SITUATING INTERIM ASSESSMENTS WITHIN TEACHERS’ PRACTICE OF DATA USE: HOW UPPER ELEMENTARY SCHOOL TEACHERS ATTEND TO, INTERPRET, AND UNDERSTAND INTERIM ASSESSMENT DATA

by

Austin Stewart Jennings

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education

Spring 2019

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ABSTRACT

My dissertation comprises three studies designed to explore nuances of data use in education that presently confound the relationship between variation in teachers’ practice of data use and student outcomes: (1) the relationships between different data sources within and across instructional practices; (2) the dimensionality of teachers’ practice of interim assessment data use; and (3) the reciprocal relationship between teachers’ existing understandings and interpretive process. In each study, I adapt and develop innovative approaches – ranging from eye tracking and network analysis to convergent and complex mixed methods study design – to not only address critical questions about data use in education, but also push the broader field of research in new theoretical and methodological directions. In so doing, my dissertation advances the field of research on data use in education and informs both education practice and policy.

In my first study, I present a statistical and network analysis of how teachers choose between and combine data sources for instructional purposes. Specifically, I analyzed survey data to map and characterize patterns in teachers’ use of formative assessment, curriculum-based assessment, interim assessment, other school- or district-wide common assessment, course grades, state assessment, and attendance or behavioral data across 36 instructional practices. Findings suggest teachers use an average of two to six data sources to inform each instructional practice. Furthermore, I uncover a complex network of preferential, substitute, and complementary relationships between data sources within teachers’ practice of data use. Implications
include a fundamental shift in understanding how teachers make sense of and use data for instructional purposes.

Then, I present a convergent mixed methods study of how patterns in teachers’ practice of interim assessment data use are related to the degree to which they synthesize interim assessment data with other data sources. First, I analyzed quantitative survey data to develop multidimensional teacher data use profiles and qualitative interview data to gather evidence of how teachers make sense of interim assessment data. Then, I integrated these results and recoded interview transcripts to explore patterns in how teachers use interim assessment data based on differences in two conditionally independent dimensions of data use: synthesis and informative value. Integrated findings suggest teachers may be broadly categorized as comprehensive or superficial data users with implications for the authenticity of their interim assessment data use. Implications include methods of identifying and supporting teachers’ capacity to meaningfully synthesize interim assessments with other data sources.

Finally, I present a complex mixed methods study of how teachers’ existing understandings of their students shape, and are in turn shaped by, how they make sense of interim assessment data. First, I synthesized conceptualizations of teachers’ interpretive process with framing theory to develop a model of the recursive relationship between teachers’ existing understandings and interpretive process. Then, I analyzed qualitative interview data and quantitative eye tracking data to explore the interconnectedness of how teachers frame, notice, and interpret interim assessment data. Integrated findings suggest teachers broadly understand students as achievers and learners with implications for how they notice and interpret types and features of
interim assessment data. Furthermore, findings suggest teachers elaborate, preserve, and reframe these understandings in response to new information. Implications include methods of modeling and supporting how teachers understand and use interim assessment data.
Data use in education is often depicted as a panacea for substandard and inequitable student achievement. Accordingly, prominent education policies such as the Every Student Succeeds Act codify expectations that teachers collect, analyze, and use student achievement data to inform their decision making. To support such efforts, states and districts have designed and implemented comprehensive assessment systems comprised of an array of assessment tools and processes, each with distinguishing characteristics and instructional implications (Perie, Marion, & Gong, 2009). To date, research on data use in education has explored how teachers understand (e.g., Coburn & Turner, 2011; Spillane & Miele, 2007), communicate about (e.g., Jimerson, 2014; Horn, Kane, & Wilson, 2015), and respond to these data sources (e.g., Farrell & Marsh, 2016; Park & Datnow, 2017). This research provides valuable insight into how teachers interpret data, how influential school stakeholders shape teachers’ understanding of data, and the specific instructional practices for which teachers use different data sources. However, such research does not attend to essential nuances of data use that presently confound the relationship between variation in teachers’ practice of data use and student outcomes.

It is only through understanding this nuanced variation in teachers’ practice of data use that we can begin to identify and support best practices that improve and address inequities in student achievement. Toward this end, my dissertation comprises three studies that create a foundation for understanding and informing the continued
study of such nuanced variation. In each study, I adapt and develop innovative approaches – ranging from eye tracking and network analysis to convergent and complex mixed methods study design – to not only address critical questions about data use in education, but also push the broader field of research in new theoretical and methodological directions. In this capacity, my dissertation simultaneously addresses understudied variation in teachers’ practice of data use, creates a foundation for future studies connecting teachers’ practice of data use with student outcomes, and informs how we can ultimately support teachers in addressing the substandard and inequitable student achievement underlying prominent education policy.

