriculum specifies not only the content but also the methods for teaching and learning the content to achieve desired learning goals through the curriculum. Wiggins and McTighe (2005) also define curriculum as something beyond the content and methods of teaching and learning:

> The etymology of the word suggests this: *Curriculum* is the particular "course to be run," given a desired end point. A curriculum is more than a traditional program guide, therefore; beyond mapping out the topics and materials, it specifies the most appropriate experiences, assignments, and assessments that might be used for achieving goals. The best curricula (and syllabi), in other words, are written from the point of view of the desired learnings, not merely what will be covered. They specify what the learner should have achieved upon leaving, what the learner needs to do to achieve, and what the teacher needs to do to achieve the results sought. In sum, they specify the desired output and means of achieving it, not just a list of content and activities. (p. 6)

As Wiggins and McTighe stated, curriculum specifies the desired outcomes of the course, which requires identifying not just the content and activities of a lesson but also pedagogies, assignments, and assessments. Based on the definitions presented in this section, a curriculum is a plan specifying the content, activities, pedagogies, assignments, and assessments for insturction.

Remillard and Heck (2014) expanded the concept of curriculum and its enactment as something more than such a plan. They defined curriculum as "a *plan for the experiences* that learners will encounter, as well as the *actual experiences* they do encounter, that are designed to help them reach specified mathematics objectives" (emphasis in original, p. 707). Remillard and Heck's definition closely connects to Burkhardt et al.'s (1990) definition of curriculum: "the complete set of learning experiences and activities that the student undergoes" (p. 6). Remillard and Heck used the term *experiences* to emphasize the fact that curriculum is not just the resources written by

curriculum developers (a later section discusses who these curriculum developers are) but also the curriculum experienced by the students through teachers' instruction in the classroom.

In this dissertation, I use the term curriculum as both a plan for the experiences—a) content (e.g., standards, learning objectives, tasks, activities), b) methods (e.g., ways of teaching, pedagogies), and c) assessments (e.g., formative, summative)—and the actual learning experiences that are expected to be achieved by students (Kim, 2018; Panasuk & Todd, 2005; Remillard & Heck, 2014; Sleep, 2012). This is mainly because teachers' curriculum design is an ongoing process from planning to implementation to reflection on the students' learning experiences.

Curriculum Enactment

Although there are some variations on the meaning of curriculum among research studies, a framework for interpreting the curriculum enactment process has been quite universal. A three-phase curriculum enactment framework has been widely accepted and used in research on mathematics curriculum (Lloyd et al., 2017). This framework has three phases—*intended curriculum* (the expected mathematics learning, which is often written in textbooks or content standards), *enacted curriculum* (the interactions between teachers and students in the classrooms to learn mathematics), and *attained curriculum* (what students actually learned). In this framework, curriculum developers expect teachers to enact the given curriculum as intended, or similarly, in the classroom. The researchers who use this three-phase framework are interested in the fidelity of the given curriculum and the effectiveness of using a certain curriculum using students' outcomes (Remillard, 2005).

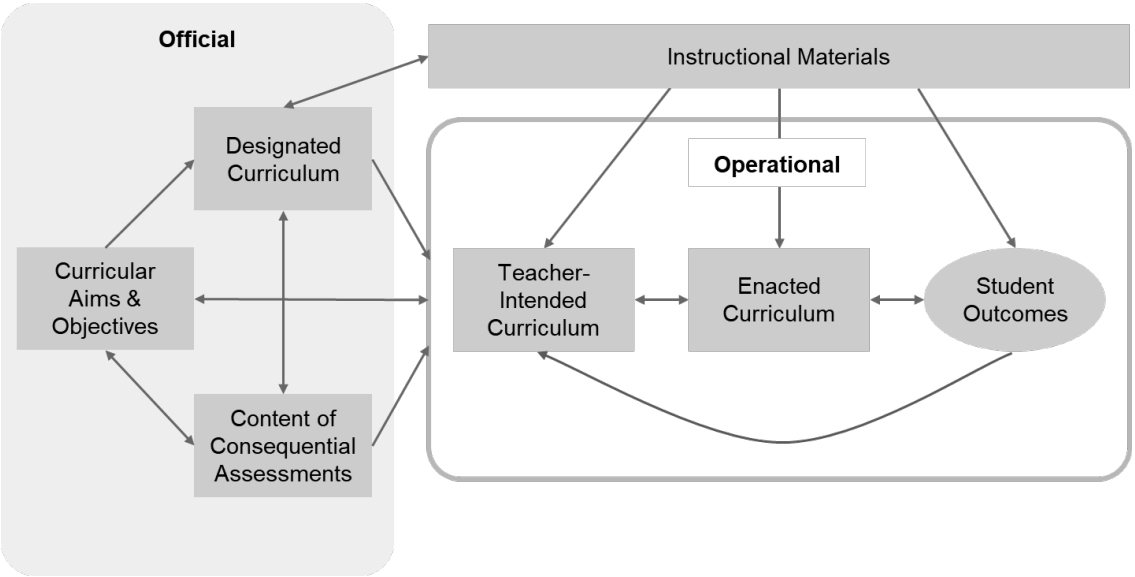
In addition to the examinations of curriculum effectiveness, the aspects of teachers or their teaching practices, such as planning instruction or enactment of planned instruction, have been centered on curriculum research (Lloyd et al., 2017). One of the research areas focusing on the aspects of teachers in the curriculum enactment is teachers' curriculum use. Many elementary and secondary mathematics teachers in the U.S. heavily rely on a single textbook (Banilower et al., 2018, 2013), and teachers rarely teach the content not found in their textbooks (Tarr et al., 2006). However, more schools are forgoing such a curriculum resource in their classrooms and expect teachers to come up with a curriculum by utilizing multiple curriculum resources available online to fulfill their district's content standards. What is missing from research into curriculum use is both what and how teachers design a curriculum to meet students' diverse needs, especially when teachers do not heavily rely on a single textbook.

Curriculum enactment is often studied as part of research programs, but there is an increasing number of studies focused on curriculum enactment, examining the curriculum planned by teachers and enacted in the classroom (Lloyd et al., 2017). Building on the traditional three-phase curriculum enactment framework mentioned above and reflecting on the demand of researching the curriculum planned and enacted by teachers, Remillard and Heck (2014) proposed a new framework for conceptualizing the curriculum enactment, named *Curriculum Policy, Design, and Enactment System* (Figure 1). They identified more components within/across the phases of the traditional curriculum enactment framework (e.g., Curricular Aims & Objectives, Content of Consequential Assessments), emphasized the interactions between the components of the

curriculum enactment system (e.g., bidirectional arrows between the components), and incorporated the influencing factors of the curriculum enactment process.

Figure 1

Visual Model of the Curriculum Policy, Design, and Enactment System



Note. Adapted from Remillard and Heck (2014).

One of the most compelling differences found in Remillard and Heck's (2014) framework, compared to the traditional framework, is the inclusion of the *Teacher-Intended Curriculum* as one of the newly-specified components of the curriculum enactment system between intended and enacted curriculum. Teacher-intended curriculum refers to teachers' interpretations and instructional decisions that they make while they interact with various resources related to curriculum and expectations from local or national stakeholders and parents (Remillard & Heck, 2014). Teacher-intended curriculum interacts with a designated textbook, online instruction resources, or the content of upcoming end-of-year exams. Teacher-intended curriculum is what teachers plan for their students so that students will have quality learning experiences for pursuing

instructional goals. Teacher-intended curriculum in the framework that highlights teacher's dynamic interactions with curriculum and that curriculum materials must be placed explicitly in the process of curriculum enactment: planning instruction, implanting planned instruction, modifying the instruction based on student learning. Thus, studying this form of curriculum will inform how teachers interpret the curriculum resources, what curriculum decisions they make to address the important mathematics ideas emphasized in the resource, and what intentions underly teachers' curriculum decisions for the curriculum design.

Teacher-Intended Curriculum

In regards to teacher-intended curriculum, much prior research focuses on teachers' different use of curriculum materials (e.g., Amador, 2019; Males & Setniker, 2019) or how different curriculum resources influence teacher-intended curriculum (e.g., Bieda et al. 2020; McDuffie et al., 2018). For example, McDuffie et al. (2018) examined how the courses' textbooks affect teachers' planning, enacting, and reflecting on the lessons and found misalignments between what teachers planned and what they actually implemented. They also found a relationship between the design of curriculum materials and the teachers' instructional orientations (i.e., direct or dialogic). For instance, a reform-oriented curriculum allowed the teachers to plan their lessons using the dialogic orientation of the curriculum**.** However, when implementing the lesson, the dialogic orientation was not delivered as planned. More surprisingly, teachers were not aware of how their implementation was different from their plan. This study uncovered that teachers could use the instructional orientation in curriculum materials when they plan a lesson, but teachers' instructional plans did not guarantee successful implementation.

Teacher-intended curriculum is a window into how teachers interpret available curriculum resources, how they make instructional decisions and based on what and how teachers imagine that their intended lessons went (Remillard & Heck, 2014; Roche et al., 2014). This form of curriculum, including teachers' written and mental instructional plans, bridges teachers' interpretations of curriculum resources/materials and their classroom activities with particular students in particular school contexts (Lloyd et al., 2017; Remillard & Heck, 2014). Although teacher-intended curriculum is hard to study due to its existence only in the teacher's mind, it can be studied through exploring artifacts such as their written lesson plans. As mentioned previously, teachers plan student learning experiences that allow students to pursue the specified mathematics learning objectives.

Teachers' Unit Planning

Curricula are pre-determined by curriculum developers who have varying perspectives on learning and instructional orientations. Therefore, topical coverage, length, or sequence of similar curriculum units or lessons differ across curriculum designers. Among the variety of curriculum resources available, teachers are required to make instructional decisions to meet their students' needs. Although many prior studies of curriculum enactment focused on the aspects of curriculum designs (e.g., textbooks with different orientations, content organization), little is known about how teachers design their own curriculum to meet students' needs. In this section, I begin with the notion of planning with curriculum resources to meet their students' needs. I then move to different levels of teachers' planning and articulate why examinations of how teachers plan curriculum units are important within mathematics education and teacher education

research. I close this section with planning as one of the common, essential teaching practices.

Planning with Curriculum Resources

Planning with curriculum resources has been considered a complex and dynamic process (Dietiker et al., 2018; Lloyd et al., 2009). Many scholars have expressed the need for insights into the complexity of how teachers design curriculum using curriculum resources (e.g., Pepin et al., 2013). Scholars have also proposed different frameworks for interpreting teachers' planning with curriculum resources (e.g., Brown, 2009). It is known that teachers' characteristics, such as knowledge, beliefs, experiences, and dispositions, impact their planning (Remillard, 2005, Remillard & Heck, 2007). In this line of research, attention to how teachers use written curriculum resources to plan mathematics instruction has grown significantly in the past two decades (Gueudet et al., 2012; Remillard et al., 2009; Stein et al., 2007). Teachers' use of curriculum materials and resources includes not only what features of curriculum resources teachers attend to but also how teachers interact with these resources to design mathematics instruction (Remillard et al., 2009).

Since the release of the Common Core State Standards for Mathematics (National Governors Association Center for Best Practices Council of Chief State School Officers) in 2010, many states and school districts have adopted standards-based curricula and provided a set of content standards for teaching and learning mathematics. With this new adoption of standards-based curricula in classrooms, more schools no longer provide written curriculum materials, such as textbooks (Banilower et al., 2018). Because textbooks have served as a primary curriculum resource for teaching mathematics (Lloyd

et al., 2017), the responsibilities for designing a curriculum have been transferred to teachers, and they are expected to develop their own curriculum utilizing curriculum resources (e.g., free online textbooks, student's worksheet) to meet the content standards set by their state or district (Webel et al., 2015; Webel & Platt, 2015). Although the field has a collective understanding of how teachers select or create tasks or lessons, little is known about how teachers put these tasks and lessons together as a unit nor make a form of curriculum for their students.

Planning of Different Curriculum Levels

Because teaching occurs over the course of an entire school year, it is important to distinguish between different types of planning. There are different levels of the curriculum, such as lesson, unit, and course (de Araujo et al., 2013); there are also different levels of planning, including yearly planning, term planning, unit planning, weekly planning, and daily planning (Yinger, 1980). Although there are different levels of teacher planning, much prior research focused more on teachers' planning of individual lessons and less on their planning at larger levels (e.g., unit planning, year planning).

Studies often define teachers' planning as only lesson planning rather than other levels of planning because teachers focus more on tasks and activities when they plan lessons and pay less attention to the connections between lessons or units (Stigler & Hiebert, 1999). However, teachers' planning of individual lessons needs to be examined as a component of a larger curriculum (e.g., unit, course) because instructional goals and mathematical ideas do not exist only within each lesson but also across lessons (Sleep, 2012). In addition, teachers' planning of individual lessons typically occurs after teachers

have already established a larger sequence of lessons. Because curriculum units are meaningful curriculum chunks, which are bounded by closely-related mathematical topics and concepts, and assessed using unit tests, teachers' unit planning can be seen as planning a mini-curriculum. A curriculum consists of content, pedagogies, assignments, and assessments; curriculum units are the chunks of curriculum, which have all the components that curriculum includes. Examining how teachers design their curriculum units would give the field more knowledge about how teachers design larger curriculum levels, such as courses. In this paper, I define unit planning as teachers' activities for designing curriculum units, including but not limited to identifying learning goals of the unit, selecting mathematical activities/tasks, determining sequences of lessons, and planning formative or summative assessments (Roche et al., 2014; Sullivan et al., 2012).

Unit Planning as Teaching Practice

Planning individual lessons and the sequences of the lessons has been emphasized as one of the core or high-leverage practices that well-prepared beginning teachers need to be equipped with (Association of Mathematics Teacher Educators, 2017; Core Practice Consortium, n.d.; Teaching Works, n.d.). There is an agreement among teachers and researchers that careful and purposeful planning is a starting point for effective mathematics instruction (National Council of Teachers of Mathematics, 2014). Understanding how teachers plan and design a curriculum for their students allows researchers and practitioners to consider, prioritize, and order decision-making for designing a curriculum.

Although there are some studies focusing on how teachers plan curriculum units, teachers' unit planning is still one of the more under-researched areas in mathematics

education (Roche et al., 2014; Sullivan et al., 2012, 2013). Teachers' knowledge has been a key resource for quality teaching, and many studies focused on identifying certain types of teacher knowledge that influenced teaching mathematics, including but not limited to *mathematical knowledge for teaching* (Ball et al., 2008; Hill et al., 2008) or *pedagogical content knowledge* (Shulman, 1986, 1987).

Recently, there has been a turn toward improving teachers' teaching directly instead of improving teachers' knowledge for teaching (Hiebert & Morris, 2012). Grossman and colleagues (2009) emphasized identifying sub-practices composing a common, bigger teaching practice, such as posing problems or orchestrating discussions. Stein et al.'s (2008) five teaching practices for orchestrating mathematically productive discussion (e.g., *anticipating students' mathematical responses*, *monitoring student responses*) or Dietiker et al.'s (2018) *curricular noticing*, consisting of *curricular attending*, *curricular interpreting,* and *curricular responding* are good examples of such cases. By specifying and identifying smaller chunks of teaching practices, teaching practices can be more manageable and teachable in teacher preparation programs or professional development (Grossman et al., 2009).

Therefore, identifying the sub-practices composing teachers' unit planning will help researchers, teacher educators, and teachers to teach and learn how to plan curriculum units effectively. To improve teachers' unit planning or support their development of the current teaching practices involved in unit planning, an exploration of the nature of teachers' unit planning, including the processes and products of unit planning, is a worthwhile task to conduct.

Unit Planning Processes and Products

As teachers plan curriculum units using a variety of curriculum resources available to them, teachers' unit planning involves two main dimensions—(1) unit planning processes and (2) its products. In this section, I review the literature on how teachers plan curriculum units and what they plan for each unit. To provide background information on my method and analysis for this study, I begin this section with a review of the literature on teachers' unit planning as sequencing or the sequence of mathematical content within a unit and its relationships to students' opportunities to learn. I close this section with what we know about teachers' planning processes and planning products.

Unit Planning as Sequencing

Teachers' unit planning does not just include adapting or creating activities or tasks for instruction. As discussed previously, teachers made a great variety of decisions related to curriculum design, which included actual questions, tasks, lessons, or units that teachers use in classrooms, as well as decisions about the sequence of them. Cobb and colleagues (2008) emphasized the fact that teachers' adaptations of the instructional sequence developed by the designers are inevitable in the process of teachers' planning:

> [A]n instructional sequence developed by one group is necessarily reshaped and transformed when others use it … teachers necessarily adjust an instructional sequence to the actual circumstances that they encounter even when they attempt to remain faithful to the designers' intentions. (p. 117)

Thus, teachers' planning includes the modifications of the sequences of mathematical content in curriculum resources or teachers' creations of that to support students' learning.

At this point, one may question why the sequence of mathematical content matters in teaching and learning mathematics. To answer this question, Dietiker's (2013) notion of mathematical stories is quite helpful. Dietiker conceptualized the sequence of mathematical content as a *mathematical story* that refers to the chronological sequence of mathematics events (or learning activities) in a mathematics textbook. Dietiker (2013) viewed the mathematics curriculum as "a form of narrative for which the sequence of mathematical events are taken as a mathematical story" (p. 286). She emphasized that different sequences of events (or tasks) would lead to students' different learning experiences, and even the mathematical storylines that students experience would greatly differ one from another.

In this line of research, Kim (2018) examined in-service elementary teachers' unit planning by documenting their modifications of the given sequence of mathematical content in textbooks and the relationships between the lesson sequences and students' opportunities to learn (OTL). Kim found that the teachers often changed the given sequence of tasks and lessons in the textbook by omitting subsets of tasks or lessons as they assumed that their students had sufficient understanding of previous tasks or lessons. She also found that the teachers barely changed the actual order of the tasks when they implemented the unit in the textbooks. Kim emphasized that even omitting some tasks in a lesson can change the mathematical stories and eventually change students' OTL. Her findings supported the existence of the relationships between the sequences of mathematical content and students' OTL (Dietiker, 2015; McCrory et al., 2016; Thompson et al., 2012).

Teachers' guides in curriculum resources, such as textbooks, are not sufficient for teachers to interpret the sequences of mathematical content in them (Ball & Cohen, 1996). In addition to the curriculum documents teachers create as results of unit planning, it is still largely unclear how they determine the sequence of mathematical content when they plan instruction. In particular, little is known about how teachers determine the sequences of lessons within a unit or the sequences of units within a course, especially when they do not simply follow the sequences of mathematical content in textbooks.

Secondary Mathematics Teachers' Unit Planning

It is known that there are often great differences between what teachers attend to in curriculum resources and what they actually put in their plans. For preservice teachers, unit planning is often selected as one of the weaknesses of student teachers by their host teachers (Zelkowski, 2009). It is also known that novice teachers are more faithful to textbooks than experienced teachers (Silver et al., 2008). Novice teachers' plans are often more like a script, but they move away from scripts as they have more experience (Mutton et al., 2011).

In addition, there are some differences even among elementary and secondary mathematics teachers. Sullivan and colleagues (2013) examined elementary and secondary in-service teachers' processes and priorities in planning. They found that both elementary and secondary teachers started planning by either selecting a task based on where students were at or reading through the official curriculum resource (e.g., textbooks) to identify learning goals. Sullivan and colleagues also found that although there was no primary resource for unit planning for elementary teachers, textbooks and individually/team-developed materials were the two most common resources for unit

planning for secondary teachers. However, little is known about what teachers actually plan for units and how they naturally plan units when they are not asked to create written plans for research studies.

Roche and colleagues (2014) examined Australian elementary teachers' unit planning processes when they were asked to create written unit plans. They found that there is a discrepancy between what teachers think their unit plans included and what they actually put in their unit plans. In particular, assessments (e.g., pre-test, post-test) were one of the unit planning elements that teachers think they had in their plans, but actually, many teachers did not include assessments in their unit plans. They also found that the majority of the elementary teachers developed unit plans collaboratively with other teachers.

In this section, I reviewed the literature related to teachers' unit planning processes and products. Although these studies documented what teachers attended to among a variety of curriculum resources available for them and what elements were listed in the teachers' unit plans as a result from the unit planning processes, which activities or lessons the teachers omitted or changed from the pre-determined curricula, these studies did not document the details of the processes of teachers' unit planning (e.g., where to start) or the products of their unit planning processes (e.g., curriculum documents that teachers create when they plan curriculum units). This study examines both what curriculum decisions teachers make and how they make such decisions in response to the constraints (e.g., time) or classroom contexts (e.g., students' needs) that they encounter.

Theoretical Framework

To explore how teachers design curriculum units, I adopt the notion of *teachers as curriculum designers* (Ben-Peretz, 1990; Brown, 2009). Although curriculum developers' exert a tremendous effort to make their intended curriculum work for all students, teachers who work closely with their students may think the given curriculum is inadequate for their students. As part of teaching, educators often improve and adjust the given curriculum to meet their diverse students' needs (Cohen & Ball, 2003; Remillard & Heck, 2014). In this view, instead of simply enacting the given curriculum, teachers make many instructional decisions based on their professional knowledge and beliefs (e.g., content knowledge, pedagogical content knowledge, curriculum knowledge) to meet the needs of their students (Ben-Peretz, 1990; Remillard et al., 2009).

In this notion, teachers are not only enactors of a curriculum but also designers who have professional judgment skills to make instructional decisions for their students who are different from other students from other parts of the state (Ben-Peretz, 1990; Brown, 2009; Drake, 2010; Remillard, 2005; Remillard et al., 2009). Teachers design their instruction for students to achieve instructional. Remillard (2005) called this type of teacher role as the teacher-curriculum *participatory relationship*. In this type of relationship, teachers are not just interpreting the existing curriculum materials. Rather, they interact with curriculum materials to design enacted curricula. In doing so, teachers are the agents who interpret the curriculum materials and decide what to use and not to use, and how to deliver the instruction to their students in order to accomplish the student learning goals. Throughout this process, teachers need to make decisions based on their own professional resources (e.g., knowledge, beliefs).

Teachers' capability for designing instructions for their students is conceptualized by Brown (2009), in what he referred to as teachers' *pedagogical design capacity* (PDC). PDC is teachers' "ability to perceive and mobilize existing [curriculum] resources in order to craft instructional contexts" (p. 24). However, teachers' design capacities might not be the same as the original curriculum developers (Ball & Cohen, 1996). Rather, their design capacities are more likely to *offload*, *adapt*, or *improvise* (Brown, 2009) the existing curriculum resources to make them more appropriate for their students to achieve the instruction goals set by the teachers. Brown proposed *the design capacity for enactment* framework for identifying the influencing factors of how teachers use *curriculum resources* (e.g., representation of tasks, representations of concepts) and *teacher resources* (e.g., teacher's knowledge, beliefs).

While Brown's (2009) framework captures how curriculum resources and teacher resources influence the ways teachers use their curriculum materials, it is important to have a framework for interpreting how teachers plan units and what they create as a result, in addition to why they plan units in certain ways. Teachers' planning activities are called *curricular reasoning*, which refers to "the thinking processes that teachers engage in as they work with curriculum materials to plan, implement, and reflect on instruction" (Breyfogle et al., 2010, p. 308). Through these thinking processes, teachers make curriculum decisions, including but not limited to the content, objectives, assessments, or instructional strategies.

Gueudet and Trouche (2009) considered teachers' planning to be one of the core elements of teachers' professional activities and introduced the distinction between curriculum resources and curriculum documents. They conceptualized curriculum

resources as all artifacts that are available for teachers to plan instruction, which includes but are not limited to textbooks, student worksheets, and software. In another piece, the authors defined *documents* or *teachers' instructional geneses* as: "teachers' documents incorporate both resources and knowledge 'piloting' their usages" (Pepin et al., 2013, p. 923), which highlights teachers' autonomy and capacities of designing a curriculum by utilizing available curriculum resources.

To this end, I attended to teachers' processes of planning curriculum units and the products of their unit planning process in order to identify a set of teaching practices that the teachers engaged with when they plan units, to illustrate the common approaches of each of the teachers' unit planning practices, and to compare and contrast the unit planning processes and products across the teachers. The use of adapted frameworks in the analysis of my data, as well as the methodology I employed in collecting my data, is discussed in the following chapter.

CHAPTER 3: METHOD

This chapter describes the procedures I used to answer the research questions: *When experienced algebra teachers actively design their curriculum, how do they design curriculum units? How are the processes and products of teachers' unit planning similar between and/or different from one another?* Guided by the participatory relationship perspective between teacher and curriculum (Remillard, 2005), this study examined the unit planning processes and products of the five experienced Algebra I teachers who actively design curriculum units. For this study, I employed an *embedded single-case design* (Yin, 2013) including the analyses of multiple subunits of the case (e.g., unit planning process, unit planning product). This single-case design is appropriate for exploring teachers' common activities because teachers' planning activities are one of the teaching practices that teachers do in everyday situations (Yin, 2013). Moreover, an embedded-case design is more appropriate than a holistic-case design because there are multiple components and outcomes resulting from teachers' unit planning. This chapter details the participants, research design, data sources, procedures, and data analyses.

Participants

For conducting this *embedded single-case study* (Yin, 2013), it is critical to choose a case that potentially represents the case of the teachers who actively design curriculum units. Thus, I purposefully selected teachers according to three criteria. First, because teachers' curriculum decisions relate to their perceived *autonomy space* regarding curriculum (Ben-Peretz, 1990), I recruited teachers who reported having strong

control over their curriculum decisions. In other words, they were largely responsible for what and how to teach mathematics in their classrooms. Second, given my interest in unit planning, I selected teachers who use and incorporate multiple curriculum resources when designing curriculum units rather than teachers who rely heavily on a single curriculum program or those who closely adhere to the structure of existing curriculum units. I made this decision because the limited curricular autonomy of teachers who rely on a single curriculum resource could constrain their design process. These two criteria for recruiting appropriate participants made it possible to gain the perspective *of teachers as curriculum designers* (Brown, 2009; Remillard & Heck, 2014). In this perspective, teachers make a variety of curriculum decisions to meet their particular students' needs at particular moments, which departed from the notion of teachers as only curriculum enactors focusing primarily on the curriculum fidelity (Remillard, 2005).

The third selection criterion was that the teachers had to have at least two years of experience teaching Algebra I or related courses. I made this decision not because there are differences in the perceived control over curriculum decisions between novice and experienced teachers (Craven & Trygstad, 2020) but because experienced teachers may have different levels of *pedagogical design capacity* (Brown, 2009) than novice teachers. This difference in teachers' pedagogical design capacity is due to the factors (e.g., teachers' knowledge and beliefs) influencing teachers' curriculum design change over time (Sherin & Drake, 2009). Thus, the teachers who have taught Algebra I over multiple years would have more experience in designing curriculum units and more stories of how their curriculum unit design has changed over time. This criterion also allowed me to document how they reported their curriculum unit design to have changed due to the

global pandemic and the constraints from it, and so I looked for teachers who taught Algebra I or a comparable course in both the 2019–2020 and 2020–2021 school years.

Teacher Selection Survey

To screen potential participants, I used the teacher selection survey (see Appendix A). First, I sent out recruitment emails using my professional networks and posted recruitment flyers on online teacher communities, such as *My NCTM*. In the emails and recruitment flyers, I asked teachers to fill out the teacher selection survey. The survey included the questions related to their background and experiences (e.g., years of mathematics teaching, years of Algebra I teaching, whether they taught Algebra I in the 2019–2020 and 2020–2021 school years). In addition, the survey included questions adapted from the *Mathematics Teacher Questionnaire* (Horizon Research INC, 2018) that was used for the *2018 National Survey of Science and Mathematics Education* (Banilower et al., 2018). The teacher selection survey included questions on whether the teachers have curriculum materials designated by their school or district to be used in their instruction, how often their instruction is based on different types of curriculum materials, how much they feel they have control over their instructional decisions, to what extent they feel they have control over curriculum decisions (e.g., selecting content, topics, skills to be taught, selecting the sequence in which topics are covered), and the nature of their mathematics instruction (e.g., use of whole-class discussions).

Teacher Selection Criteria

A total of 17 teachers completed the teacher selection survey. I would like to acknowledge that these 17 teachers are probably not representative of typical teachers, but the purposes of this study were to explore the nature of the teachers' unit planning, not to generalize the findings of this study to any mathematics teachers. The more details of the limitations of this study will be discussed later in this chapter. As the survey results came in, I looked through the teachers' responses and selected 8 teachers who met all the following selection criteria:

1. Used multiple instructional/curriculum materials to teach the course
2. Felt that they had strong control over curriculum decisions (i.e., scored three or more out of five on the following dimensions)
    a. Determining course goals and objectives
    b. Selecting content, topics, and skills to be taught
    c. Selecting the sequence in which topics are covered
    d. Determining the amount of instructional time to spend on each topic
3. Taught Algebra I or a comparable course for at least 2 years, including the 2019-2020 school year
4. Taught Algebra I or a comparable course in both the 2019-2020 and 2020-2021 school years

I sent out an invitation email to each of the 8 teachers who met the criteria. Of the 8 teachers, 6 experienced high school mathematics teachers from across the United States agreed to participate in this study. One of the 6 teachers only completed the first interview and did not complete the entire data collection process. The remaining 5

teachers completed the data collection process and were included in this study. Each participant was compensated with a $50 gift card sponsored by the Department of Learning, Teaching, and Curriculum at the University of Missouri-Columbia. The basic demographic information of the 5 participants is summarized in Table 1.

Table 1

Summary of Study Participants

Name	Gender	Teaching Experience*	Course	School	Setting
Anderson	Male	18 years	Secondary Math I	Alternative	Suburban
Cabal	Male	4 years	Algebra I	Public Charter	Urban
Harris	Female	5 years	Algebra I	Public	Urban
Vincent	Female	7 years	Algebra I Honors/Basic	Public	Suburban
York	Female	8 years	Algebra I	Public	Suburban

Note. All the teachers had the same years of experience teaching Algebra I or comparable courses.

Each of the participant teachers had at least 4 years of experience teaching Algebra 1 (or comparable courses), including the 2020–2021 school year. All but Mr. Anderson taught Algebra I, which is the first sequence of the traditional mathematics subject-based curriculum series (e.g., Algebra I-Geometry-Algebra II sequence). Mr. Anderson taught *Secondary Mathematics I*, which is the first high school mathematics course using integrated curriculum that includes multiple high school mathematics subjects. He also was the only teacher who worked at an alternative school. The other teachers taught at a

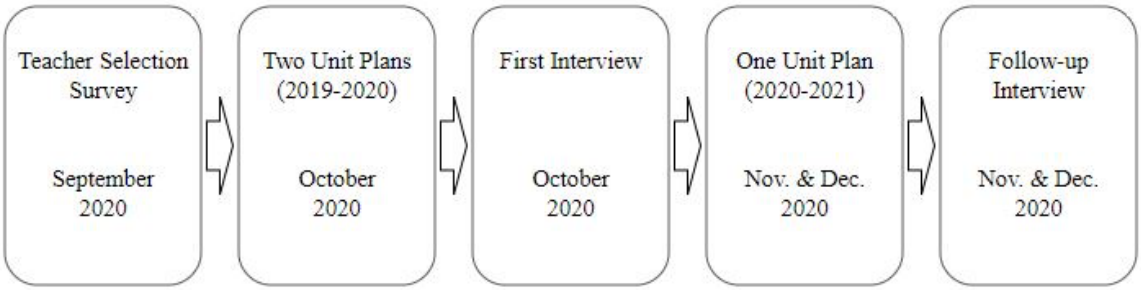
public school, including a public charter school. None of the teachers taught in a rural area or worked in the same school district.

Data Sources and Procedures

To explore the teachers' unit planning processes and products, I used multiple data sources—teacher selection survey, teachers' unit plans, instructional materials used for teaching the units, and two semi-structured one-on-one interviews—to allow for data triangulation (Merriam & Tisdell, 2015). The overall study design is represented in Figure 2.

Figure 2

Overview of Data Collection Procedure and Data Sources



Procedure

As described above, I initially sent out emails using my professional network and I posted flyers on social media, including accounts for mathematics teacher professional organizations. I contacted all the teachers whose responses on the recruitment survey met the inclusion criteria for participation. Once they agreed to participate in the study, I asked them to submit two unit plans, from the 2019–2020 school year, that they thought were representative of a typical unit. I also asked the teachers to submit the instructional materials they used for teaching the units.

I scheduled the first interview about a week or two in advance to give me sufficient time to read through the plans and materials beforehand and prepare clarifying questions on their unit-planning processes and products, as needed. The interviews were held over Zoom because the teachers were in different states than me. Each interview lasted between 40 minutes and 90 minutes and was video-recorded through the Zoom platform. Once each teacher completed their first interview, I transcribed the interview using the auto-generated transcript feature of Zoom platform. I cleaned up the transcripts as I went through them, and I briefly summarized each teacher's unit planning using a Google Sheet before I conducted a follow-up interview with each teacher.

Before the follow-up interviews, I asked the teachers to submit a third unit plan for a unit on functions (or the unit in which they introduce the concept of functions to the students) from the 2020–2021 school year. As with the first interview, I read through the unit plan before the follow-up interviews. For the follow-up interviews, I asked additional questions about how their plans for the unit went and whether they made any adjustments from what they originally planned for the unit. Each follow-up interview lasted between 45 minutes to 85 minutes. Like the first interviews, the follow-up interviews were also video-recorded and transcribed for further analysis.

Two Unit Plans from 2019–2020

The first set of data sources was the teachers' unit plans and instructional materials from the previous school year (i.e., the 2019–2020 school year). Each teacher sent two unit plans for this first round: one on any topic reflecting that reflected their typical construction of a curriculum unit (e.g., pacing, lesson sequence, timing of assessments) and the other specifically on quadratic functions. For the first unit plan, the

teachers submitted a unit of their choice, which represented how they typically designed a curriculum unit (e.g., how they introduce the mathematical concepts associated with the unit, how/where they employ application problems in the unit, when they assess student learning).

For the second unit plan, teachers submitted their plans for quadratic functions and equations so that I could compare and contrast unit plans on the same mathematics topic. However, it ended up teachers submitting a third unit plan on function since one teacher did not teach quadratic functions at all in Algebra I. I initially wanted to have the teachers' plans on the quadratic unit that they would teach later in the semester so that the teachers would have an opportunity to discuss not only what they planned but also what they changed from what they originally planned while they implemented their unit plans. Because there are a variety of ways to introduce, develop, and summarize quadratics functions and equations (Charles et al., 2015; Dietiker et al., 2014; Education Development Center, 2009), having unit plans on the same mathematical concepts would allow me to document the similarities and differences of unit goals, objectives, unit plan elements, unit length, lesson sequences, and assessments across the teachers. However, Ms. Vincent did not teach many of the concepts related to quadratic equations and functions in Algebra I; thus, it was not ideal for me to compare and contrast the teachers' unit plans on the quadratic units. After consulting with my academic advisor, I asked the teachers to submit their plans for the (linear) function unit, in which they first introduce the concept. The details of this third unit plan are unpacked in the section of unit plan from 2019–2020 school year.

To capture the formats and elements of the teachers' unit plans, I accepted any form of unit plan that the teachers typically used, such as calendar or formal unit plan templates. As a result, the products of the teachers' unit planning varied greatly in terms of types, purposes, and elements composing the products. The details of these products are unpacked in the findings chapter. After the first interview, I asked the teachers to submit the curriculum resources that they referenced and the instructional materials that they used for teaching these two units (e.g., handouts, slides, assignments, quizzes, tests) to fully visualize what they planned and implemented for these units. These curriculum resources ranged from official standard documents (e.g., state standards, district standards) to online learning management platforms (e.g., iXL, Delta Math). The details of these curriculum resources are described in the findings chapter.

First Interview

To record the teachers' unit planning processes and rationales for their curriculum decisions, I used *semi-structured qualitative interview* techniques (Merriam & Tisdell, 2015). As many details of teachers' unit planning occur in their mind, they cannot be directly observed by a researcher. Thus, I adopted interviews as my primary data source to determine how algebra teachers design their curriculum units. The semi-structured qualitative interview was suitable for this study because it was flexible enough to allow for additional questions for clarifying teachers' responses, particularly since the teachers differed in their unit planning processes and so this flexibility was helpful.

In October 2020, I conducted one-on-one interviews through Zoom. For the first interview, I developed a semi-structured qualitative interview protocol (see Appendix B) under my academic/dissertation advisor's directions and revised it after piloting with

doctoral students in my Ph.D. program. After the pilot, I reworded some interview questions for clarity. The interview protocol originally had four parts, but after consulting with the advisor, I decided to take out the accommodation strategies section, and it ended up having three parts: a) teacher's unit plan content including teacher's goals for student learning, b) teacher's design process of unit planning, and c) teacher's priorities among the learning goals of the unit.

Before the first interview, I read through the teachers' unit plans and instructional materials to get familiar with the details of their plans and to prepare to clarify or use follow-up interview questions in addition to the questions on the interview protocol. To explore the mathematics content that is intended and perceived by the teachers, I began interviews by asking them to walk me through their plans for the units. To capture teachers' unit planning process, including starting points and curriculum resources, I asked questions such as, "Tell me about your unit planning process?" "What do you consider when you design this unit?" and "What curriculum resources did you look up or use in order to design this unit?" To document teachers' perceptions of curriculum units and unit planning, I included questions such as, "What makes a unit?" "How do you determine a unit?" and "What are the most important things in unit planning compared to lesson planning?"

To uncover teachers' priorities among the learning objectives and goals for students, I asked some hypothetical questions related to unexpected schedule changes, such as shortening unit lengths or having a couple of extra days to cover units. For instance, I included interview questions such as, "Let's imagine you might have to teach this unit in a shorter time frame than you planned. How would you teach this unit? What

are the absolute essentials of this unit?" or "Let's imagine another teacher in your department is a little bit behind, and it seems like you have one or two extra days to make both classes at the same pace. What are the things that you would like to adjust from your unit plan? Where would the extra things go in your unit plan?" Through these questions, the teachers expressed what they wanted to me, but they usually did not include such specifics in their unit plans.

In addition to answering the main research questions, I included questions on how they would like to teach the same unit if they were no longer able to do face-to-face instruction next year in order to document how the teachers went through instructional format changes (i.e., remote learning during the COVID-19 pandemic). As the teachers had dealt with such a disruption at the time of the interviews, they shared their thoughts on the adaptation or integration of remote learning components based on their year's experience with remote learning and disruptions.

One Unit Plan from 2020–2021

To capture both what teachers planned and how they implemented them, I asked the teachers to submit one more unit plan for an upcoming unit. The first two unit plans were from the 2019–2020 school year, so the teachers had already taught that unit. Collecting the teachers' plans for the upcoming unit gave me more insights into how they planned for the future unit, which is close to how teachers actually plan units. Another reason for this additional unit plan was to have the teachers' plans on a common topic to compare and contrast. As previously explained, I was unable to obtain unit plans on a common topic at first; therefore, the third unit plan was needed to fulfill this purpose.

I specifically asked the teachers to submit their unit plans for the unit of functions (or for the unit in which the teachers introduced the concept of functions for the first time in Algebra I). Like the unit plans for the unit of quadratic equations and functions from the 2019-2020 school year, teachers' third unit plans for the unit of functions were added to the data set for the understanding of the elements of teacher's unit plans. This third unit plan gave me data not only for underpinning the elements of teacher's unit plans with the other two unit plans but also for capturing how the teachers consider their curriculum units as part of the entire course.

Follow-Up Interview

To capture how the teachers' plans for the unit on functions went and how they viewed the unit in relation to the entire Algebra I course, I conducted the follow-up interviews once the teachers completed teaching the unit. Because the teachers planned to teach the function unit at various time in Fall 2020 prior to mid-December, I conducted the interviews in November and December 2020.

In the follow-up interviews, I asked questions about how their unit plans went and whether they made any adjustments from what they originally planned, in addition to the same questions from the first interviews. In particular, I asked questions like, "Tell me about how the unit went" or "What were the things that didn't go well as planned?" to document what actually happened in the classrooms and how teachers responded to it to achieve the planned objectives and goals of the unit. Moreover, to reveal how the teachers view the unit in relation to other units and the entire course, I asked questions such as, "What led you to decide to teach this unit at this particular time of the year?" The details of the follow-up interview protocol are included in Appendix C.

When I interviewed the teachers, they also shared their tentative curriculum maps (i.e., sequences of units or topics) for the remainder of the 2020–2021 school year, which was also added to the data set. Like the first interviews, all the interviews were video-recorded and transcribed through the Zoom video conferencing platform for further analysis. The details of data analysis are described in the following sections.

Data Analysis

To reveal the teachers' unit planning processes and the characteristics of unit planning products, I analyzed their unit plans and interviews using multiple analytic frameworks and qualitative analysis strategies, which are summarized in Table 2.

Table 2

Summary of Analytic Frameworks and Strategies for Data Analysis

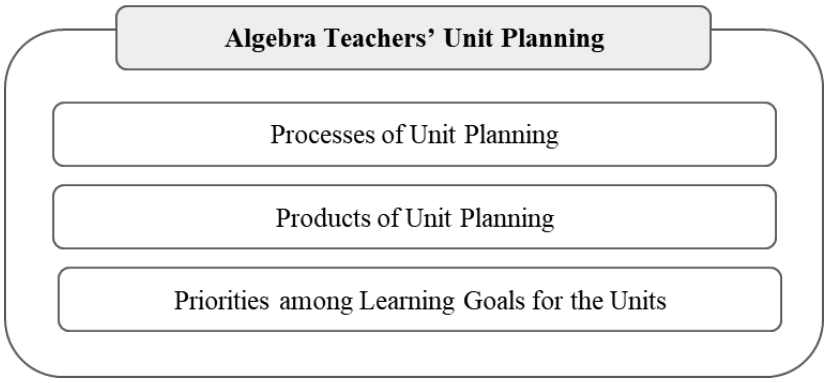
Research Questions	Analytic Frameworks & Strategies
1. When experienced algebra teachers actively select/create their curriculum, how do they design curriculum units?	• *Teacher Planning* (Roche et al., 2014) • *Logic Models* (Yin, 2013) • *Elements of Unit Plan* (Roche et al., 2014) • *Pedagogical Design Capacity* (Brown, 2011)
2. How are the process and product of the teachers' unit planning similar to or different from one another?	• *Cross-case Synthesis* (Yin, 2013)
a) What aspects of the unit plan do they prioritize?	• *Open Coding* (Yin, 2013)

Instead of analyzing the teachers' unit planning holistically, I analyzed the teachers' unit planning by attending to multiple analysis units of the embedded single case—the unit planning of Algebra I teachers who actively design their curriculum units—because the teachers' unit planning is complex and multifaceted, and consist of various layers of

teaching practices. The analysis of the subunits of the case includes the teachers' a) unit planning processes, b) unit planning products, and c) priorities among learning goals of the units (Figure 3). In the following sections, I describe the details of data analysis that I conducted to reveal each subunit of the teachers' unit planning processes and products.

Figure 3

Subunits for Analyzing Teachers' Unit Planning



Processes of Unit Planning

To illustrate the teachers' unit planning processes, I primarily analyzed their interviews. Once each of the first interviews was completed and transcribed, I imported the interview transcripts into one qualitative data analysis software, MAXQDA. Then, I read through the transcripts with the audio recordings to get familiar with the data and left some marginal notes while doing so. To prepare for the follow-up interviews, I made quick notes by summarizing the first interviews in terms of unit goals, unit planning process (e.g., what they did first to plan the unit), conceptions of unit planning, typical student population, possible responses to hypothetical questions regarding time constraints using Google Sheets as a preliminary analysis of each teacher's unit planning process. An example of summarizing the first interviews is presented in Figure 4. Once I

completed the follow-up interviews with the participant teachers, I imported the transcripts and audio recordings into MAXQDA, as I did for the first interview data.

Figure 4

An Example of the Interview Summary

	Unit Topic, Collaboration,	Types of Unit Plans	Product -- Plans for the Unit	Process
			1. Let's assume I'm a new mathematics tea a. Tell me about the goals of this unit. b. What do you expect your students to get	2. Tell me about your unit planning process a. Where do you start?
Anderson	Exponential Functions (Quarter 2); Individual	quarter plans contain standards; a list of key things that the teachers are trying to cover Lesson Outline -- a page per quarter, two lines per day	Exponential Functions 1) make a pattern with algae blocks 2) draw the patterns using graph papers 3) make a table and count the blocks 4) graph the number of blcosk on the table 5) go to equation last Use similar sturcture for linear, expenential, and quadratic functions	a) looking through the district's standards and understand what they are covering b) making quarter standard sheet by taking the district standard sheet and reducing them into the ones that he can cover in each quarter c) putting the standards in order that he thinks he would put them in by thinking about what concepts makes sense to come before other concepts d) mapping out lessons using Canvas by blocking out topics/units e) deciding number of days or hours to each topic based on various things (e.g., quizzes, tasks)

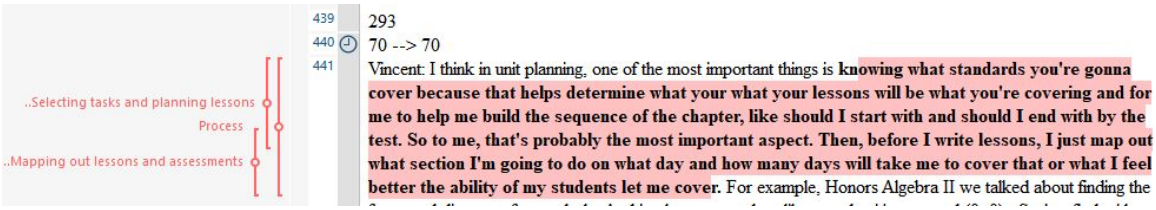
To analyze the processes of teachers' unit planning, I first identified the teachers' teaching practices that were involved in their unit planning processes. By building on Roche et al.'s (2014) and Gueudet and Trouche's (2009) frameworks for teacher's planning, I initially coded the transcripts using their five unit planning practices—a) *checking school or web resources and/or student text*, b) *examining curriculum content descriptions to identify the important ideas*, c) *establishing specific learning goals*, d) *selecting and sequencing tasks including adapting them for students*, and e) *planning the teaching and assessment including differentiating for particular students*. After coding Mr. Anderson's and Mr. Cabal's initial interviews, I added three unit planning practices to the initial coding scheme—a) *monitoring students' progress*, b) *modifying unit plans*, and c) *evaluating implemented unit plans*.

Once I completed the coding for all the teachers, I noticed there were overlaps between some of the unit planning practices. For example, I found that the teachers

mapped out lessons and assessments before they actually found or created lessons and assessments. Therefore, I separated *mapping out lessons and assessments* from *selecting and sequencing tasks, including adapting them for students*. For example, I coded the early and later portion of what Ms. Vincent said about her unit planning process as *mapping out lessons and assessments* and *setting learning goals* (Figure 5).

Figure 5

Sample Codes for Unit Planning Process Analysis



Thus, I coded, "Before I write lessons, I just map out what section I'm going to do on what day and how many days will take me to cover that or what I feel better the ability of my students let me cover. (Ms. Vincent, First Interview, 10/26/2020)" as *mapping out lessons and assessments*. I coded the rest of her interviews, and others' interviews, in a similar manner. Similarly, I combined *monitoring students' progress* and *modifying unit plans* when I wrote up my finding section. As a result, I combined some unit planning practices together. For example, I combined a) *checking school or web documents, teacher resources and/or student texts* with b) *examining curriculum content descriptions to identify the important ideas* as *checking and examining curriculum resources,* and I then came up with the adapted framework for teachers' unit planning practices.

Once I identified the types of unit planning practices, I put the excerpts from either the first interview or follow-up interview, which related to the timing of and

approaches to each of the unit planning practices. An example of the unit planning practice analysis is presented in Figure 6.

Figure 6

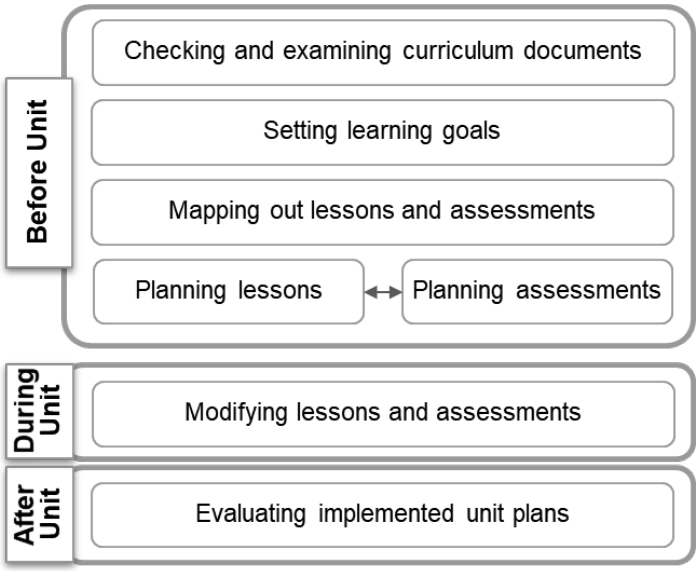
An Example of Unit Planning Practice Analysis

	Process
	Selecting Tasks and Planning Lessons
Anderson	TIMING - Yeah, I'd be well the quizze I made last year but or the year before, but they still, I mean the principles, the same I would have designed the activity first and the questions after. So like here. The questions, you can still see it right? I would have picked these after designing the lesson. (Mr. Anderson, Follow-up Interview, 11/13/2020, Pos. 182) APPROACH - So usually I develop the test items after I develop the learning activity. But then when I go and build the test or quiz, then sometimes I realized that my learning activity isn't going to address the questions that I'm finding readily available. So sometimes that results in a change in the lesson plan. But usually I try to just pick items that match what the, what the learning activity already was. So there's a little bit of back and forth, but usually it's pick the learning activity first and then pick assessment items that match. (Mr. Anderson, Follow-up Interview, 11/13/2020, Pos. 176)

In addition to identifying and characterizing each of the unit planning practices, because the teachers enacted these planning practices in sequential order, I utilized the *logic model technique* (Yin, 2013), which is used for illustrating a complex chain of events or occurrences when the events or occurrences happen sequentially. As a result, I created the logic models of the teachers' common unit planning processes. An example of the logic model of teachers' unit planning process is presented in Figure 7.

Figure 7

Logic Model of Teacher's Unit Planning Process



Products of Unit Planning

To understand the teachers' unit planning products, I analyzed the documents and instructional materials that the teachers created during their unit planning processes. I created a coding scheme for analyzing the teachers' unit plan elements by adapting Roche et al.'s (2014) framework for analyzing essential elements of written unit plans. Using this framework as an initial coding scheme, I analyzed each teacher's unit plans, including the instructional materials used for teaching each unit.

Once I collected the teachers' unit plans, I began analyzing all three unit plans of each participant teacher by applying the coding scheme above. The coding process was open to additional codes (Yin, 2013) in case the unit plans of the teachers included some elements that were not listed on the initial coding scheme. The initial coding scheme was refined through multiple iterations of data coding. The refined coding scheme was tested by another coder. The additional coder and I independently coded one of the collected

unit plans, compared the codes, and discussed the codes until we reached an agreement. The final coding scheme is summarized in Table 3.

Table 3

A Framework for Analyzing Teachers' Unit Plan Elements

Codes	Subcodes	Descriptions
Math Content and Goals	Math Content Standards	Mathematical ideas identified in the Standards
	Math Practice Standards	Mathematical performances identified in the Standards
	Learning Goals/Targets	Learning goals/intentions for students
Assessment	Test Items	Formative or summative assessment
	Proficiency Specified	Assessment items/tasks specific to the proficiencies
	Student Attitude	Ways of assessing student attitude
Lesson/Task	Titles	Titles of tasks/lessons
	Descriptions	Detailed descriptions of the tasks/lessons
	Tentative Schedule/Sequence	Suggested order of tasks/lessons
	Relevant Resources	Links to relevant resource materials
	Differentiation	Differentiation/accommodation for diverse learners
	Relevant Standards	Identification of the Standards addressed by the tasks/lessons
	Tasks/Activities	Tasks/activities for each lesson
	Reflection Questions	Reflection questions for students
	Assignments	Assigned problems or online modules
Pedagogies and Lesson Structure	Questions	Questions teachers might ask as students are working on the tasks/lessons
	Time Allocations	Time allocations for unit length (number of days/weeks/lessons)
	Grouping of Students	Suggestions for grouping of students
	Equipment	Suggestions for particular equipment or other resources to be used
	Technology	Suggestions for forms of technology to be used
	Lesson Structure	Suggestions for lesson structure

Note. Adapted from Roche et al. (2014).

Once I completed the coding for all the collected unit plans, I made a table to represent the types of elements in each teacher's unit plans. In the table, I listed all the elements of the unit planning products of each teacher, and I identified the most and least common elements of the unit planning products that the teachers created while planning units. The table is available in the chapter of findings.

Teachers' Priorities among Learning Objectives and Goals

To document teachers' priorities among the objectives and goals for students for a unit, I analyzed the teachers' responses to the interview questions regarding teaching the same units to different levels of students or different populations of students. In addition, I analyzed the objectives and goals associated with the activities or lessons that the teachers would like to leave off if they run out of time or slip in if they have one or two extra days to cover the units. I used an *open coding* (Yin, 2013) method to theorize teachers' priorities among their learning objectives and unit goals. Once I completed the coding process, I compared the learning objectives and goals between the original unit plans and what the teachers mentioned in the interviews. Like the other subunits of the teacher's unit planning, I compared the similarities and differences among the teachers to find emerging themes and patterns across them. The resultant codes and themes across the teachers will be chased in the Findings chapter.

Resources for Unit Planning

To explore how curriculum resources and various factors influence teachers' unit planning, I analyzed their interview transcripts using the coding scheme adapted from Brown's (2009) *Design Capacity for Enactment Framework* and Remillard and Heck's (2014) influencing factors of the teacher-intended curriculum. The adapted coding

scheme is summarized in Table 4. Just as I did for the analyses of the teachers' unit planning processes, I first analyzed the teachers' answers on what curriculum resources they used and how they used each of the resources, then examined the emerging patterns across the participant teachers.

Table 4

A Framework for Analyzing Influencing Resources and Factors

Codes	Subcodes	Source/supporting literature	Descriptions
Curriculum Resources	Physical Objects and Representations of Physical Objects	Amador, 2019; Grant et al., 2009	The material nature of the curricula themselves, and materials that are recommended by, but not included within, the curriculum materials
	Representations of Tasks	Grant et al., 2009; Land et al., 2015	Instructions, procedures, and scripts that are intended for enactment by teachers and students
	Representations of Concepts	Ding & Carlson, 2013; Stein & Kaufman, 2010; Tarr et al., 2008	The depiction and organization of domain concepts and their relationships through means such as diagrams, models, explanations, descriptions, and analogies
Teacher Resources	Subject Matter Knowledge	Ball et al., 2008; McCrory et al., 2016	Knowledge of the facts and concepts in the domain
	Pedagogical Content Knowledge	Ball et al., 2008; Baumert et al., 2010; Charalambous & Hill, 2012	Combination of general pedagogical knowledge and domain knowledge to describe knowledge of how to teach a particular domain
	Goals & Beliefs	Lloyd, 1999; Rosenblatt, 1986	Teachers' orientations toward the material they teach
Expectations		Grant et al., 2009; Grossman, 1990	Expectations of the local context, school, community

Note. Adapted from Brown (2011) and Remillard and Heck (2014).

Limitations

In this study, there are certain limitations of the design and findings. Though my choice of a case study design afforded me the opportunity to study the teacher unit planning processes and products in-depth, it also presents constraints. Yin (2013) stated that, "Rather than thinking about your case as a sample, you should think of it as the opportunity to shed empirical light about some theoretical concepts or principles" (p. 40). This study also includes some interview questions regarding hypothetical situations, such as disruptions caused by unexpected schedule changes. The teachers' responses would not necessarily be comparable to their unit planning processes for actual students. Because statistical generalization is not the purpose of the case study design, I make no claims that what I have found in studying these five teachers is indicative of teachers as a whole. However, I do claim that what I found in studying these five teachers has allowed me to explore the processes and products of the teachers' unit planning, which informed the answers to my research questions.

CHAPTER 4: FINDINGS

The purpose of this study was to understand how experienced mathematics teachers design curriculum units, including their unit planning processes and products. The teachers' unit planning processes were not linear or static; they were cyclical and ongoing. The creation of unit planning products occurred differently from teacher to teacher in terms of types, purposes, and elements comprising their unit planning products. Each of the teachers taught the same course (Algebra I) for multiple years without changing school buildings, so they had a sense of not only what mathematics content they needed to cover but also who their students were (e.g., students' strengths or weaknesses as a whole). I begin this chapter by detailing the teachers' unit planning processes. Then, I examine the products of their unit planning process. I close the chapter with a discussion of the aspects they prioritized in their unit plans.

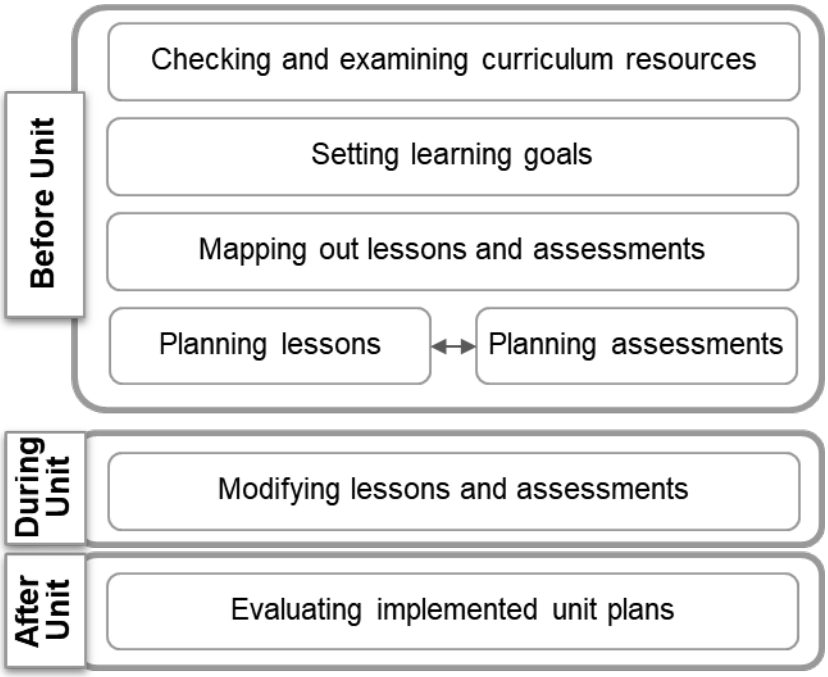
Processes of Unit Planning

The unit planning process involved a set of teaching practices. The order of these practices followed a general sequence for each teacher, however, there was some variation depending on when the teachers planned each unit and whether they planned the assessments first or the lessons first. The teachers' unit planning process was cyclical and ongoing during three phases: a) *before unit*, b) *during unit*, and c) *after unit*. All five teachers engaged in the same set of unit planning practices—a) *checking and examining curriculum resources*, b) *setting learning goals*, c) *mapping out lessons and assessments*, d) *selecting tasks and planning lessons*, e) *planning assessments*, f) *modifying lessons*

and assessments, and g) *evaluating implemented unit plans*. The sequencing of these practices that emerged across the teachers is represented in Figure 8.

Figure 8

Common Practices and Sequence of Teachers' Unit Planning Process



There were seven common unit planning practices. Generally the teachers began their unit planning with *checking and examining curriculum resources* and ended with *evaluating implemented unit plans*. In the following sections, I discuss each of the unit planning practices in depth by illustrating common approaches and the timing of each unit planning practice across the teachers. I view the five teachers who actively design curriculum units as one case; therefore, instead of describing each teacher's unit planning process from beginning to finish, I have organized this chapter by providing examples of how the teachers enacted each practice within their unit planning. I also highlight similarities and differences across the teachers' enactments, as there were some variations in terms of sequencing and timing of each practice.

Checking and Examining Curriculum Resources

The first unit planning practice that all of the teachers did was *checking and examining curriculum resources*. This practice entailed examining available curriculum resources (e.g., district/state standards, state assessments, textbooks) to identify the standards and objectives for establishing learning goals and mathematical ideas for the unit. Although there was some variation in terms of which curriculum resources they consulted and, to some extent, when they examined these resources during the school year, how they enacted this practice was consistent across the teachers.

All of the teachers began their unit planning by reading through the standards listed on state/district curriculum resources. Although these were a set of standards chosen by the state/district, the teachers noted there were still too many standards to cover in Algebra I. Thus, as they read through the standards, the teachers identified which standards they thought must be covered in each unit within the given time frame (i.e., school days). For example, Mr. Anderson discussed how one of his district curriculum resources listed a large number of standards that the district expected him to teach. He noted that almost all of the standards listed in the curriculum resources were labeled as *key* standards, which means his district wanted teachers to prioritize these standards when they teach. Based on his experience, however, it was not possible to cover all these standards in the given timeframe:

> This is what we get from the district. On the left side, you get a list of standards, written in 'fancy' language. With keys next to the ones [standards] that they [the district] think are 'key' standards; you'll notice that it's almost all of them. And in many cases, it is all of them.

> And then on the right half, they tell you which chapters in the district content you're supposed to line it up with. […] So, I would start with this in the sense of looking at what topics are they covering. (Mr. Anderson, First Interview, 10/16/2020)

Thus, as the first step in unit planning, Mr. Anderson thought it was important to examine the district's standards and identify those he deemed essential so that he could use those to shape his learning goals for the unit. District standards were the most common curriculum resource that all of the teachers read through to help identify what content they need to cover in Algebra I.

All but Mr. Cabal mentioned that they also examined other curriculum resources besides the state/district's list of standards to ensure alignment across the curriculum materials they used. To determine what they need to cover in their Algebra I course, the teachers attended to how each mathematical topic was represented in the resources and assessments, such as how the topics were sequenced or described in each standard. For example, Ms. Vincent examined state assessments and textbook standards to ensure alignment among these curriculum materials. She described the importance of this practice for helping design instruction that allowed students to meet the necessary learning goals not only for the current course and its state assessments but subsequent mathematics courses as well:

> I look at the textbook, and we have state assessment. So I also look at what serves standards around the state tests to see where it aligns with the chapter. So I know exactly what I need to cover for that test and also what I want to cover it to get them ready for Algebra II and

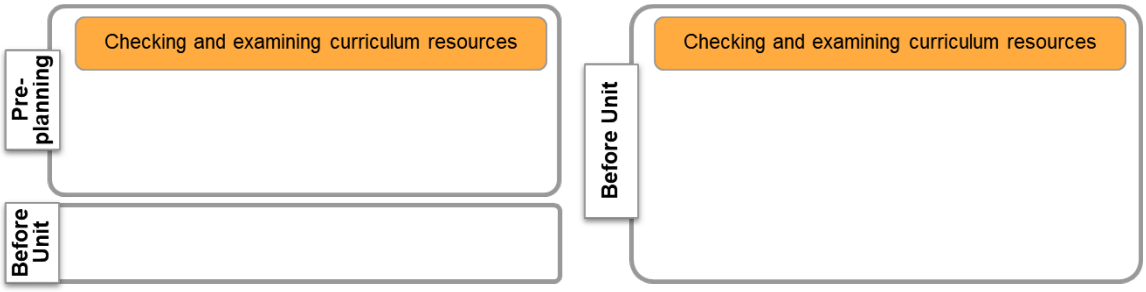
> Geometry. So, usually start with the standards part of it. (Ms. Vincent, First Interview, 10/26/2020)

Ms. Vincent examined the actual items on the assessments to review "what will be assessed" so that she can determine what she needs to cover in her Algebra I course. In the later interview, she expressed that she would like to have more test preparation with students if time is allowed. In general, it was clear that not only curriculum resources but also assessments influence the mathematics content that the teachers plan to teach.

Although the teachers typically began their unit planning process by examining these curriculum resources, not all of the teachers examined these resources at the same time of the school year. The timing depended on whether or not the teachers planned larger curriculum levels. One group of teachers—Mr. Anderson and Mr. Cabal—examined curriculum resources in their extensive *pre-planning* phase (Figure 9a), when they did quarter planning and year planning. Mr. Anderson discussed that he created his plans for each quarter at the beginning of the school year, so he began with the district's content standards to see which standards and textbook chapters align with one another. The other teacher, Mr. Cabal, also discussed that he did most of his planning during summer because he wanted to focus more on checking students' understanding and progress during the school year. As a result, he spent extensive time during the summer updating his plans and instructional materials, which included checking his curriculum resources as part of it. The teachers in this group, Mr. Cabal and Mr. Anderson, completed *checking and examining curriculum resources* at the beginning of the school year, or even before the school year began.

Figure 9

Checking and Examining Curriculum Resources in Unit Planning Process



(a) (b)

In contrast, the other group of teachers—Ms. Harris, Ms. Vincent, and Ms. York—examined curriculum resources both before every unit and as the school year progressed (Figure 9b). For example, Ms. Harris and her colleagues started unit planning over the summer, but they only completed their planning for the first unit just before the school year began:

> We basically plan the next unit as we're doing [the current unit]. So right now, we did planning over the summer but we spent all of our time to plan in Unit 1. And so, you know, it [Unit 1] was awesome but now we're in Unit 3. We're teaching it right now, and we're planning Unit 4 (Ms. Harris, First Interview, 10/14/2020)

Thus, throughout the school year, the teachers repeatedly came back to examine the relevant curriculum resources and the standards on those resources before each subsequent unit. Like Ms. Harris, the other two teachers—Ms. Vincent and Ms. York—also examined curriculum resources whenever they planned each unit.

Overall, *checking and examining curriculum resources* was the first practice in the teachers' unit planning process. It also was a prerequisite for the subsequent unit planning practices, such as *setting learning goals*. The teachers noted the importance of beginning with *checking and examining curriculum resources* as it "helps determine what

your lessons will be [and] what you're covering" (Ms. Vincent, First Interview, 10/26/2020). Regardless of when the teachers planned each unit, the teachers began their unit planning with checking and examining curriculum resources and it guided the subsequent unit planning practices, such as *setting learning goals*, *planning lessons*, or *planning assessments*.

Setting Learning Goals

The second unit planning practice, carried out by all but one teacher, was *setting learning goals*. This practice entailed setting specific goals that the teachers wanted students to achieve by the end of the units. Although the teachers enacted this practice right after they examined curriculum resources, there was some variation in terms of the types of learning goals the teachers created and how the teachers enacted this practice, which I will outline in this section.

All of the teachers who created some types of learning goals for each unit did so immediately after they examined curriculum resources, but before they planned out the components of unit plans, such as lessons, assessments, or tentative schedules for the unit. The sequence of the first two practices was illustrated in Figure 10. For example, Mr. Anderson created a list of standards that he would like to cover in each unit once he read through the district standards. The other four teachers did not explicitly mention what time of the year they set their learning goals. However, it was clear that they established these learning goals before they planned lessons or assessments because they selected tasks and developed assessments based on these learning goals. *Setting learning goals* immediately followed *checking and examining curriculum resources* regardless of

whether the teachers set their learning goals in the *pre-planning* phase or the *before-unit* phase.

Figure 10

First Two Practices of Anderson and Cabal (Left) and Harris, Vincent, and York (Right)

(a) (b)

For establishing learning goals for each unit, the teachers created their own curriculum documents (e.g., a list of standards for each quarter) by adapting the standards listed on state/district/school curriculum resources. For example, Mr. Anderson (Figure 10a) created his own quarterly plans once he had a clear sense of what he needed to cover based on available curriculum resources:

> Once I've looked at what topics they're covering, that's when I would make that [quarterly] standard sheet that has like the seven or eight standards per quarter . . . so then I would make, that's the first thing I create. I take the district standard sheet and I reduce it to the standards that I think I can cover in a quarter. And I tried to put them in order that I think I would put them in. So I try to think about what concepts make sense to come before other concepts. So that's what that standard sheet really helps me with, too. Just like 'What five or six, seven things am I going to cover this quarter?' (Mr. Anderson, First Interview, 10/16/2020)

I unpack the details of Mr. Anderson's quarterly plan documents in the later sections. These quarterly plans listed a set of topics (e.g., linear functions) in a sequence. In a similar sense, Mr. Cabal and Ms. York created a set of learning goals for each unit, which were called learning targets. The teachers broke the standards listed on the curriculum resources into smaller pieces so these were in more teachable and manageable sizes. For example, the teachers rewrote the standards listed on the curriculum resources using student-friendly words, such as "I can identify key features on a linear graph (origin, x-intercept, y-intercept, increase/decrease)." One teacher, Ms. Harris (Figure 10b), listed learning goals on her class note packets for her students but she did not specify when or how she determined learning goals in the interview. However, the last teacher, Ms. Vincent, did not list learning goals on any of her curriculum materials nor discuss whether she determined learning goals.

As with *checking and examining curriculum resources*, *setting learning goals* was another prerequisite to other unit planning practices (e.g., *selecting tasks and planning lessons*; *planning assessments*). In particular, Mr. Cabal thought about where he and his students ended up after completing the unit. Such unit-end goals (e.g., understanding, particular skills) guided his development of tasks, lessons, and assessments that compose units:

> I like to use that 'backward design' where I think back to like, "What's the whole picture where we're trying to end up?" and start with the learning targets and then from there develop the resources and the notes that would lead to them being able to identify those learning targets and then having units build up on each other so that by the end of the year

> they've got a pretty solid exposure to the basic algebraic concepts. (Mr. Cabal, Follow-up Interview, 11/24/2020)

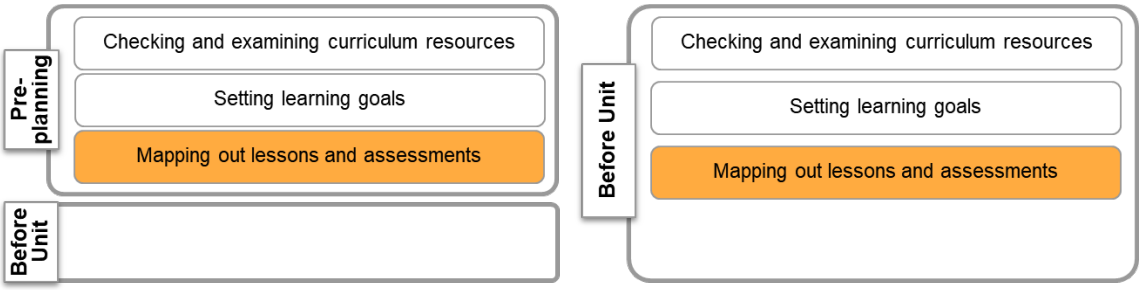
To summarize, the teachers set learning goals immediately after they examined curriculum resources but before they developed lessons or assessments. In *setting learning goals*, the teachers reduced the number of standards that they needed to cover in each unit and/or broke the standards into smaller chunks of standards, then created learning targets. Recreating standards into smaller and more simple learning goals allowed the teachers to feel that these end-unit goals were more manageable and teachable. As these established learning goals or targets guided what to cover and how to teach in the unit, *setting learning goals* set the stage for the other unit planning practices.

Mapping out Lessons and Assessments

The third unit planning practice was *mapping out lessons and assessments*. The teachers developed a schedule for lessons and assessments, which included the sequences of lessons and assessments (i.e., in which order they want to deliver the lessons) and pacing of lessons/units (i.e., how many days they want to spend on each lesson). All the teachers developed a schedule of lessons and assessments after they established learning goals but before they selected lessons or planned assessments (Figure 11). However, there was some variation in terms of how they mapped out lessons and assessments. Like the previous two unit planning practices, *mapping out lessons and assessments* served as a prerequisite to the subsequent practices. The teachers thought about the schedule first and then thought about details of lessons and assessments of the unit.

Figure 11

Mapping out Lessons and Assessments in the Pre-planning *and* Before-unit *Phases*



(a) (b)

To map out lessons and assessments, Mr. Anderson and Mr. Cabal created a schedule for the entire year in their pre-planning phase (Figure 11a). Before the school year began, they planned out in which order they would teach certain topics and how many days they would spend on each (sub-)topic. In contrast, Ms. Harris, Ms. Vincent, and Ms. York determined the schedules unit by unit as the school year went on (Figure 11b). Because these three teachers planned every unit right before it began, they set a tentative schedule for each unit and often changed it based on students' understanding and progress towards the desired learning goals. The details of schedule changes are discussed in the later sections.

In terms of how the teachers enacted this practice, the teachers considered how many days they would spend on each lesson and topic and how many days they have in each quarter. Three of the teachers—Mr. Anderson, Mr. Cabal, and Ms. Vincent—discussed how they planned out lessons. They said they planned out lessons based on how many days each unit typically took in previous years. For example, Ms. Vincent said that she learned how students do in each unit (e.g., what challenges students to encounter, how many days she needs to teach each small concept) through her teaching experience. She planned out a schedule for the unit based on "what section" she would cover each day and "how many days" it would take to cover that section (Ms. Vincent, First

Interview, 10/26/2020). Thus, based on her experience, Ms. Vincent assigned an expected number of days to each unit and lesson. In contrast, Mr. Anderson began with counting how many school days he had in each quarter and what concepts he needed to cover in the quarter.

Regarding the sequences of mathematical content, the teachers used different sequences to teach linear functions. There were two groups —(1) Ms. Harris and Ms. Vincent followed the given sequence of lessons to teach linear functions, and (2) Mr. Anderson, Mr. Cabal, and Ms. York created their own sequences of lessons.

In the first group, Ms. Harris and Ms. Vincent followed the pre-designed sequence of lessons in the unit of linear functions. Both teachers used *Big Ideas Math* (Big Ideas Learning LLC., CITE), one of the most commonly used high school mathematics textbooks (Hayes, 2018), and followed the lesson sequences in the textbook. Both teachers began the linear function unit with a lesson on the definition of functions, which included the definitions of the domain, range, or function. They then moved to another lesson on the linear relationships between two values using tables, set diagrams, and graphs. In the third or fourth lesson, they introduced the concept of slope and then moved to slope-intercept and standard forms at the end of the unit (Table 5).

Table 5

Lesson Sequences of Linear Functions of Big Ideas Math, Ms. Harris, and Ms. Vincent

Big Ideas Math*	Ms. Harris	Ms. Vincent
Chapter 5 Linear Functions	Unit3 Linear Functions	Unit 3 Linear Functions
5.1 Domain and Range of a Function Ext. Relations and Functions 5.2 Discrete and Continuous Domains 5.3 Linear Function Patterns 5.4 Function Notation Ext. Special Functions 5.5 Comparing Linear and Nonlinear Functions 5.6 Arithmetic Sequences	3.1 Introduction to Functions 3.2 Determining if a Relation is a Function 3.3 Intro to Linear Functions 3.4 Slope 3.5 Slope-Intercept Form 3.6 Standard Form of a Linear Function	3.1 Function 3.2 Linear Function 3.3 Function Notation 3.4 Slope-Intercept Form 3.5. Standard Form

Note. *The lists of content were recreated and retrieved from https://www.bigideasmath.com/review/algebra1_toc_fl2.php

Ms. Harris described her principles for determining the sequence of lessons in a unit: "We go from the textbook unless we all agree that we would like to do it in a different order. So it's not really like research-based (Ms. Harris, First Interview, 10/14/2020)." As Ms. Harris stated, she and her colleagues in the same department essentially adopted the sequence of lessons in the textbook, and they sometimes adjusted the given lesson sequence by combining or omitting some sections of the unit rather than replacing them with other tasks or lessons or adding additional tasks or lessons to the given sequence.

Although there are no significant differences between the lesson sequence of Ms. Harris and that of Ms. Vincent, Ms. Vincent talked about her sequencing principle in addition to just benchmarking the lesson sequences in the textbook. Ms. Vincent mentioned that she usually put lessons with simple and foundational concepts at the beginning of the units and complex and application concepts at the end of the units:

> I take all those things when I build those lessons, and I always start with the simple stuff first at the beginning of the chapter, like almost in the textbook. And then I sometimes followed the sections in order, and other times I don't like how the book is laid out so I'll switch the order. I just think, sometimes I can feel off a topic better than what the book can be. It kind of jumps around. And then I just keep building on that; we do application problems [at the end of the chapter]. (Ms. Vincent, First Interview, 10/26/2020)

No other teacher mentioned this simple-first and complex-later principle in their interviews, but I also found that none of the teachers began the linear functions unit with an application problem or a complex concept, like perpendicular or parallel lines.

The second group of teachers, Mr. Anderson, Mr. Cabal, and Ms. York, determined the lesson sequences based on their own principles. However, the principles were not clear. Mr. Anderson and Mr. Cabal said they put the standards and lessons in the order that they think "make sense to come before other concepts" (Mr. Anderson, First Interview, 10/16/2020). Fortunately, Mr. Cabal mentioned the following in his interview:

> Essentially, I guess when I was first handed over everything [from the teacher who taught Algebra I before me], I tried to organize it and sequence it in a way that built up concepts. So, like, previous unit concepts would help build up to understanding four units that were further along. So I guess I chose what made the most sense sequentially in terms of sequence. (Mr. Cabal, First Interview, 10/09/2020)

Mr. Cabal also mentioned "what made the most sense sequentially," but tried to put lessons in an order such that the prior lessons would give students more foundational

work and concepts to learn in the later lessons. Mr. Anderson and Mr. Cabal began the linear function unit by introducing the concept of slope and then moved to slope-intercept form with graphing. Mr. Cabal then moved to the situations of two lines lying on a coordinate plane—perpendicular and parallel lines and its relationships, while Mr. Anderson moved to the concepts of function, including domain, range, function notation, input, output, etc. Mr. Anderson's lesson sequence for the unit of linear functions is the opposite of the other four teachers because the other four teachers put the concepts of function before the unit of linear function as a more foundational work than linear function (Table 6).

Table 6

Mr. Anderson's and Mr. Cabal's Lesson Sequences of Linear Functions Unit

Mr. Anderson's	Mr. Cabal's
Module 2. Linear Functions	Unit 3. Linear Functions
2.1 Intro to Slope	3.1 Determining Slope
2.2 Graphing Using Slope-Intercept Form	3.2 Determining Slope
2.3 Write Linear Equations from Graph in Slope-Intercept Form	3.3 Slope-Intercept Form
	3.4 Slope-Intercept Form
2.4 Graphing from a Story	3.5 Slope-Intercept Form & Quiz
2.5 Domain and Range	3.6 Parallel & Perpendicular Lines
2.6 Functions and Function Notation	3.7 Parallel & Perpendicular Lines
2.7 Inputs and Outputs	3.8 Unit Review
2.8 Intercepts and End Behavior	3.9 Unit Test

Ms. York is the only teacher who began with lessons on plotting points in coordinate planes and then moved to lessons on slopes and intercepts of linear functions without introducing the concepts of function. She mentioned the following in her interview:

> I really pulled on, like, that relations and functions and linear [relationships], but I didn't go too much into relations and functions more than, like, 'This is a graph.

> This is an equation. This is a table. Here they are.' We can move between them and they mean the same thing. (Ms. York, Follow-up Interview, 12/17/2020)

Instead of elaborating on the concept of functions, she wanted her students to have a sense that these different representations really mean the same relationships between two variables. This is a unique unit design among the teachers, although she used *Big Ideas Math* to pull some problems or definitions. It is interesting to see how the teachers used the same textbook but very differently. Ms. Harris and Ms. Vincent benchmarked the given lesson sequence in the textbook, but Ms. York only used tasks and problems, not the lesson sequence in the textbook.

In terms of schedule types that the teacher created, Ms. York and Ms. Vincent only created relatively short but flexible schedules compared to the other three teachers. Ms. York and Ms. Vincent only planned tentative weekly schedules instead of long-term schedules (e.g., monthly or quarterly schedules). To make schedules flexible enough to accommodate any changes, they only scheduled a week or two in advance instead of mapping out lessons and assessments throughout the unit or beyond. Ms. York said that she often needed to adjust the schedule based on her students' progress during the unit, so she preferred to create flexible schedules. Ms. Vincent noted that a detailed unit schedule might be less helpful for her because it was so common to make changes to the schedule.

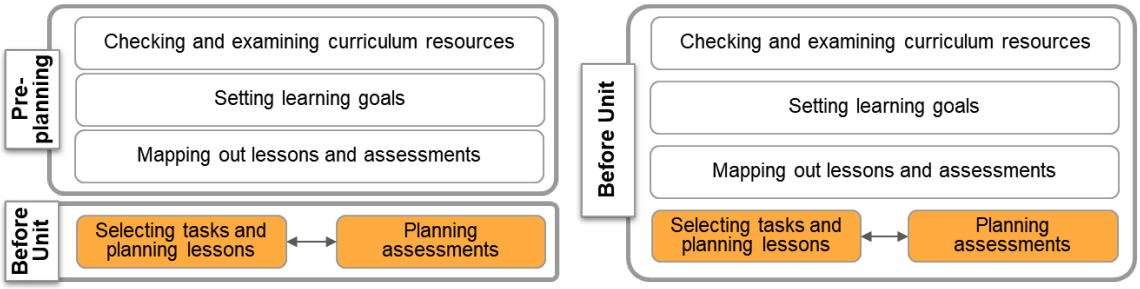
To summarize, *mapping out lessons and assessments* was the third unit planning practice and it typically occurred after the teachers determined learning goals. There was some variation in terms of the duration and flexibility of unit schedules. Although these schedules were tentative, they helped teachers think about the pacing and timing of the lessons and assessments for the unit.

Planning Lessons and Planning Assessments

Planning lessons and *planning assessments* were the last two unit planning practices that occurred in the *before-unit* phase (Figure 12). Before the unit began, the teachers planned lessons and developed assessments that aligned with the established learning goals. While the teachers were consistent in how and at what time of the school year they enacted these two practices, there was some variation in terms of the sequences of these two practices that the teacher enacted.

Figure 12

Examples of Teachers' Planning Lessons and Planning Assessments



The teachers fell into two separate categories based on what they plan first—either assessments or lessons. The first group—Mr. Cabal and Ms. Harris—set assessments (e.g., quizzes, tests) first, then created class note packets including activities and tasks that corresponded to lesson plans aligned with those assessments. For example, Ms. Harris and her colleague first set the common assessment for the students who were taking Algebra I at the school, then picked activities and designed lessons. In addition to the common assessment, the teachers wanted to have coherence across the lessons and assessments. So, she and her colleagues selected mathematics problems based on their established learning goals for both assessments and homework:

> So we try to make like the Delta Math homework. If you've done all the homework, then you know how to do the test . . . we take the same skills from the test [and then] make it homework. So you've seen all the test skills as homework before. (Ms. Harris, First Interview, 10/14/2020)

Once the teachers set the assessments, they selected problems from the same resource so that they would have coherence between assessments and lessons. As Ms. Harris and her colleague used Delta Math for their assessments, they wanted to make sure they covered similar problems either in lessons or as homework assignments so that students were familiar with the types and styles of assessments. If they had planned lessons first, then they would have more difficulty in planning assessments.

The other group—Mr. Anderson, Ms. York, and Ms. Vincent—selected activities that they wanted to do with their students, then planned assessments aligned with those activities. For example, Mr. Anderson first checked pre-made activities, such as Desmos activities, and made sure the activities were good enough to achieve the established learning goals after completion. After he picked activities, he adapted assessments from online or adjusted that he had in a previous year:

> So usually I develop the test items after I develop the learning activity. But then when I go and build the test or quiz, then sometimes I realized that my learning activity isn't going to address the questions that I'm finding readily available. So sometimes that results in a change in the lesson plan. But usually I try to just pick items that match what the learning activity already was. So there's a little bit of back and forth,

> but usually it's picked the learning activity first and then picked assessment items that match. (Mr. Anderson, Follow-up Interview, 11/13/2020)

For Mr. Anderson, then, the sequence of *planning lessons* and *planning assessments* was not linear. There was a little bit of back and forth because there were some occasions when he went back and changed his plans for the lesson. However, in his case, the process generally flowed from designing lessons to designing assessments.

The common approach to planning lessons and assessments was updating the lessons and assessments that the teachers had each used in the previous year. Instead of creating new materials from scratch, the teachers wanted to use the ones that they had used before and replace some activities, lessons, or assessments. For example, Mr. Cabal described what and how he modified his:

> I think they [assessment items] just been modified from whenever I was inherited them. So I try to change them frequently either by scrapping the entire problems or changing the wording and the organization of them. So I mean it's a continual process of modifications until I'm satisfied with it. And I'm sure that going forward, I'll probably change some things as well, just to include what I want it to look like. (Mr. Cabal, Follow-up Interview, 11/24/2020)

Like Mr. Cabal discussed, the teachers modified the assessment items, but mostly wording, for more clarity. In addition to taking out entire problem sets or changing the wording, the teachers slipped in another lesson or quiz if they felt it was needed:

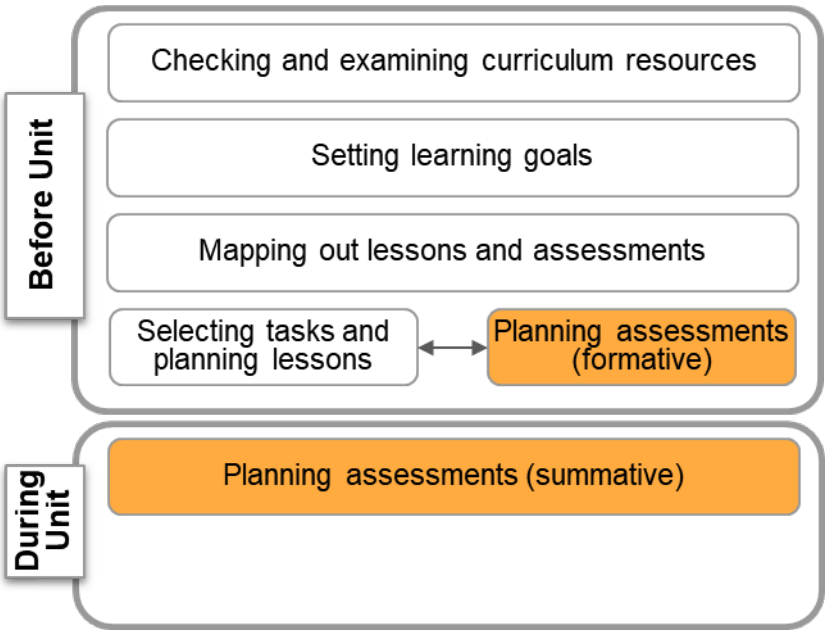
> I have courses already built in here [the online learning platform] where I can go in and reuse a previous quarter. But I'm always tweaking it constantly tweaking it. So I might look at it and say, 'well, actually want another sequence quiz' or 'I want another linear systems quiz' and [then] I'll just make another one. (Mr. Anderson, First Interview, 10/16/2020)

Although Mr. Anderson already had a set of lessons and assessments, he examined his materials from a previous year and sometimes added another quiz if needed.

No matter the sequence of planning lessons and planning assessments, all but Ms. Vincent set their assessments before the unit began (Figure 13).

Figure 13

Ms. Vincent's Planning Assessments in Unit Planning Process



Ms. Vincent, on the other hand, planned assessments on two different occasions—once before the unit and another during the unit:

> Formative assessments, I create as I make a lesson. So I'll make smart board notes I see what's on there or when I'm creating the homework. And then I modeled formative assessments off of what I'm asking in class . . . I then build a test based on the quizzes and other formative assessments between the quizzes and test. The quiz lets me know what they are understanding [and] what they need more help with. So I put those items back on a test to see if they've improved or not in those regards. (Ms. Vincent, First Interview, 10/26/2020)

Ms. Vincent first planned formative assessments (e.g., quizzes) when she planned her lessons, and then planned summative assessments (e.g., tests), based on the formative assessments, as the unit went. For her, *planning assessments* did not just occur before the unit but rather throughout the unit so that she would fully reflect what she taught and accurately measure students' progress towards the established learning goals.

To summarize, before the unit began, all the teachers enacted both *planning lessons* and *planning assessments*. Despite some overlaps between these two practices, the teachers enacted one at a time. Due to teaching the same course over multiple years, the teachers primarily modified the lessons and assessments that they used in a previous year by replacing the pre-made tasks adapted from online resources or textbooks with their own inventions.

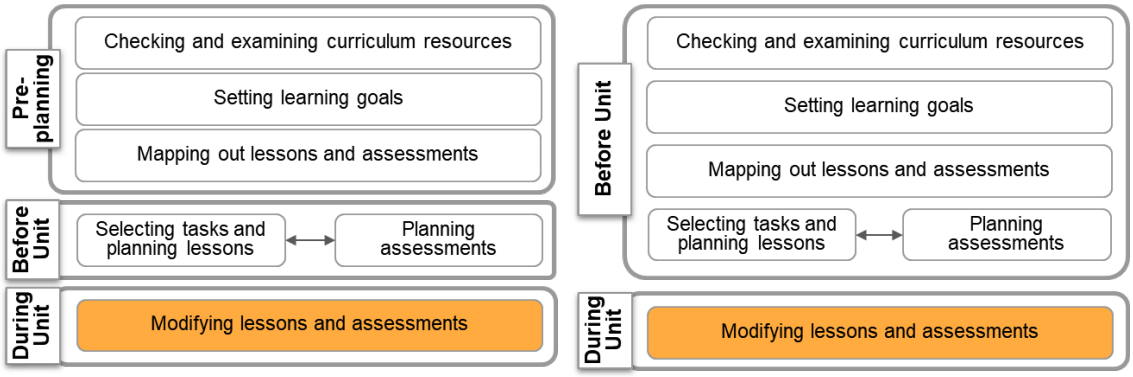
Modifying Lessons and Assessments

The next unit planning practice that all the teachers did was *modifying lessons and assessments*. Although the teachers planned out most of the lessons and assessments before the unit began, the teachers' unit planning process was not finished yet. Rather,

during the unit, the teachers monitored students' understanding and progress toward the established learning goals. Based on the monitoring, they modified their unit plans, including unit pacing and assessments. As the unit was already in motion, the teachers did not drastically change their planned lessons or assessments. Rather, they primarily slowed down the pace of the unit or made small changes to the planned summative assessments (e.g., unit tests). The teachers' unit planning process up to *modifying lessons assessments* is represented in Figure 14.

Figure 14

Modifying Lessons and Assessments in the During-Unit *Phase*



First, the most common modification during the unit was changing the unit pacing, and specifically slowing down the unit pacing, especially when teachers noticed students' progress toward the learning goals was getting behind the planned pace. Using a variety of formative assessments (e.g., warm-ups, exit tickets, questioning), the teachers monitored students' understanding and decided whether they would stay longer on a certain topic or provide extra time to prepare the summative assessments. For example, Ms. York discussed how she decided to change her planned unit schedule:

> But students aren't being there that I want them to be, right? . . . They'll take an exit ticket. We've done a quiz, something like that. And it's just

> like they're not where I'm wanting them to be. And so I will just hold whatever the plan was for the next day and go back and remediate . . . if I realized as a class it's not going where I want it to go, then I just adjust and make those changes as I see fit really ultimately to get to whatever the end goal is. (Ms. York, First Interview, 10/16/2020)

When Ms. York noticed students were getting behind where she had anticipated, she slowed down her unit pacing and made sure the students were getting back on track before she proceeded to later lessons in the unit. Another teacher, Mr. Cabal, also changed his planned unit pacing and provided extra time for test preparation when his students were not ready for taking a test. Instead of sticking with what he planned, Mr. Cabal decided to provide extra time for students to study and prepare for their unit tests:

> I made up for some of the last class for time on the unit review day because normally they [other teachers] give students options to work on the unit review. But there was really no one ready for it. So I just gave them more classroom time on that day as well. (Mr. Cabal, Follow-up Interview, 11/24/2020)

Based on Mr. Cabal's examination of his students' preparedness toward the summative assessment, he decided to give students more time to prepare for their tests. It is clear overall that the teachers primarily slowed down the planned unit pacing; none of the interviewed teachers sped up their pacing.

Second, the teachers modified their assessments in the process of finalizing the assessments during the unit. Two teachers changed their assessments, one because they did not teach the content as planned, and the other because they had not had enough time

to meet and discuss students' progress and thus to make decisions collaboratively within their department. For example, Ms. York made modifications to the planned tests as she noticed her students were not close to the learning goals that she established at the beginning of the unit planning:

> I would say, a lot of times I write the test in the beginning, based on those standards, like the learning targets that I've created focusing on because 'Here's what I want them to know.' But definitely, it's happened multiple times in teaching this [unit], if we didn't get there, so then I will re-write the test or revise based on what was actually taught. (Ms. York, Follow-up Interview, 12/17/2020)

Although she initially created her assessments at the beginning of her unit planning process, she revised the items based on what she actually taught and finalized them before the unit test. Ms. Harris also discussed her test modifications for the 2020–2021 school year:

> So, last year we would like [to] make sure the test was set before designing the rest of the content. And I pretty much didn't change the test, like, ever while I was teaching because it was really important for all the algebra teachers to have the same test. I don't think I really changed any tests like during while we were teaching unless. yeah, I don't think we did. But this year [2020-2021] is different because we do have, like the teachers do have more time to collaborate. This year, so we do meet every week and kind of check in, like how our students are doing, so we have, like, for I think our second test we did make

> some adjustments to it because like we were able to all talk about it in the middle of the unit, which wouldn't have happened last year. (Ms. Harris, First Interview, 10/14/2020)

As she highlighted, if the teachers had more time to meet and collaborate, then they would adjust test items as needed. It was not clear from the interviews what they adjusted on the test but it was clear that time is one of the influencing factors influencing test modifications.

To summarize, *modifying lessons and assessments* was the only unit planning practice that occurred in the during-unit phase. The teachers enacted *modifying lessons and assessments* after all of the plans were established, except Ms. Vincent, who continuously planned her assessment throughout the unit. In the *during-unit* phase, the teachers adjusted their planned unit schedule, but mostly focused on adjusting pacing, not lesson sequence. The teachers finalized the assessment items to reflect students' progress toward the targeted learning goals and what they actually taught in the unit.

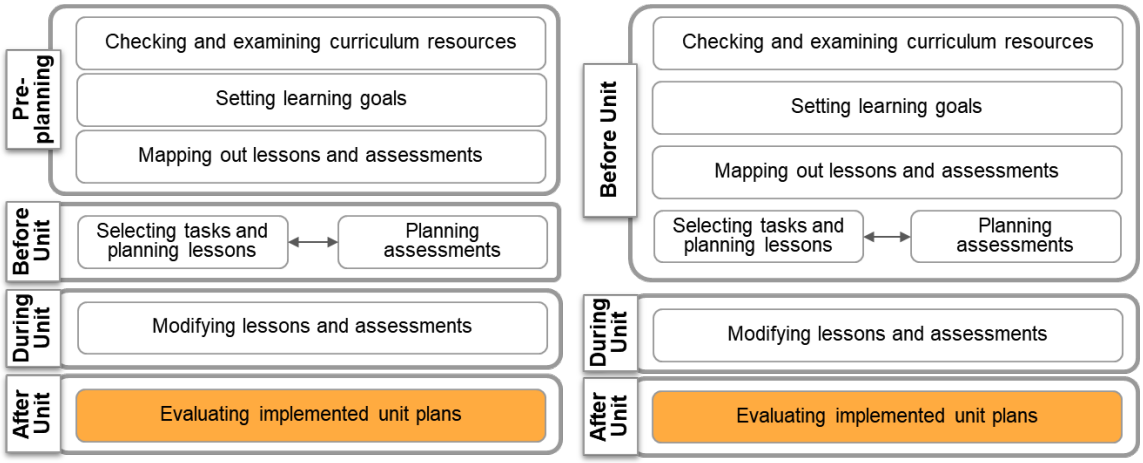
Evaluating Implemented Unit Plans

The last practice that occurred in the teachers' unit planning process was *evaluating implemented unit plans*. Even after implementing the unit, the teachers' unit planning did not end. This practice entailed self-assessment, evaluating not only what they planned but also how it was actually implemented, and feedback from their colleagues if they planned units together with other teachers in the same school and students regarding the unit. The teachers evaluated their enacted unit plans when they were almost done with the unit, though there were some variations in terms of how they evaluated their implemented unit plans.

Three teachers—Mr. Anderson, Mr. Cabal, and Ms. York—evaluated their implemented unit plans using students' feedback on the unit that they just completed. In addition to students' feedback, the teachers consistently checked whether their unit as they planned or not as expected. Although the teachers' own reflections occurred throughout the unit, collecting students' feedback on the unit occurred close to the end of the unit. The teachers got students' feedback later in each unit because the students had more ideas of how the unit went compared to the beginning of the unit. Figure 15 presents the timing of evaluating implemented unit plans within the unit planning process.

Figure 15

Evaluating Implemented Unit Plans in the After-Unit *Phase*



The first approach to evaluating implemented unit plans was collecting feedback from the students regarding how the unit went. For example, Mr. Cabal used this approach to learn from his students about the pacing of the unit and whether they had difficulty in learning the concepts. Mr. Cabal asked students how they felt regarding the unit pacing, using questions like, "Was it too fast or too slow? Was [it] difficult? Was [it]

too easy?" (Mr. Cabal, Follow-up Interview, 11/24/2020). Additionally, he asked students to review every resource he provided:

> For every classwork, again, the quizzes and tests as well. And then ask them, 'Would you keep this the same [or] change it or did you not do this?' and anytime they would want to change something, I asked them what they would want to change about it. Just so I can get some feedback. (Mr. Cabal, Follow-up Interview, 11/24/2020)

He tried to reflect on his students' feedback during the summer when he planned the forthcoming year. Ms. York also collected students' feedback, but focused more about their own reflection on the learning experience within the unit. Like Mr. Cabal, she repeatedly collected students' reflections every unit so that she had better knowledge of what students learned or where they had difficulty.

The second approach the teachers used was looking back on students' performance and reflecting on how the teachers themselves believed the unit plan unfolded. Mr. Anderson shared that he changed his unit plans this year for the students working from home. He broke the concepts into smaller pieces than a previous year and tried to make short lecture videos, although he felt this change was not effective for the students who came in person. Regardless of his efforts for the students at home, however, none of them really worked on the materials at all and he felt his efforts were useless:

> But last quarter when I did this one I was thinking the kids were going to work from home. So I built these lessons, thinking that this was stuff they could do from home, they aren't doing it from home. And so at the end of that quarter . . . I was so frustrated. I thought, nobody's doing

> this stuff from home. Why am I teaching in a way that I know is not as effective? For the kids who aren't doing it, why don't I go back to teaching what I know works for kids who are here and in person. (Mr. Anderson, Follow-up Interview, 11/13/2020)

Once Mr. Anderson noticed what he prepared did not work for his students, he concluded that he would go back to what he had done prior. Teachers' own reflection of how the plans went was used for deciding how to teach next year.

To summarize, teachers' unit planning did not end once they had plans for the units. Rather, their unit planning continued during and even after the unit. Three of the teachers explicitly discussed how they evaluated their implemented unit plans. These teachers examined how successful their plans were by collecting students' feedback using surveys and also by examining students' performance. The teachers collected the information regarding not only how their plans went but also how students felt about the implemented plans (e.g., pacing, content difficulty). As the three teachers did the survey or reflection at the end of each unit, they had a better sense of how students felt about each unit, including elements such as pacing or content. Thus, through this practice, the teachers grasped what they needed to keep or change for the following units or even the next school year.

Summary of Unit Planning Processes

To plan units, the teachers engaged with a set of unit planning practices not only before units but also during and after units. The teachers' unit planning processes were not linear or static but the practices were dynamic and ongoing. Although the teachers enacted the majority of the unit planning practices before units, the teachers continued

their unit planning as they monitored students' progress, modified what they planned, and re-evaluated their implemented unit plans once the units were over.

The teachers' unit planning practices had been enacted primarily one at a time, but these practices overlapped and were somewhat connected in practice. For example, all of the teachers established learning goals by first examining the standards listed on the available curriculum resources, then choosing some standards from the list of standards, and finally breaking those standards into smaller pieces, like learning goals, with student-friendly language. Thus, setting goals and examining curriculum resources happened simultaneously, making it hard to distinguish one practice from another.

In unit planning, the teachers kept discussing unit pacing and lesson sequences in addition to what to teach (i.e., standards). Moreover, the teachers mapped out lessons and assessments of the unit using a calendar. Mapping out lessons and assessments included the pacing and sequence of lessons within each unit but also, for some teachers, the pacing and sequence of units for the entire course. For those teachers, unit planning was part of planning for a larger curriculum unit, such as quarter planning or year planning. These teachers thought about the bigger pictures first, like where these units need to be placed during the school year and how long they take to cover each lesson or unit. The teachers made decisions based on their experience from a previous year and their anticipation of how their students would do in the units.

Overall, the teachers planned their courses unit by unit instead of lesson by lesson. Curriculum units (e.g., chapters) were the unit of planning for most teachers. The teachers set learning goals for each unit but they did not set overall learning goals for the entire course. Similarly, the teachers ended each unit with an assessment (e.g., unit test)

for checking whether students achieved expected learning goals. For the teachers who planned one unit by one unit as the school year went on, they repeated the entire cycle with the seven unit planning practices. For the two teachers who planned the entire course in their *pre-planning* phase, they tended to map out units and quarters for the entire year instead of only the upcoming units.

To summarize, the unit planning processes consisted of a set of common practices that most of the teachers enacted repeatedly throughout the year. For some teachers, unit planning was part of year/quarter planning instead of its own entity, and the details of each unit were determined when the teachers planned out the year and quarters. Many of the practices occurred before the unit began. Once the unit was underway, the teachers only made small changes, such as slowing down the planned unit pacing or aligning assessment items with what they taught. As the unit was nearly complete, the teachers evaluated their implemented unit plans and used the information for improving their upcoming units.

Products of Unit Planning

To fully understand the teachers' unit planning, it is important to document what they actually created as a result of unit planning. As with the processes of teachers' unit planning, I found that the products of teachers' unit planning differed teacher by teacher in terms of types, purposes, and elements comprising the products. The common types of unit planning products included the plans for a larger curriculum level (e.g., quarter plan), the learning target trackers, the curriculum guides (i.e., unit overview), the class note packets, and assessments. The types of products created by each teacher are summarized in Table 7.

Table 7

Summary of Unit Plan Products Organized by Unit Planning Practices

	Mr. Anderson	Mr. Cabal	Ms. Harris	Ms. Vincent	Ms. York
Checking and examining curriculum resources	NA	NA	NA	NA	NA
Setting learning goals	Quarter Tracker	Syllabus Curriculum Guide	Note Packet	NA	Priority Standards* Learning Tracker
Mapping out lessons and assessments	Quarter Outline*	Curriculum Map*	Note Packet	NA	Long Term Planning* Unit Plan*
Planning lessons	Online Module	Note Packet	Note Packet Lecture Video	Handout	Handout
Planning assessments	Online	Pencil-and-Paper	Online	Pencil-and-Paper	Pencil-and-Paper
Modifying lessons/assessments	NA	NA	NA	NA	NA
Evaluating implemented unit plans	Teacher Evaluation	Self-reflection Student Survey	Self-reflection	NA	Self-reflection

Note. * Teacher-only materials that were not provided to students

In addition to the product types, there were some common elements of unit planning products across the teachers. The elements that each teacher considered and included in any unit planning product that they developed are summarized in Table 8. The common elements are those that three or more teachers included in their unit planning products (e.g., content standards, learning goals and learning targets, tentative schedules, assignments). In contrast, there were some elements that only a few teachers considered (e.g., practice standards, relevant resources related to each lesson/unit). Thus, when the teachers planned units, they created products mainly concerning a) unit focus (e.g., standards, learning goals), b) tentative schedule (e.g., pacing, lesson sequence), and c) instructional materials (e.g., note packet, tasks, assignments).

Table 8

Summary of Elements of Unit Planning Products

		Mr. Anderson	Mr. Cabal	Ms. Harris	Ms. Vincent	Ms. York
		Quarter Tacker; Quarter Outline; Online Module; Assessments; Teacher Evaluation	Syllabus; Curriculum Guide; Curriculum Map; Note Packet; Assessments; Student Survey	Note Packet; Assessments; Self-Reflection; Lecture Videos*	Handout; Assessments	Priority Standards; Learning Tracker; Long Term Planning; Unit Plan; Handout; Assessments; Self-reflection
Math Content & Goals	Math Content Standards	W	W			W
	Math Practice Standards					W
	Learning Goals/Targets	W	W	W		W
Assessment	Test Items	W	W	W	W	W
	Proficiency Specified					W
	Student Attitude					

Lesson/Task	Titles	W	W	W	M*	W
	Descriptions					W
	Tentative Schedule/Sequence	W	W	W	M*	W
	Relevant Resources	W				
	Differentiation					
	Relevant Standards	W	W			W
	Tasks/Activities	W	W	W	W	W
	Reflection Questions	W	W	W		W
	Assignment	W	W	W	W	W
Pedagogies & Lesson Structure	Questions			W		
	Time Allocations	W	W	W	M*	W
	Grouping of Students					W
	Equipment	M	W			

Technology	M	W			
Lesson Structure	W	W	W	M*	W

Note. W represents the element that appeared on teachers' written plans. M* represents the elements that did not appear on the plans but were discussed in the interviews.

There are two major themes in the teachers' unit planning products. First, not all of the teachers had products for each unit planning practice. In other words, some unit planning practices did not have any planning products. For example, while *examining curriculum resources*, the teachers did not create any written products, but they created some products while *setting learning goals*. As *checking and examining curriculum resources* and *setting learning goals* occurred simultaneously or immediately after the first practice, the unit planning products, such as syllabus, curriculum guide, or priority standards, were the products of these two practices. In addition to the connectedness between unit planning practices, some products of unit planning existed in a non-written format. For example, Ms. Vincent discussed that she had learning goals and tentative schedules in mind, but she did not specify or identify them in a written form. For this reason, not every unit planning practice produced curriculum documents as unit planning products.

Second, unit planning products were created for different audiences. Some products were created by the teachers for their own use. Three teachers—Mr. Anderson, Mr. Cabal, and Ms. York—created their curriculum documents purely for their own use instead of providing them to students or parents to inform the content of and tentative schedule of the unit or course. For example, Mr. Cabal created two different products, the *syllabus* and the *curriculum map*; the former was created for informing parents and students of the content and schedule, and the latter was created for recording and tracking his class schedule and pacing. Mr. Anderson and Ms. York also created such products (*quarter outline* and *long-term planning*, respectively); they only used these products for

planning lessons, assessments, and units throughout the year but did not provide them to students or parents.

In the following sections, I introduce the types and purposes of the unit planning products that were created as result of each unit planning practice (e.g., *setting learning goals*). For each unit planning practice, I explain how one teacher's unit planning products are similar to and different from another teacher's by comparing elements composing each product. At the end of this section, I summarize the compared and contrasted elements of unit planning products that each teacher created to make it more clear what teachers produced through their unit planning.

Standards and Learning Targets

The first set of products that the teachers created were curriculum documents listing a set of mathematics topics, standards, and learning targets. In *checking and examining curriculum resources* and *setting learning goals*, three teachers created documents listing mathematics topics or learning goals for each unit. Although the other two teachers did not create such documents, there was evidence that they considered and determined targeted mathematics content standards and learning targets for each unit. Thus, whether the teachers listed specific learning goals in a written form or not, they all established goals for the units, and those goals guided the teachers' subsequent unit planning practices.

Three teachers—Mr. Cabal, Ms. York, and Mr. Anderson—created their own curriculum documents, listing a set of mathematical topics and standards in the desired sequence. These documents were in a variety of forms beyond unit plans, such as quarter plans or year plans. For example, Mr. Cabal created *Syllabus* and *Curriculum Guideline*

(Figure 16), which included a) a list of topics, b) a sequence of the topics, and c) tentative schedules of the unit or course. While the syllabus served as a guide for the entire course, the curriculum guidelines served as a guide for each unit.

Figure 16

Mr. Cabal's Course Content in Syllabus (top) and Course Guideline (bottom)

COURSE OUTLINE:

The following topics will be covered throughout the course of the year. These are tentative dates for exams. All dates are subject to change, depending on coordination with other faculty members or school calendar changes. It may also change if it becomes necessary to spend more time on one topic, and/or less time on another, though we should do our best to stay on track. We would rather spend more time on fewer things than rush through with minimal comprehension in order to finish the schedule.

Unit 01 - Algebraic Manipulation
- Week 1: Introductions, Policies & Procedures, Properties of Mathematics, Solving Simple Equations
- Week 2: Solving Rational Equations and Unit Review
- Week 3: Algebraic Manipulation Test

Unit 02 - Functions
- Week 3: Properties of Functions and Evaluating Functions
- Week 4: Writing & Graphing Functions and Function Operations
- Week 5: Unit Review and Functions Unit Test

Unit 03 - Trigonometry
- Week 5: Trig Ratios
- Week 6: Calculating Side Lengths and Angles
- Week 7: Unit Review and Trigonometry Unit Test

Q1 Cumulative Exam
- Week 7: Q1 Review and Cumulative Exam

Unit 04 - Linear Functions
- Week 8: Determining Slope and Slope-Intercept Form
- Week 9: Parallel & Perpendicular Lines and Unit Review
- Week 10: Linear Functions Unit Test

02 - Functions Unit Overview

Topics:
- Forms of a function (equation, table, graph)
- Evaluating a function
- Graphing function
- Domain and range
- Determining if a data set is a function or not
- Function operations

Tentative Assessment Dates:
- Functions Quiz 1 (After 2.2 ~ 10/8)
- Functions Unit Test (After Unit Review ~ 10/15)

Ms. York also created two such documents, called *Priority Standards* and *Learning Targets* (Figure 17). These documents listed the content standards related to each unit and the corresponding learning targets for each standard. As mentioned in a previous section,

these learning targets were the learning goals that she wanted her students to "get out of" completing the units. As briefly highlighted in the previous sections, she created these documents because she wanted her students to check and track their understanding of these targeted learning goals for each unit. She mentioned that establishing learning targets was not just for her own use but also for her students because she believes the students would benefit from having these targets to track their progress towards the targeted learning goals.

Figure 17

Ms. York's Learning Targets (top) and Learning Target Tracker (bottom)

QUADRATICS	
Standards	*Learning Targets*
F.IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* CCSS.MATH.CONTENT.HSF.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* F.IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated	**LT: I can solve quadratic equations in context and explain the significance of the solutions.** *LT: I can identify and explain the purpose of maxima and minima of a quadratic function.* • *I can identify the vertex on a graph. (S)* • *I can use vertex form to identify the max/min. (S)* • *I can use the coefficients of standard form (-b/2a) to identify where the line of symmetry is. (S)* • *I can use factored form to find symmetry. (K)* • *I can use the line of symmetry to find the vertex. (K)* • *I can complete the square from standard form to find the vertex. (K)*

QUADRATICS LEARNING TARGET TRACKER

LT	Learning Targets	Scores			
L1	***I can identify and explain the purpose of maxima and minima of a quadratic function.***	Homework	Quiz	Quiz	Exit Ticket
L1:a	*I can identify the vertex on a graph.*	Homework	Quiz	Quiz	Exit Ticket
L1:b	*I can use vertex form to identify the max/min*	Homework	Quiz	Quiz	Exit Ticket
L1:c	*I can use the coefficients of standard form (-b/2a) to identify where the line of symmetry is.*	Homework	Quiz	Quiz	Exit Ticket

The other product that the teachers created during *setting learning goals* was a list of learning targets for students to track their own progress towards the learning goals. For example, Mr. Anderson called such documents *Quarter Tracker* (Figure 18). He provided

it to his students so they could track where they are and check whether they completed homework and assessments for each intended learning target. The teachers listed a set of learning targets that were smaller chunks of the standards listed on the curriculum documents.

Figure 18

Mr. Anderson's Quarter Tracker for the Unit on Solving Equations

Core Standard Priority Level 1 - Teach, Assess, Ensure 2 - Teach, Assess 3 - Teach		Standard Description	Assessment Description	Standard Learned
		Module 1: Solving Equations		
2		1.1a I can write algebraic expressions		
1		1.1 I can solve 1-step equations		
1		1.2 I can solve 2-step equations		
2		1.3 I can solve literal equations and combine like terms		

Whereas Mr. Anderson created such documents for each quarter, Mr. Cabal and Ms. York created such documents for each unit. These learning targets were usually listed in the order of their level of complexity (e.g., solving one-step equations came before solving two-step equations) but the order did not necessarily represent the sequence of actual lessons.

The other two teachers, Ms. Harris and Ms. Vincent, did not create such curriculum documents, but Ms. Harris included the focused learning goals on her class note packets. The details of her note packets are unpacked later. However, Ms. Vincent did not have any documents listing learning goals although she discussed that she examined the state standards and state assessments to know what she needs to cover.

Standards and learning targets were the first unit planning products that resulted from *setting learning goals*, in conjunction with *checking and examining curriculum documents*. Each teacher chose and listed a set of standards and learning goals on one or

more documents for both themselves and students. These documents were not just created for the teachers' own use, such as making sure the alignments between the standards and learning targets, but also created for informing the students of unit-end goals: what they are learning and where they are headed.

Curriculum Map and Unit Plan

The products of *mapping out lessons and assessments* were mostly schedules (both sequence and pacing) for each unit or quarter. There was some variation of what was included in each product but, overall, the teachers tried to include at least tentative schedules in terms of what topics would be covered and in what sequence they would cover them. When the teachers planned out their units, they did not just schedule each lesson and assessment but also considered how each lesson and assessment aligned with the standards and learning targets that they determined based on curriculum resources and selected learning goals for each unit.

In addition, the teachers developed tentative schedules and recorded them for their own use. The teachers created other documents (e.g., syllabus, class note packet) which also included tentative schedules, but these documents were created for informing students of upcoming topics, assignments, and assessments. However, the teachers did not distribute students or parents the documents that were created from when the teachers mapped out lessons and assessments. Rather, the teachers used these documents to check whether their pacing was on track. For example, Mr. Cabal created a document called *Curriculum Map* (Figure 19). Using a calendar, he specified titles of lessons, classwork, assignments, and assessments for each date. For each week, he also listed guiding

questions on the right side of the calendar, which guide each week's lessons and assessments.

Figure 19

Mr. Cabal's Curriculum Map

Resources:						
Day:	Monday	Tuesday	Wednesday	Thursday	Friday	Guiding Questions:
Date:		1	2	3	4	What are the properties of right triangles involving trignometric functions?
Theme:	Trigonometry					
Topic:		2.9 Function Operations	2.10 Unit Review	2.11 Functions Unit Test	3.1 Trig Ratios	
LESSON		HW 13; MFM; Classwork 2.4	Fire Drill (9-10 AM) HW 14;Self assessment;Q/A;Finish	Functions Unit Test	New seats;Unit overview;Self asses	
Date:	7	8	9	10	11	How do you calculate the missing component of a right triangle using trigonometric functions.
Theme:	Trigonometry					
Topic:	3.2 Trig Ratios	3.3 Finding Side Lengths	3.4 Finding Side Lengths	3.5 Quiz	3.6 Finding Components	
LESSON	Unit 2 Test Corrections;MFM;Clas	HW 15;Lecture 3.2 (Finding Side Le	HW 16; MFM; Classwork 3.2; Self assessment;	HW 17; Q/A; Quiz 3.1-3.2; Classwork	HW 18; 3.3 Lecture (Finding Components);z be//njn	
Date:	14	15	16	17	18	
Theme:	Trigonometry					
Topic:	3.7 Finding Components	3.8 Unit Review	3.9 Trig Unit Test	3.10 Corrections & Reflections	Q1 Cumulative Exam	
LESSON	HW 19; MFM; Classwork 3.3;	HW 20;Self assessment;Q/A;Finish	Turn in binders;Trigonometry unit	Review test;Test corrections;Reflecti		

Another teacher, Mr. Anderson, also created a planning product, called *Quarter Outline* (Figure 20). In this document, he listed all the lesson titles, main classwork activities, and quizzes for each quarter and put them in order. As he planned out each quarter based on how many days he had in the quarter, he listed his daily lessons throughout each quarter. For him, *Quarter Outline* was the document giving him an at-a-glance view of what he must cover each quarter.

Figure 20

Mr. Anderson's Quarter Outline

Math 1 Quarter 1 (23 A, 22 B)

1. Writing Expressions using Algebra
    a. Pool Border Problem (Desmos)
    b. 1.1 Quiz Creating Expressions
2. Solving Equations (1 step)
    a. Kuta Practice together
    b. 2.1 Quiz 1 Step Equations
3. Benchmarks (combine with lesson 4?)
    a. Benchmark
4. Solving Equations (2-Step)
    a. Kuta Practice together
    b. 2.2 Quiz 2 Step Equations
5. Literal Equations
    a. Combine Like Terms Practice
    b. Literal Equations Practice
    c. 2.3 Quiz Combine like terms…

Related to the practice of *mapping out lessons and assessments*, Ms. York created two similar documents—*Long Term Planning* and *Project Planning* (Figure 21). In both documents, she listed tasks and assessments that aligned with the established learning goals. On *Long Term Planning*, Ms. York not only assigned what she will do with her students (i.e., tasks and assessments) but also listed related standards from CCSSM and the learning targets that she created. On *Project Planning*, she planned what she would do with students each day of lessons. For her, these two documents served as not just plans for when to teach each mathematics concept but also her own analysis of how each lesson related to the standards and learning targets. She included her student grouping for each activity (e.g., group collaboration, the whole group debrief). These little notes served to remind her what she need to prepare for the class.

Figure 21

Ms. York's Long-Term Planning (top) and Project Planning Document (bottom)

Time	Common Core Standards	Learning Targets	Tasks	Assessment
Week 1	A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. F-IF.4 For a function that models a **relationship between two** quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. F-IF.9 **Compare** properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	LT1: I can identify Key Features on a linear graph (origin, x-intercept, y-intercept, increase/ decrease) LT 2: I can represent a linear function with a graph, table, or equation.	Day 1: -What makes a good graph? -Quadrants -Plot (x,y) coordinates -X & Y axis -Gather data -Create scatter plot -Challenge: Draw line of best fit, write equation, make a prediction Day 2: -Slope from stairs -Quiz-Quiz Trade graph vocab -Guided notes about graph -Circle Up Debrief Day 3: -Invisible rules of math notes -Plotting points to create graph	Day 1: -Completion of graph (not in class-homework) Day 2: -Something new I learned was……. -My thinking was confirmed about……. Day 3: -Exit Ticket

Day 1 Lesson Plan			Day 2 Lesson Plan
5 math facts about me (flipgrid)			Invisible Rules of Math
4 4s task			4 Representations Model
Group collaboration			iXL Q.1
Whole group debrief			Table from Equation Notes
IXL-B.1 B.2			Q.13
Need a notebook			iXL Grading (smart score 80-3)
			Debrief Jamboard (One new skill or idea I have developed from today was...)
			Google Form Exit Ticket (Complete table from equation)

As part of the *mapping out lessons and assessments* practice, the teachers created curriculum documents, including tentative schedules. These documents were primarily for teachers' own use, and each document recorded lesson titles, activities, assignments, and/or assessments for each date or week. Like the products from *selecting learning targets*, the details of each document varied, from Mr. Cabal's *Curriculum Guideline* (a calendar with notes) to Ms. York's *Long Term Planning* (a weekly schedule listing all the relevant standards, learning targets, tasks, and assessments).

Note Packets and Online Course Modules

When the teachers planned lessons and assessments, they created tangible materials/documents. Thus, when the teachers came to this phase of unit planning, they were more like to examine available resources and adapt them to put them in a format of lesson. The teachers put these tasks, assessments, and other items in queues and made them accessible to complete during each class period, allocating time for completing them into a given time frame.

All but Mr. Anderson created class note packets or handouts as result of *selecting tasks and planning lessons.* The teachers' class note packets included the most variety of elements among the unit planning products. The common elements included tentative unit schedules, mathematics tasks, and reflection questions for students. For example, Ms. Harris and Mr. Cabal created class note packets for each unit. They included tentative schedules in the front and reflection questions at the end of the packets. As described above, the teachers developed assessments first and then developed lessons so that they could create these note packets once they set assessments. In addition to a tentative schedule for the unit, Ms. Harris listed "essential questions" for each lesson, which were the overarching questions that guided the tasks and the entire lesson (Figure 22). She included these questions for her students to focus on what they learn about and where they are headed.

Figure 22

Ms. Harris's Essential Questions in Class Note Packet

Solving Systems of Equations by Graphing (5.1)

Essential questions:

What form should linear equations be in to be able to solve a system of equations by graphing?
How can you identify the solution to a system of equation on a graph or on a table?

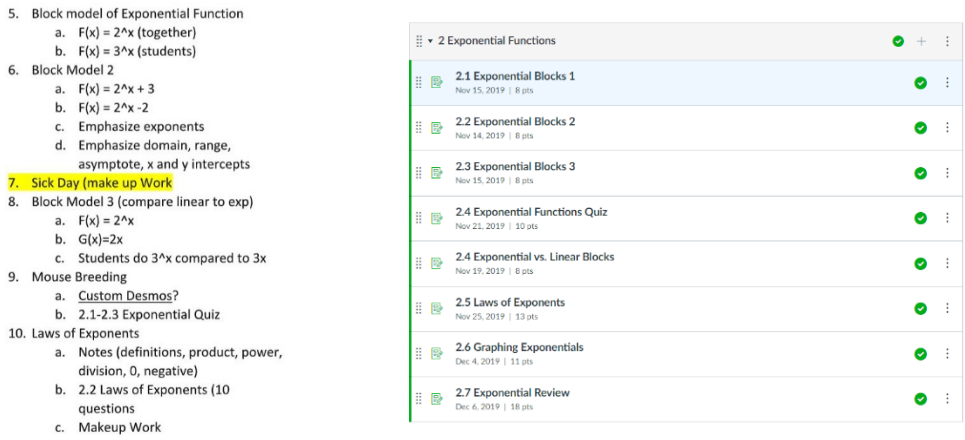
System of linear equations:	The solution to a system of equations is

Mr. Cabal also included a variety of elements in his class note packets, such as titles of lessons and self-assessment questions, mathematics tasks, or learning trackers. He broke a unit into three to four "classworks" and built classwork with three to five learning targets, which he established from setting learning goals.

Ms. Vincent and Ms. York created handouts, but not in the format of packets. Rather, these handouts included mathematics tasks and notes but not guiding questions for each unit. Mr. Anderson was the only teacher who did not create any sort of note or handout. Instead, he built modules using an online learning management system (Figure 23). Using his quarter plans, he created a module for each lesson and created a separate online course for each quarter.

Figure 23

Mr. Anderson's Quarter Outline (left) and Online Module (right)

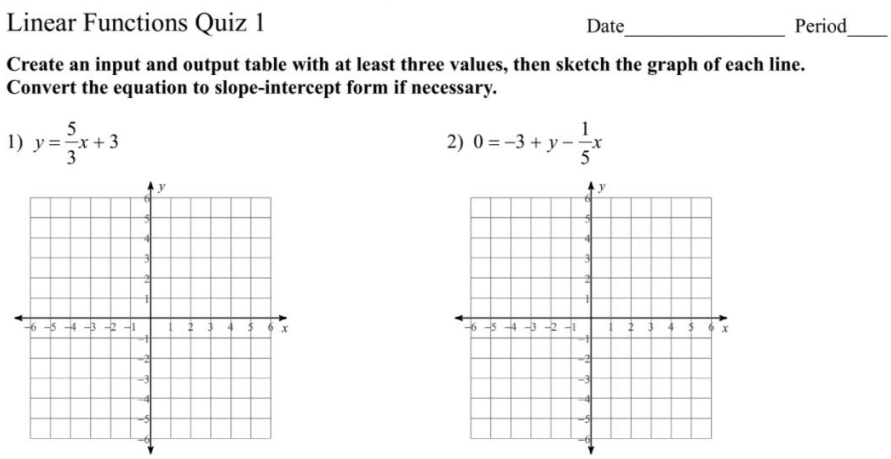


Assessments

The teachers created a variety of assessments as a result of the planning process, including tasks such as warm-ups, quizzes, exit tickets, and tests. Most of these assessments focused on measuring students' procedural fluency or conceptual understanding. These assessments did not aim to measure students' attitudes or dispositions towards mathematics. The teachers developed some of their assessment items on their own and adapted some pre-made items that were provided from their school, then put the items into some form of written assessments (Figure 24). These included paper-and-pencil assessments in the case of Mr. Cabal, Ms. Vincent, and Ms. York, and online assessments in the case of Mr. Anderson and Ms. Harris.

Figure 24

Mr. Cabal's Quiz on Linear Functions Unit


Linear Functions Quiz 1 Date_____ Period____

Create an input and output table with at least three values, then sketch the graph of each line. Convert the equation to slope-intercept form if necessary.

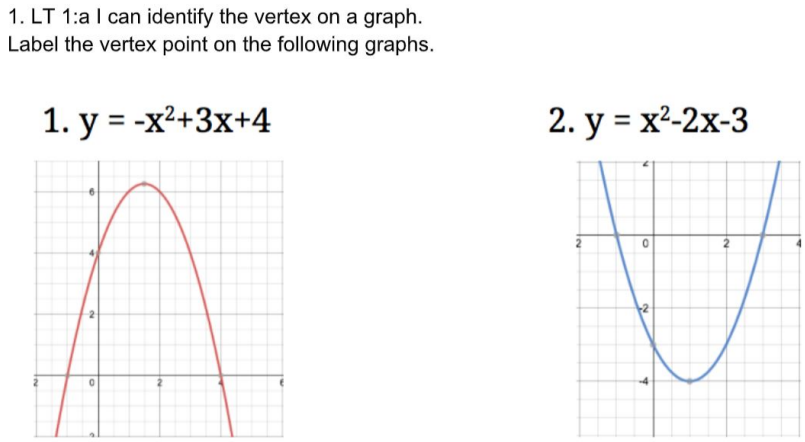
1) $y = \frac{5}{3}x + 3$

2) $0 = -3 + y - \frac{1}{5}x$

Although the teachers identified the unit/chapter title on each assessment (such as "Chapter 3 Graphing Quiz" or "Linear Functions Unit Test") on the first page of the assessments or online modules, most did not specify which learning goals corresponded to each assessment. Ms. York was the only teacher who listed learning targets on the unit test (Figure 25). For each unit test, she put assessment items under each related learning target, which made it clear what each item was measuring.

Figure 25

Ms. York's Learning Targets and Assessment Items on Unit Test


1. LT 1:a I can identify the vertex on a graph.
Label the vertex point on the following graphs.

1. $y = -x^2+3x+4$

2. $y = x^2-2x-3$

Lastly, none of the assessments measured students' attitudes towards mathematics. This relates to the learning targets that the teachers established at the beginning of the unit planning process. None of the established learning goals, which were listed on the curriculum documents that the teachers created, focused on students' attitudes or disposition towards mathematics. Rather, most of the questions were related to procedural fluency or conceptual understanding of targeted mathematics concepts.

Reflections and Evaluations

Once the teachers enacted their planned unit, they used a variety of methods for evaluating their implemented unit plans. All but one teacher created evaluation questions and embedded them into their curriculum documents, such as online learning modules or class note packets. For example, Mr. Cabal, Ms. Harris, and Ms. York created self-reflection questions for students, asking students how they felt they understood the targeted mathematical concepts and were progressing towards targeted learning goals. These three teachers wanted their students to self-check whether they were ready to take quizzes or tests.

In addition to self-reflection questions, Mr. Cabal created an online survey to get students' feedback on the materials that they used for the unit. On the survey, he asked questions like "How was the pacing of this unit for you?" or "How was the difficulty of this unit for you?" Mr. Anderson also created and embedded a teacher evaluation survey at the end of each quarter module. He asked students to fill it out to get feedback regarding his instruction and how the students felt about the overall learning experience.

All but one teacher created self-reflection questions and surveys to collect students' feedback on the implemented unit plans. Although not all the teachers created

such unit planning products, some teachers, like Mr. Cabal, attended to such information to improve upcoming units and next year.

Summary of Unit Planning Products

The products of teachers' unit planning were various in terms of types, elements, and formats. Depending on the purposes, the teachers created some documents for their own use but also created some for students and parents. As the teachers taught the same course over multiple years, they each tried to improve these documents rather than trying to create new ones from scratch. The unit schedule was the most common element of the document that the teachers created during their unit planning. Even though some elements did not appear on all of the documents, this does not mean that the teachers did not consider those elements of unit planning. Rather, some elements were more noticeable and other elements were relatively less noticeable.

Priorities among Learning Goals in Unit Planning

To understand the teachers' priorities among learning goals for the units, I analyzed the objectives and goals associated with the lessons and assessments that the teachers would like to leave off or slip in depending on time allowance. The teachers did not simply cut out the equal amount of content from each lesson or add it to each lesson. Rather, they tried to save time by combining lessons or taking out some lessons from their unit plans. Application problems were one of the priorities that the teachers wanted to do add if they have more time. I begin this section by introducing the lessons and activities that the teachers wanted to add if they had more time, and I end this section by introducing the ones that the teachers wanted to cut or leave off if they ran out of time.

What Teachers Want to Do More

What the teachers wanted to do more of was largely two categoris—application problems and test practices. In other words, some teachers wanted to do more challenging problems because their students did not have enough time to complete such problems, as these problems usually require an extensive amount of time to complete. However, other teaches wanted to do more test practice, as they were worried about their students' performance on their summative assessments (e.g., unit test, state assessment).

The first unit component that all five teachers wanted to do was more application problems. The teachers wanted students to work on more of these problems because they wanted students to have opportunities for showing their understanding of the concepts and skills they had learned in the unit. The teachers wanted the students to deepen their understanding of the meaning of these concepts and skills in real-world contexts. For example, Ms. York wanted to do application problems, like a small project, because she preferred that "kids make sense and understand the purpose of the skills that they've been working on" (First Interview, 10/16/2020). Another teacher, Ms. Harris, expressed her desire to do such application problems in every unit if she had enough time:

> [I'd] like to add, maybe have the pumpkin carving project as practice and getting ready for a bigger project. There's a city slope planning project, or creating a city on Desmos with lines. So the pumpkin project would be like, 'Okay, we're gonna have a project later that's more difficult. So we're going to start with this,' and then work on that. (Ms. Harris, Follow-up Interview, 11/17/2020)

Because such application problems, however, usually require extensive time to complete due to their complexity, the teachers could not incorporate as many as they wanted in their unit plans. Thus, it was clear that although the teachers wanted to do more than just introduce targeted topics/concepts and master skills required by the state or district, there was not enough time for a more conceptual understanding of them.

In addition to application problems, the teachers wanted to do more practices for high-stakes assessments. Because the teachers did not necessarily design their units for students to prepare for the tests, two of the teachers discussed that they wanted more opportunities to make students familiar with the actual items on the tests. For example, Mr. Cabal would like to incorporate more SAT type of questions in the units, if he has a couple of extra days in the unit, because such questions on the SAT are "different from what they're used to," (Mr. Cabal, First Interview, 10/09/2020) and the students did not have enough opportunities to practice those types of questions. By exposing his students to such test items as frequently as he could, he would like to make them familiar with the tests and perform well on the tests.

Ms. Vincent also wanted to do more test preparation, but not SAT preparation. She wanted to do more practices, such as unit reviews, before the quizzes or tests. However, she wanted to do different things based on how her students did in the unit, if she had a couple of extra days. If her students did well, then she would like to do something fun, like a scavenger hunt. However, if her students did perform well, then she would like to do more reviews before quizzes or tests. By doing more practice right before the assessments, she wanted her students to feel confident and perform well on them. Therefore, the teachers needed to make sure that students became familiar with test

items on the exams so that they perform well on these. The teachers' priorities if they had more time in the unit mostly focused on having more opportunities to apply what students learned in the real-world contexts and to get them familiar with the types of items on the tests.

What Teachers Would Let Go

What the teachers wanted to give up was the unit components that would be covered in another time or practice problems. To do so, the teachers were either a) dropping some lessons or portions of lessons or b) combining similar lessons into one lesson. First, all but one teacher, Ms. Harris, wanted to cut out some lessons or portions of lessons to secure enough time to cover the rest of the planned unit content. Depending on the importance of each lesson or its component relative to others, the teachers distinguished the lessons and components of each into two categories—essentials and non-essentials. For example, Ms. Vincent examined her linear function unit and chose not to cover absolute value, dimensional analysis, and proportions:

> I can always cover it [absolute value, dimensional analysis, and proportions] later on in the year. Absolute value or dimensional analysis in science. So that's not 100% necessary. [Proportions] aren't Algebra I standards. Proportions are an 8th-grade standard. So that's something that I just cover with them as a review. I don't need to cover that if I need to. Again, I can always do it later on. (Ms. Vincent, First Interview, 10/26/2020)

As these three concepts were not the core standards for Algebra I, she wanted to drop these concepts and save time for other standards in the linear function unit. Like Ms.

Vincent, Mr. Anderson would like to cut out the concepts that he is likely to cover later in the course or a subsequent course, such as Algebra II. He wanted to skip X-and Y-intercepts and end behavior of linear functions because "we've been talking about that [intercepts] already, and end behavior for straight lines is not very interesting. So, end behavior is more interesting for exponential" (Mr. Anderson, Follow-up Interview, 11/13/2020). As there had been or would have been an opportunity to cover the specific concepts, he simply dropped covering from his unit plan. The last teacher, Mr. Cabal, also chose to drop one of the lessons from his linear function unit:

> I probably just dropped 2.3 [Function Operations] altogether. And that will give us about two or three extra days to work on 2.1 [Properties of Functions] and 2.2.[Evaluating Functions] because I think the other teacher that I teach algebra with didn't get to 2.3 at all because of the timing. (Mr. Cabal, Follow-up Interview, 11/24/2020)

By taking out the lesson that the students in other Algebra I classes would not have, Mr. Cabal made sure his students learned at least the same concepts so that there would be less difficult when they took subsequent courses. Mr. Cabal also wanted to reduce the number of practice problems from what he originally planned if there was not enough time to cover what he planned:

> I would maybe put the problems in half, so I do the evens or do the odds on the classwork so that they still get all the concepts, but maybe not as much practice with them. (Mr. Cabal, First Interview, 10/09/2020)

For him, students' opportunities to learn were the most important element of curriculum decisions. By dropping a lesson other students would not learn or reducing the number of practice problems, he hoped to secure enough time to cover all the planned concepts.

Ms. Harris was the only teacher who wanted to combine lessons to secure time to cover the other concepts that she planned for the lesson. Instead of cutting out the entire lesson, she wanted to shorten the time allocation for each concept and cover multiple, but very closely related, concepts on the same day. For example, Ms. Harris wanted to combine two lessons in the unit on solving systems of linear equations. She wanted to teach the substitution method and elimination method on the same day because these two solution methods are the only two methods solving linear systems algebraically. In her follow-up interview, she also wanted to teach the slope-intercept form and standard form of linear functions on the same day because these two were just different ways of representing linear functions. Thus, it was clear that combining related lessons was one of her strategies to secure time for covering other concepts in her planned units.

When the teachers did not have enough time to cover all the concepts that they planned to teach in the unit, they wanted to either cut out less important portions of lessons (e.g., practice problems) or concepts that students might learn at another time, or combine closely related lessons in the same unit. The teachers examined whether students would learn the concepts that they thought were optional at another time or whether it was okay to introduce two related concepts on the same day. Thus, they wanted to make sure students had sufficient learning opportunities for each of these concepts required by the state or district.

Summary of Learning Goal Priorities

When reducing learning goals, teachers chose specific concepts or problems to cut from or slip into their planned units. The teachers examined the importance of their unit components (e.g., concepts, problems, warm-ups, reviews) and made decisions based on not only the component's importance to students' mathematics learning but also their progress towards the desired learning goals. Practice problems and the additional concepts for the unit were two big components that the teachers wanted to give up if they ran out of time. Application problems were the most common components that the teachers wanted to do more if they have more time. Through such problems, the teachers wanted students to have opportunities to apply the knowledge and skills that they learned through the unit. From the interview questions, it was clear that time allowance made the teachers choose and focus on some of the learning goals that they wanted to pursue if they had enough time. Interestingly, the time variance did not influence the teachers' plans on assessments but only their plans on lessons and pacing.

Conclusion

In this chapter, I reported how the five experienced algebra teachers designed curriculum units by exploring their unit planning processes and products. The teachers engaged with the seven unit planning practices from *checking and examining curriculum resources* to *evaluating implemented unit plans*. The teachers' unit planning was a cyclical and ongoing process, which occurred not just before the unit began but also during the unit was in motion and even after the unit ended. There were two groups of teachers—a group of teachers who did their unit planning for all the units extensively

during their *pre-planning* phase and another group of teachers who repeat all the unit planning practices when they planned and enacted unit by unit.

Throughout their unit planning processes, the teachers created a variety of curriculum materials in terms of types, purposes, and elements. These products mainly included the unit-end goals, such as content standards or learning targets, and tentative schedules for the units and beyond the units, such as months, quarters, or years. Because the teachers taught the same course multiple years, they used the same documents multiple years and they primarily tried to improve these documents for their current students by improving the elements of the documents.

Some factors were influencing the teachers' unit planning processes and products more than others. The types of curriculum materials that the teachers used to influence not only the teachers' unit planning products but also their unit planning processes. In addition, the student's progress towards the established learning goals was another influencing factor. As the teachers changed their unit pacing and assessments, it influenced mostly the teachers' unit planning products. The existence of diverse students definitely influenced the teachers' unit plans but not the teachers' unit planning processes. Lastly, the teachers were ready for giving up extra stuff, such as additional practices or the content beyond the current content standards, if they ran out of time. Interestingly, the teachers wanted to do more application and challenging problems with their students. Due to the time constraints, the teachers had to prioritize some of the lessons within the unit based on their examination of importance and students' opportunities to learn. Time constraints were one of the factors influencing both the

teachers' unit planning products greatly in terms of the amount of unit content and its pacing.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

In this study, I sought to answer the research question, *When experienced algebra teachers actively design their curriculum, how do they design curriculum units?* And, *How are the processes and products of teachers' unit planning similar between or different from one another?* To answer these questions, I conducted a case study (Yin, 2013) of five experienced high school mathematics teachers who came from school districts of varying sizes across the nation and who were actively designing curriculum units. More specifically, I analyzed the teachers' unit planning processes and products. My analysis resulted in the identification of a set of seven unit planning practices that the teachers enacted *before*, *during*, and *after* each unit. As a result of their unit planning processes, the teachers created multiple unit planning products, such as *learning trackers* or *curriculum maps*. The teachers' unit planning was a set of goal-oriented teaching practices; their planning was a cyclical process, including modifications of planned units in the during-unit phase and evaluations of enacted units in the after-unit phase. In the remainder of this chapter, I discuss the implications and importance of these findings and describe how the nature of teachers' unit planning connects to and builds on prior research.

Discussion

Processes of Unit Planning

This study expanded the traditional conception of teachers' unit planning to include not only planning but also enacting and reflecting. Traditionally, planning is

defined as teachers' decision-making before instruction (e.g., Panasuk & Todd, 2005), based on how they imagine their intended curriculum will go. This study found that teachers plan not only before each unit but also during (e.g., their unit planning continued as they kept modifying their unit plans based on students' progress when the unit) and after each unit (e.g., evaluating implemented unit plans once the unit was over to gather information for modifying plans for upcoming units or next year). This expanded view of planning aligns with Sherin and Drake's (2009) conception of teachers' curriculum use before, during, and after instruction and Grueudet and Trouche's (2009) conception of documentational genesis as an ongoing process.

In particular, the findings of this study highlight the different timing of influences of each component of Remillard and Heck's *curriculum enactment system*. For example, curriculum resources (e.g., designated curriculum, curricular aims, and objectives, or consequential content assessments) influence mostly the first five unit planning practices (e.g., setting learning goals, planning lessons). In contrast, enacted curriculum and student outcomes influence mostly the last two unit planning practices (e.g., modifying lessons and assessments, evaluating implemented unit plans). This finding confirms Remillard and Heck's conceptualization that *official curriculum* is more about initial unit planning and the *operational curriculum* is more about adjustments and modifications of the plans that came from the initial unit planning. Thus, this finding adds to our understanding of teachers' continuous engagement with planning during and after a unit and the reflective aspects of their unit planning, which were often missing from the literature on teacher planning.

Second, this study found that unit planning consists of more than selecting tasks and planning individual lessons. Teachers' planning has been conceptualized as making decisions on the content (i.e., *what* to teach) and pedagogies (i.e., *how* to teach) of mathematical concepts (e.g., Stein et al., 2007). However, there was another dimension of the teachers' decision-making in unit planning: the sequencing of lessons and assessments. In other words, the teachers made curriculum decisions about the timing of when to introduce new mathematical concepts and when to assess students' understanding of the concepts. This confirms the notion of teachers as curriculum designers (Ben-Peretz, 1990; Brown, 2009); the teachers made final curricular decisions to fulfill both students' needs and their progress toward established learning goals (Remillard et al., 2009).

Lastly, the results of this study also note the differences between lesson planning and unit planning. The teachers' unit planning focused more on sequencing lessons based on the desired progressions and development of targeted mathematical ideas within a unit. The teachers considered the progression and development of mathematical ideas much as they did for lesson planning. However, unit planning is more about making connections beyond a single lesson, within and across each unit. These considerations closely relate to the notion of curriculum coherence (Schmidt et al., 2005), which proposes that a mathematics curriculum must be coherent, focused, and rigorous enough for students to develop not only their knowledge of mathematics contents but also their mathematical practices. To be more specific, teachers' consideration of the progression of relative difficulties and complexities of topics relates to the hierarchical nature of subtopics of the unit, which is also known as one of the features of mathematics subjects

(Schmidt et al., 2005). Therefore, algebra teachers' unit planning is more like a teachers' purposeful and thoughtful planning considering mathematical connections and progression across individual lessons within a unit (Sleep, 2012).

Products of Unit Planning

Beyond the teachers' unit planning processes, this study documented the teachers' diverse unit planning products in terms of type, purpose, and elements of the products that resulted from their planning processes. In particular, the findings of this study highlight different types of teacher-intended curriculum and identify the characteristics of each teacher-intended curriculum type. Teachers usually do not put the details of their plans in written formats unless they are required to do so (McCutcheon, 1980). However, this study revealed that some unit planning products had details created by the teachers. For example, *learning targets* or *learning trackers* were two examples that included such details. The teachers created these planning documents because the state/district standards were too big to manage and teach. As a result, all but one teacher listed all of the learning goals of each unit in a written format, which contradicts much of what prior research found (see, e.g., Brown, 1988). Thus, teachers do not have all the details of their plans in written form, but, depending on the unit planning products, teachers can have all the details if needed.

Second, different levels of curriculum planning produce different types of documents and may include additional elements in the documents. In other words, what teachers create during unit planning differs from what they make during lesson planning. Unit-end goals, lesson sequences, and unit pacing were the unique elements that existed only in unit planning products. Unlike instructional materials (e.g., class notes, handouts)

created during lesson planning, these unit planning documents were for the teachers' own use instead of distribution to the students or parents. Because the primary audience of these products were the teachers themselves, there were very minimal details to communicate the ideas underlying their curriculum decisions. Furthermore, these unit planning documents primarily recorded the lesson titles and the sequence within each unit (e.g., a calendar with tentative schedules), so there was no need to include all of the details of each lesson or the rationale behind the lesson sequences. The brief nature of these unit planning products was not captured in much prior research, as there were discrepancies between the elements composing written unit plans for a study and the elements composing teachers' own unit plans (Roche et al., 2014). Based on this study, as teachers plan at larger curriculum levels, the details they record become briefer.

Third, teachers' unit plans are the accumulation of iterative processes of what they planned, enacted, and improved over a long period. The findings of this study confirmed that teachers did not plan their units from scratch. Because teachers usually work in the same school for multiple years, they try to plan their units based on their experiences of the typical students in their school building and make changes to their plans only if needed. However, teachers' unit planning products would not be the documents that teachers create for a new academic year, which aligns with prior research on the nature of teachers' planning (Brown, 1988). Instead, these products are more likely to be the ones that teachers created and improved between the first time they taught the course and the current school year.

Influencing Factors of Unit Planning

Teachers' unit planning processes and products are influenced by both *curriculum resources* and *teacher resources*. The teachers' use of curriculum resources is captured in this study. For example, Ms. Vincent used *Big Ideas Math* to mimic the lesson sequences or unit sequences, and Ms. Harris used *Delta Math* quite explicitly to plan assessments, which also shaped her lessons. This aligns with Brown's (2009) proposed framework for conceptualizing teachers' curriculum use and influencing factors. My study adds nuance to the influence of curriculum resources in unit planning. How teachers' use of different *curriculum resources* influences students' learning has been studied in the field (e.g., Remillard et al., 2014; Tarr et al., 2013). However, how teachers' use of different curriculum resources influences teachers' processes of curriculum design is not well understood. Thus, more research is necessary to fully capture teachers' curriculum design processes.

Second, this study adds new details about the influence of *teacher resources*. In particular, it contributes to our understanding of the influence of the teachers' knowledge of students in how teachers build the content of unit plans. The teachers had a sense of where their students were at and what they were capable of regarding certain mathematical concepts. For example, students' progress towards the established learning goals was one of the influencing factors in both mathematics content and assessments because the teachers changed their unit pacing and assessments based on their perceptions of students and their monitoring of students' progress toward the established learning goals. Because what teachers plan to teach relates to students' opportunities to learn, teachers' decisions to provide different content to different groups of students may

result in different *opportunities to learn* for students (Kim, 2018), and teachers' perceptions/beliefs of particular student groups work like teachers' knowledge of them (de Araujo, 2017).

Implications

Implications for Research

The results of this study expand conceptions of teachers' planning. Previous studies only considered teachers' decision-making before instruction. This study, however, also considers teachers' decision-making during and even after instruction. This extension was proposed by Sherin and Drake (2009) as a way to characterize preservice teachers' teaching practices as they engaged in the process of their curriculum use for designing lessons. The findings of this study suggested that in-service teachers' unit planning occurs not only before but also during and after instruction, during which the teachers engage with multiple unit planning practices, from planning to reflecting on units. In particular, teachers' monitored students' progress and evaluated implemented unit plans, which highlights the teachers' curricular responsiveness to students' progress. Making curricular responses to students' progress and implemented units closely relates to the notion of *curricular noticing framework* (Dietiker et al., 2018), which is not necessarily sequential but rather includes dynamic interactions among attending, interpreting, and responding. However, future research is needed to characterize the details of these additional aspects of unit planning practices.

In addition to investigating the aspects of each of these unit planning practices, future research efforts also must focus on specifying differences within each of the seven unit planning practices and investigating the relationship between them. While some

researchers have offered frameworks for identifying different aspects of teachers' planning, those tools are limited in terms of identifying teachers' planning practices before instruction (e.g., Sullivan et al., 2013) or focusing on teachers' use of curriculum documents instead of capturing the entire process of teachers' unit planning. For example, Roche et al.'s (2014) proposed framework for identifying teachers' unit planning process did not address the teachers' planning process during and after each unit. Thus, more work needs to be done to develop frameworks for characterizing the continuity of teachers' unit planning processes across time and for increasing knowledge of each of the unit planning practices.

Second, the results of this study highlight the influences of unit plan implementation and its outcome on teachers' unit planning processes and products. Although the interactions between teachers' planning, implemented plans, and student outcomes are part of curriculum enactment (Remillard & Heck, 2014), these interactions seem to influence only the teachers' unit planning products (i.e., content, unit pacing, lesson sequences) instead of their unit planning processes (i.e., unit planning sequences, approaches to each unit planning practice). This urges more research on what factors influence the sequences of teachers' unit planning or their approaches to each unit planning practice. Thus, future studies should document how experienced teachers' interactions with other components of the enactment system influence their curriculum design processes or products.

Implications for Teacher Education

This study highlights the common sequences of experienced teachers' unit planning processes; therefore, its results have implications for both teacher education and

K-12 schools. In this section, I cover implications for teacher education, and in the following section, I detail implications for K-12 schools. The first key implication for teacher education is that the seven unit planning practices provide a valuable framework for developing both preservice and in-service teachers' pedagogical design capacities. Many teaching practices have been introduced as smaller parts of teaching practices, making them more manageable and teachable (Grossman, Compton, et al., 2009; Grossman, Hammerness, et al., 2009). Thus, it may be valuable to offer these seven planning practices as a framework to preservice teachers and teacher educators to ensure that teachers attend to each of these practices and engage with a subset of them each before, during, and after the unit.

Second, the results of this study highlight the common elements of teachers' unit planning products. Preservice teachers are less likely to have opportunities to plan larger curriculum levels during teacher education programs because lesson planning is often referred to as *instructional planning*. The results of this study also highlight some elements that in-service teachers often neglect or forget to include in their unit plans (e.g., mathematical practices standards, alignment between learning goals, and assessment items). Thus, both preservice and in-service teachers can use this list of unit planning elements as a guide for unit planning, which makes them check and picture what they need to consider when they design their curriculum units.

Implications for K–12 Schooling

The results of this study demonstrate teachers' professional obligations to the content of the official curriculum. Even if teachers were running out of time, they tried to introduce and cover all the concepts they were supposed to cover within the course. This

dedication could lead to a possible over-emphasis on content coverage. It is known that many mathematics teachers feel obligated to cover all the content listed in curriculum resources, and time is one of the main obstructs to improving or transforming their instruction. Based on the findings of this study, the teachers wanted to enhance students' understanding of mathematics through application problems. Thus, some policy changes (e.g., reducing the number of contents in each course, offering multi-year courses, and developing self-paced courses) would allow teachers to provide more opportunities to deepen students' understanding of mathematical concepts.

The results of this study also highlight different types of planning modes—all but one teacher planned units alone. It is known that secondary mathematics teachers plan more individually than elementary mathematics teachers (Sullivan et al., 2013). However, Ms. Harris showcased some possibilities of collaborative unit planning with her colleagues in the same department. *Co-planning* can reduce the burden of designing curriculum units and make space for teachers to share experiences and knowledge regarding students (see Marzocchi et al., 2021). Thus, teachers would not only have common learning goals, activities, or assessments but also think about how they could accommodate different groups of students in the same school building. Because the current retention rate of teachers is low, collaboratively designing a curriculum would reduce the burden that even experienced teachers encounter in curriculum design.

Closing Remarks

With this study, I sought to better understand the processes and products of unit planning. All of the teachers in this study planned, implemented, and reflected on curriculum units by considering both the required curriculum and their students. Teachers

carefully examined relevant content standards on curriculum resources, set learning goals by breaking the standards into smaller and teachable chunks of standards, mapped out lessons and assessments using a calendar, planned individual lessons and assessments, modified unit pacing and assessments based on students' progress, and evaluated implemented plans based on their own reflection and student feedback. The teachers created multiple planning documents during unit planning, and these documents were often very brief and minimally detailed, akin to reminders and memos of aspects to note during the unit.

Despite the growing attention on teachers' curriculum design process, the results of this study suggest that there is more work to be done to characterize the nature of teachers' curriculum design processes and products and to support the development of the teachers' pedagogical design capacities. Both curriculum resources and teacher resources influence teachers' curriculum design processes and products; therefore, I encourage future researchers, teacher educators, and K-12 practitioners to continue to find ways to improve curriculum materials and support preservice teacher education and in-service professional development as it pertains to curriculum design. I challenge teachers to continuously reflect and collect information regarding their enacted units so that they can improve their intended curriculum to provide more meaningful and effective learning experiences to their students. Finally, I hope that we, as a community of mathematics educators, will invite teachers to lend their invaluable knowledge and experiences toward bridging mathematics curricula requirements and students' needs.

REFERENCES

Amador, J. M. (2019). Preservice teachers ' use of curricular resources for mathematics lesson design. *Mathematics Teacher Education and Development*, *21*(1), 51–81.

Association of Mathematics Teacher Educators. (2017). Standards for Preparing Teachers of Mathematics. Retrieved from amte.net/standards

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special ? *Journal of Teacher Education*, *59*(5), 389–407.

Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). *Report of the 2018 NSSME+*. (December), 442.

Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 National Survey of Science and Mathematics Education*. Chapel Hill, NC.

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., … Tsai, Y. M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal*, *47*(1), 133–180. https://doi.org/10.3102/0002831209345157

Ben-Peretz, M. (1990). *The teacher-curriculum encounter: Freeing teachers from tyranny of texts*. Albany, NY: State University of New York Press.

Bieda, K. N., Lane, J., Evert, K., Hu, S., & Opperman, A. (2020). A large-scale study of how districts ' curriculum policies and practices shape teachers ' mathematics lesson planning. *Journal of Curriculum Studies*, *52*(6), 770–799.

Breyfogle, M. L., McDuffie, A. R., & Wohlhuter, K. A. (2010). Developing curricular reasoning for grades preK–12 mathematics instruction. In R. R. B. Reys, R. E. Reys (Ed.), *Mathematics curriculum: Issues, trends, and future directions* (pp. 307–320). Reston, VA: National Council of Teachers of Mathematics.

Brown, D. S. (1988). Twelve middle-school teachers' planning. *The Elementary School Journal*, *89*(1), 69–87.

Brown, M. W. (2009). The teacher–tool relationship: Theorizing the design and use of curriculum materials. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 17–36). New York, NY: Routledge.

Burkhardt, H., Fraser, R., & Ridgeway, J. (1990). The dynamics of curriculum change. In I. Wirszup & R. Streit (Eds.), *Development in school mathematics education around the world* (pp. 3–29). Reston, VA: National Council of Teachers of Mathematics.

Charalambous, C. Y., & Hill, H. C. (2012). Teacher knowledge, curriculum materials, and quality of instruction: Unpacking a complex relationship. *Journal of Curriculum Studies*, *44*(4), 443–466. https://doi.org/10.1080/00220272.2011.650215

Core Practice Consortium. (n.d.). Core practice consortium. Retrieved from https://www.corepracticeconsortium.com/core-practice

de Araujo, Z. (2017). Connections between secondary mathematics teachers' beliefs and their selection of tasks for English language learners. *Curriculum Inquiry*, *47*(4), 363–389. https://doi.org/10.1080/03626784.2017.1368351

Dietiker, L. (2015). Mathematical story: A metaphor for mathematics curriculum. *Educational Studies in Mathematics*, *90*(3), 285–302.

https://doi.org/10.1007/s10649-015-9627-x

Dietiker, L., Males, L. M., Amador, J. M., & Earnest, D. (2018). Curricular Noticing: A Framework to Describe Teachers' Interactions With Curriculum Materials. *Journal for Research in Mathematics Education*, *49*(5), 521. https://doi.org/10.5951/jresematheduc.49.5.0521

Ding, M., & Carlson, M. A. (2013). Elementary teachers learning to construct high-quality mathematics lesson plans: A use of the IES recommendations. *Elementary School Journal*, *113*(3), 359–385. https://doi.org/10.1086/668505

Grant, T. J., Kline, K., & Crumbaugh, C. (2009). How can curriculum materials support teachers in pursuing student thinking during whole-group discussions? In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics Teachers at Work: Connecting Curriculum Materials and Classroom Instruction* (pp. 103–117). New York, NY: Routledge.

Grossman, P. (1990). *The making of a teacher: Teacher knowledge and teacher education*. New York, NY: Teachers College Press.

Grossman, P., Compton, C., Igra, D., & Williamson, P. W. (2009). Teaching practice : A cross-professional perspective. *Teachers College Record*, *111*(9), 2055–2100.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice*, *15*(2), 273–289. https://doi.org/10.1080/13540600902875340

Gueudet, G., Pepin, B., & Trouche, L. (Eds.). (2012). *From Text to 'Lived' Resources: Mathematics Curriculum Materials and Teacher Development*. https://doi.org/10.1017/CBO9781107415324.004

Gueudet, G., & Trouche, L. (2009). Towards new documentation systems for mathematics teachers? *Educational Studies in Mathematics*, *71*(3), 199–218. https://doi.org/10.1007/s10649-008-9159-8

Hayes, M. L. (2018). *2018 NSSME+: Status of high school mathematics*. Chapel Hill, NC.

Hiebert, J., & Morris, A. K. (2012). Teaching, rather than teachers, as a path toward improving classroom instruction. *Journal of Teacher Education*, *63*(2), 92–102. https://doi.org/10.1177/0022487111428328

Hill, H. C., Blunk, M. L., Charalambous, C. Y., Lewis, J. M., Phelps, G. C., Sleep, L., & Ball, D. L. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction*, *26*(4), 430–511. https://doi.org/10.1080/07370000802177235

Horizon Research INC. (2018). *2018 NSSME + Mathematics Teacher Questionnaire*. Retrieved from http://horizon-research.com/NSSME/wp-content/uploads/2018/12/2018-NSSME-MTQ-Formatted.pdf

John, P. D. (2006). Lesson planning and the student teacher: Re-thinking the dominant model. *Journal of Curriculum Studies*, *38*(4), 483–498. https://doi.org/10.1080/00220270500363620

Kim, O.-K. (2018). Teacher decisions on lesson sequence and their impact on opportunities for students to learn. In *Research on Mathematics Textbooks and Teachers' Resources* (pp. 315–339).

Land, T. J., Tyminski, A. M., & Drake, C. (2015). Examining pre-service elementary mathematics teachers' reading of educative curriculum materials. *Teaching and*

Teacher Education, *51*, 16–26. https://doi.org/10.1016/j.tate.2015.05.009

Lloyd, G. M. (1999). Two teachers' conceptions of a reform-oriented curriculum: Implications for mathematics teacher development. *Journal OfMathematics Teacher Education*, *2*, 227–252.

Lloyd, G. M., Cai, J., & Tarr, J. E. (2017). Issues in curriculum studies: Evidence-based insights and future directions. *Compendium for Research in Mathematics Education*, 244–272.

Males, L. M., & Setniker, A. (2019). Planning with curriculum materials: Interactions between prospective secondary mathematics teachers' attention, interpretations and responses. *International Journal of Educational Research*, *93*, 153–167. https://doi.org/10.1016/j.ijer.2018.09.016

Marzocchi, A. S., Druken, B. K., & Brye, M. V. (2021). Careful co-planning for effective team teaching in mathematics. *International Electronic Journal of Mathematics Education*, *16*(3), em0663.

McCrory, R., Floden, R., Ferrini-mundy, J., Reckase, M. D., Senk, S. L., Mccrory, R., … Senk, S. L. (2016). Knowledge of algebra for teaching : A framework of knowledge and practices. *Journal for Research in Mathematics Education*, *43*(5), 584–615.

McCutcheon, G. (1980). How do elementary school teachers plan? The nature of planning and influences on it. *The Elementary School Journal*, *81*(1), 4–23.

McDuffie, A. R., Choppin, J., Drake, C., Davis, J. D., & Brown, J. (2018). Middle school teachers' differing perceptions and use of curriculum materials and the common core. *Journal of Mathematics Teacher Education*, *21*(6), 545–577. https://doi.org/10.1007/s10857-017-9368-0

Moses, B., & Cobb, C. (2001). *Radical equations: Math literacy and civil rights*. Boston, MA: Beacon Press.

Mutton, T., Hagger, H., & Burn, K. (2011). Learning to plan, planning to learn: the developing expertise of beginning teachers. *Teachers and Teaching*, *17*(4), 399–416. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/13540602.2011.580516

National Governors Association Center for Best Practices Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics*. Washington D.C.: National Governors Association Center for Best Practices, Council of Chief State School Officers.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Retrieved from http://edr.sagepub.com/content/37/9/645.full

Pepin, B., Gueudet, G., & Trouche, L. (2013). Re-sourcing teachers' work and interactions: A collective perspective on resources, their use and transformation. *ZDM - International Journal on Mathematics Education*, *45*(7), 929–943. https://doi.org/10.1007/s11858-013-0534-2

Remillard, J. T., Harris, B., & Agodini, R. (2014). The influence of curriculum material design on opportunities for student learning. *ZDM - International Journal on Mathematics Education*, *46*(5), 735–749. https://doi.org/10.1007/s11858-014-0585-z

Remillard, J. T., & Heck, D. J. (2014). Conceptualizing the curriculum enactment process in mathematics education. *ZDM - International Journal on Mathematics Education*, *46*(5), 705–718.

Remillard, J. T., Herbel-Eisenmann, B. A., & Lloyd, G. M. (Eds.). (2009). *Mathematics teachers at work : Connecting curriculum materials and classroom instruction*. New York, NY: Routledge.

Roche, A., Clarke, D. M., Clarke, D. J., & Sullivan, P. (2014). Primary teachers' written unit plans in mathematics and their perceptions of essential elements of these. *Mathematics Education Research Journal*, *26*(4), 853–870. https://doi.org/10.1007/s13394-014-0130-y

Rosenblatt, L. M. (1986). *Writing and reading: The transactional theory*. Champaign: University of Illinois at Urbana-Champaign.

Schmidt, W. H., Wang, H. C., & McKnight, C. C. (2005). Curriculum coherence: An examination of US mathematics and science content standards from an international perspective. *Journal of Curriculum Studies*, *37*(5), 525–559. https://doi.org/10.1080/0022027042000294682

Shulman, L. S. (1986). *Paradigms and research programs in the study of teaching: A contemporary perspective*.

Shulman, L. S. (1987). Knowdge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–21.

Silver, E. A., Ghousseini, H. N., Charalambous, C. Y., Mills, V., Silver, E. A., Ghousseini, H. N., … Mills, V. (2008). Exploring the curriculum implementation plateau: An instructional perspective. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics Teachers at Work: Connecting Curriculum Materials and Classroom Instruction* (pp. 245–265). New York, NY: Routledge.

Stein, M. K., Engle, R. A., Smith, M. S., & Hughes, E. K. (2008). Orchestrating

Productive Mathematical Discussions: Five Practices for Helping Teachers Move Beyond Show and Tell. *Mathematical Thinking and Learning*, *10*(4), 313–340. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/10986060802229675

Stein, M. K., & Kaufman, J. H. (2010). Selecting and supporting the use of mathematics curricula at scale. *American Educational Research Journal*, *47*(3), 663–693. https://doi.org/10.3102/0002831209361210

Stein, M. K., Kaufman, J. H., Sherman, M., & Hillen, A. F. (2011). Algebra: A challenge at the crossroads of policy and practice. *Review of Educational Research*, *81*(4), 453–492.

Stein, M. K., Remillard, J., & Smith, M. S. (2007). How curriculum influences student learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 319–369). Greenwich, CT: Information Age Publishing.

Sullivan, P., Clarke, D., Clarke, D., Gould, P., Leigh-Lancaster, D., & Lewis, G. (2012). Insights into ways that teachers plan their mathematics teaching. *Mathematics Education: Expanding Horizons (Proceedings of the 35th Annual Conference of the Mathematics Education Research Group of Australasia*, 696–703.

Sullivan, P., Clarke, D. J., Clarke, D. M., Farrell, L., & Gerrard, J. (2013). Processes and priorities in planning mathematics teaching. *Mathematics Education Research Journal*, *25*(4), 457–480. https://doi.org/10.1007/s13394-012-0066-z

Tarr, J. E., Grouws, D. A., Chávez, Ó., & Soria, V. M. (2013). The effects of content organization and curriculum implementation on students' mathematics learning in second-year high school courses. *Journal for Research in Mathematics Education*, *44*(4), 683–729. https://doi.org/10.5951/jresematheduc.44.4.0683

Tarr, J. E., Reys, R. E., Reys, B. J., Chavez, O., Shih, J., & Osterlind, S. J. (2008). The impact of middle-grades mathematics curricula and the classroom learning environment on student achievement. *Journal for Research in Mathematics Education*, *39*(3), 247–280.

Taylor, M. W. (2016). From effective curricula toward effective curriculum use. *Journal for Research in Mathematics Education*, *47*(5), 440–453.

Teaching Works. (n.d.). High leverage practices. Retrieved from http://www.teachingworks.org/work-of-teaching/high-leverage-practices

Thompson, D. R., Senk, S. L., & Johnson, G. J. (2012). Opportunities to learn reasoning and proof in high school mathematics textbooks. *Journal for Research in Mathematics Education*, *43*(3), 253–295. https://doi.org/10.5951/jresematheduc.43.3.0253

Webel, C., Krupa, E., & McManus, J. (2015). Teachers' evaluations and use of web-based curriculum resources in relation to the Common Core State Standards for Mathematics. *Middle Grades Research Journal*, *10*(2), 49–64.

Webel, Corey, & Platt, D. (2015). The role of professional obligations in working to change one's teaching practices. *Teaching and Teacher Education*, *47*, 204–217. https://doi.org/10.1016/j.tate.2015.01.007

Yin, R. K. (2013). *Case Study Research: Design and Methods* (5th ed.). Los Angeles, CA: SAGE Publications, Inc.

Yinger, R. J. (1980). A study of teacher planning. *The Elementary School Journal*, *80*(3), 107–127.

Zelkowski, J. (2009). Tackling low-level cognitive task teaching in secondary

mathematics : An approach to shaping preservice teachers ' preconceived beliefs. *Journal of Inquiry & Action in Education, 3*(1), 70–94.

APPENDIX

Teacher Selection Survey

- https://missouri.qualtrics.com/jfe/form/SV_6QlcbjklViJGwGV. Adapted from Teacher Questionnaires for 2018 The National Survey of Science & Mathematics Education, Horizon Research, Inc., Retrieved from http://horizon-research.com/NSSME/wp-content/uploads/2018/12/2018-NSSME-MTQ-Formatted.pdf

Contact Info
In this survey, you will be asked about your teaching background (e.g., the number of years of teaching mathematics) and how you design your lessons/units for the course that you have taught in 2019-2020 school year. The entire survey will take about 10 minutes. Thank you for your time in advance.

Your Name (Last, First)

_____

School Name

_____

Email Address

_____

Are you willing to participate in a research study about Algebra teachers' design of curriculum units?

○ Yes (1)

○ No (2)

○ Maybe (3)

Teacher Background

Q1 How many years have you taught mathematics including 2020-2021 school year?

_____

Q2 How many years have you taught Algebra 1 including 2020-2021 school year?

_____

Q3 What math courses are you currently teaching 2020-2021 school year? (Select all that apply)

- Algebra I (1)
- Geometry (2)
- Algebra II (3)
- Pre-cal (4)
- Calculus (5)
- Other (specify) (6) _____

What math courses did you teach 2019-2020 school year? (Select all that apply)

- Algebra I (1)
- Geometry (2)
- Algebra II (3)
- Pre-cal (4)
- Calculus (5)
- Other (specify) (6) _____

Display This Question:

If What math courses are you currently teaching 2020-2021 school year? (Select all that apply) = Algebra I

Specify the Algebra I course(s) that you are teaching 2020-2021 school year. (e.g., Algebra I Honors, Algebra A/B)

_____

Which best describes the mathematics instruction provided to the entire class?

- ○ This class receives mathematics instruction only from you. (1)
- ○ This class receives mathematics instruction from you and other teachers (for example: a mathematics specialist or a teacher you team with). (2)

Mathematics Instruction

This section will ask about your instruction on an algebra-related course (e.g., Algebra I, Algebra II). If you teach multiple courses including Algebra I, please answer the following questions for teaching Algebra I. As some questions have a list of items, please read the entire list and then answer the questions.

Instructional Materials

Q1. Thinking about your instruction in this class over the entire year, how often is instruction based on materials from each of the following sources? [Select one on each row.]

	Never (1)	Rarely (e.g., a few times a year) (2)	Sometimes (e.g., once or twice a month) (3)	Often (e.g., once or twice a week) (4)	All or Almost All Mathematics Lessons (5)
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks (1)					
State, county, or district-developed units or lessons (2)					
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity) (3)					
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers) (4)					
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math) (5)					
Units or lessons you created (either by yourself or with others) (6)					
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum (7)					

Q2. Does your school/district designate instructional materials (textbooks, units, or lessons) to be used in this class?

○ Yes (1)

○ No (2)

Display This Question:

If Q2. Does your school/district designate instructional materials (textbooks, units, or lessons) to... = Yes

Q2-1. Which of the following types of instructional materials does your school/district designate to be used in this class? [Select all that apply.]

- Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks (1)
- State, county, or district/diocese-developed instructional materials (2)
- Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity) (3)
- Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers) (4)
- Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math) (5)

Curriculum Decisions

Q3. How much control do you have over each of the following for mathematics instruction in this class? [Select one on each row.]

	No Control (1)	(2)	Moderate Control (3)	(4)	Strong Control (5)

Determining course goals and objectives (1)					
Selecting curriculum materials (for example: textbooks) (2)					
Selecting content, topics, and skills to be taught (3)					
Selecting the sequence in which topics are covered (4)					
Determining the amount of instructional time to spend on each topic (5)					
Selecting teaching techniques (6)					
Determining the amount of homework to be assigned (7)					
Choosing criteria for grading student performance (8)					

Q4. How often do you do each of the following in your mathematics instruction in this class? [Select one on each row.]

	Never (1)	Rarely (e.g., a few times a year) (2)	Sometimes (e.g., once or twice a month) (3)	Often (e.g., once or twice a week) (4)	All or Almost All Mathematics Lessons (5)

Explain mathematical ideas to the whole class (1)					
Engage the whole class in discussions (2)					
Have students work in small groups (3)					
Provide manipulatives for students to use in problem-solving/investigations (4)					
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities) (5)					
Have students read from a textbook or other material in class, either aloud or to themselves (6)					
Have students write their reflections (for example: in their journals, on exit tickets) in class or for homework (7)					
Focus on literacy skills (for example: informational reading or writing strategies) (8)					
Have students practice for standardized tests (9)					

Interview Protocol for First Interview

Unit Plan Content

1. Let's assume I'm a new mathematics teacher who just got hired for next year. And you hand over this unit plan to me and want to make sure we are on the same page. Walk me through your plans for this unit.
    a. Tell me about the goals of this unit.
    b. What do you expect your students to get out of this unit?

Design Process

2. Tell me about your unit planning process
    a. Where do you start?
    b. What do you consider when you design this unit? (e.g., content, goals, tasks, procedure, assessments)
    c. When do you develop test items for formative or summative assessment?
    d. What curriculum resources do you look up or use in order to design this unit?
        i. How do you use those? What do you modify or adapt, if any, from the original curriculum resources?
3. What makes a unit? How do you determine a unit?
    a. How do you determine the length of the unit?
4. What are the things that you think are the most important in unit planning compared to lesson planning?

Perception of Particular Groups of Students

5. Tell me about the student population that you have in your mind when you plan this unit.
6. Let's imagine you are going to teach an Algebra I Honors. How would you teach that course?
    a. Do you expect any change in your plan for the unit?
7. How about a two-year algebra course (i.e., Algebra A/B courses). How would you teach such a course?
    a. Do you expect any change to your plans for the unit?
8. Let's imagine you have a large proportion of ELL students in your class, how would you accommodate them?
    a. Tell me about why you want to accommodate them X and Y ways
9. Let's imagine you have a large proportion of students with IEP in your class, how would you accommodate them?
    a. Tell me about why you want to accommodate them X and Y ways

Unexpected Schedule Changes

10. Imagine your principal announces that you will have a pep rally during your class one day. Talk about the adjustments you would make, if any, to your unit plan.

11. Let's imagine you might have to teach this unit in a shorter time frame than you planned. How would you teach this unit? What are the absolute essentials of this unit?"
12. Imagine another teacher in your department is a little bit behind and it seems like you have one or two extra days to make both classes at the same pace. What are the things that you would like to adjust from your unit plan?
    a. Where would the extra things go in your unit plan?

Unexpected Instruction Format Change

13. As we have been doing for the last quarter of the 2019-2020 school year, what if we are no longer able to do face-to-face instruction next year, how would you like to teach the same unit next year?
    a. Any changes to your plans for the unit? Why?
    b. What are the things that you do not change for sure? Why?

Interview Protocol for Follow-up Interview

Unit Plan Content

1. Walk me through your plans for this unit.
    a. Tell me about the goals of this unit.
    b. What do you expect your students to get out of this unit?

Implemented Unit Plan

2. Tell me about how the unit went.
3. What were the things that didn't go well as planned? Why?
    a. What did you change from your original plan?
4. What were the things that went well as planned? Why?
5. If you are gonna teach this unit next year, how do you want to teach this unit?
    a. What are the things that you keep the same? Why?
    b. What are the things that you leave off or replace? Why?

Design Process

6. Tell me about your unit planning process
    a. What led you to decide to teach this unit at this particular time of the year?
    b. How did you decide the boundary of this unit? In your terms, what makes a unit? What constitutes a unit?
    c. Where did you start?
    d. What did you consider when you design this unit? (e.g., content, goals, tasks, procedure, assessments)
    e. When did you develop test items for formative or summative assessment?
7. What curriculum resources did you look up or use in order to design this unit?
    a. How did you use those? What did you modify or adapt, if any, from the original curriculum resources?
8. What are the things that you think are the most important in unit planning compared to lesson planning?

Perception of Particular Groups of Students

9. Tell me about the student population that you have in your mind when you plan this unit.
10. Let's imagine you are going to teach an Algebra I Honors. How would you teach that course?
    a. Do you expect any change to your plans for the unit?
11. How about a two-year algebra course (i.e., Algebra A/B courses). How would you teach such a course?
    a. Do you expect any change in your plan for the unit?
12. Let's imagine you have a large proportion of ELL students in your class, how would you accommodate them?
    a. Tell me about why you want to accommodate them X and Y ways

13. Let's imagine you have a large proportion of students with IEP in your class, how would you accommodate them?
    a. Tell me about why you want to accommodate them X and Y ways

Unexpected Schedule Changes

14. Imagine your principal announces that you will have a pep rally during your class one day. Talk about the adjustments you would make, if any, to your unit plan.
15. Let's imagine you might have to teach this unit in a shorter time frame than you planned. How would you teach this unit? What are the absolute essentials of this unit?"
16. Imagine another teacher in your department is a little bit behind and it seems like you have one or two extra days to make both classes at the same pace. What are the things that you would like to adjust from your unit plan?
    a. Where would the extra things go in your unit plan?

Unexpected Instruction Format Change

17. As we have been doing for the last quarter of the 2019-2020 school year, what if we are no longer able to do face-to-face instruction next year, how would you like to teach the same unit next year?
    a. Any changes to your plans for the unit? Why?
    b. What are the things that you do not change for sure? Why?

VITA

Jaepil Han grew up in Daegu, South Korea. He earned Bachelor of Science degrees in Electronic Engineering and Mathematics from Kyungpook National University in Daegu, South Korea in 2012, a Master of Art in Mathematics Education from the University of Georgia in 2017, and a Ph.D. in Learning, Teaching, and Curriculum with a focus on Mathematics Education from the University of Missouri in 2022. Jaepil also received a Qualitative Research Graduate Certificate from the University of Missouri in 2022.