1.1 Dissertation Overview

The purpose of my dissertation is to explore three nuances of upper elementary school teachers’ data use: (1) the relationships between different data sources within and across instructional practices; (2) the dimensionality of teachers’ practice of interim assessment data use; and (3) the reciprocal relationship between teachers’ existing understandings and interpretive process. To address these objectives, I adapt and develop innovative theoretical and methodological approaches to the analysis of a novel mixed methods data set comprised of survey, open-ended interview, and eye tracking data (see Figure 1.1).
Table 1.1: Data Sources, Research Questions, and Methods by Study

<table>
<thead>
<tr>
<th>Participants</th>
<th>Data</th>
<th>Study 1 Preferences, Substitutes, and Complements</th>
<th>Study 2 Comprehensive and Superficial Data Users</th>
<th>Study 3 Students as Achievers and Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Respondents</td>
<td>36-item measure of teachers’ practice of data use</td>
<td>(1) What data sources do upper elementary school teachers use to inform their instructional practice? (2) What is the relationship between data sources within and across instructional practices? &lt;br&gt; <strong>Methods</strong> (Quantitative) Statistical and network analysis</td>
<td>(1) How do upper elementary school teachers attend to interim assessment data within their broader practice of data use? (2) How do upper elementary school teachers make sense of interim assessment data in relation to dimensions of their broader practice of interim assessment data use? &lt;br&gt; <strong>Methods</strong> (Quantitative) Statistical and network analysis</td>
<td></td>
</tr>
<tr>
<td>(n = 88)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>response rate = 75%</td>
<td></td>
<td></td>
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<tr>
<td>Interviewees</td>
<td>Multi-scale measure of teachers’ data use attitudes, perceptions, beliefs, and practices</td>
<td></td>
<td></td>
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<tr>
<td>(n = 23)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>participation rate = 70%</td>
<td></td>
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<tr>
<td></td>
<td>Open-ended interview initiated with a grand tour question</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Record field of view, eye position, and gaze</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* subsample of survey respondents</td>
<td></td>
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</tr>
</tbody>
</table>
1.1.1 Relationship Between Data Sources Within Teachers’ Practice

Teachers need an array of data sources to meaningfully understand and respond to diverse student learning needs (Hamilton et al., 2009; Young & Kim, 2010). For example, teachers may develop lesson-specific classroom assessments to elicit timely feedback that informs day-to-day instructional content and pacing. By contrast, teachers may rely on interim assessments aligned with their end-of-year state assessment to gauge students’ mastery of grade-level skills and content. While research provides preliminary evidence of how data sources are situated within teachers’ instructional practice, such studies do not directly attend to the interaction between different assessments within teachers’ practice of data use (Riggan & Nabors Oláh, 2011). Accordingly, although we may know teachers use multiple data sources to inform a given practice, we do not know to what degree teachers choose between or combine data sources to develop nuanced instructional responses. Before we can connect data use to student outcomes and responsibly guide teachers’ synthesis of data sources, we need to develop a methodological approach to studying, and a foundational understanding of, the interaction between data sources within teachers’ practice.

In my first study, I use a 36-item measure of teachers’ practice of data use to map a multipartite network connecting teachers to practices in which they engage, practices to data sources that inform teachers’ engagement, and data sources to teachers who use them to inform their practice. Whereas existing research may indicate the proportion of teachers who either use classroom or interim assessment to inform a given practice, my novel application of network analysis allows me to draw specific conclusions about the degree to which teachers synthesize these data sources.
Based on this methodological approach, I am further able to decompose and characterize the interconnectedness of data sources as preferential, substitute, or complementary. As such, this study not only provides nuanced insight into the interaction of data sources within teachers’ practice but also provides a methodological foundation for studying the relationships between teachers’ synthesis of data sources, interpretive processes, and instructional responses.

1.1.2 Dimensionality of Teachers’ Practice of Interim Assessment Data Use

Interim assessments are a particularly salient focus in research on data use in education as they provide feedback that can be aggregated and used at multiple levels (Perie et al., 2009). For example, teachers may use interim assessment data at the student-level to differentiate instruction based on students’ unique instructional readiness or aggregate such data at the classroom-level to determine the proportion of students performing below grade level in an instructional area. By contrast, school or district administrators may aggregate interim assessment data beyond the classroom-level to explore broader trends in student achievement. To date, research indicates teachers use interim assessment data to inform a broad array of practices including, but not limited to, pacing instruction (Hoover & Abrams, 2013), evaluating instructional strategies (Horn et al., 2015), grouping (Park & Datnow, 2017; Shepard, Davidson, & Bowman, 2011), identifying “bubble kids” (Blanc et al., 2010; Christman et al., 2009), reteaching (Farrell & Marsh, 2016; Goertz, Nabors Oláh, & Riggan, 2009; Nabors Oláh, Lawrence, & Riggan, 2010), and differentiating instruction (Park & Datnow, 2017; Hoover & Abrams, 2013). However, as evidenced by my preceding study, we also know teachers do not make sense of interim assessment data in isolation. Accordingly, before we can identify best practices in teachers' use of interim
assessment data, we need to understand whether and how patterns in teachers’ practice of interim assessment data use are related to the degree to which they synthesize interim assessment data with other data sources.

In my second study, I use the 36-item measure of teachers’ practice of data use and an extended survey of teachers’ data use attitudes, perceptions, beliefs, and practices to measure three dimensions of teachers’ practice of interim assessment data use: frequency of use, synthesis with other data sources, and perceived informative value. Then, I code transcripts from open-ended interviews during which teachers accessed and explained how they use interim assessment reports for instructional purposes. Finally, I integrate these results within a convergent mixed methods framework and recode interview transcripts to explore patterns in how teachers use interim assessment data based on differences in two conditionally independent dimensions of data use: synthesis and informative value. This study not only demonstrates how my preceding application of network analysis can be used by researchers to develop more nuanced insight, but also directly contributes to a contextualized understanding of interim assessment data use with implications for instructional support coaches, school administrators, and interim assessment developers.

1.1.3 Teachers’ Existing Understandings and Interpretive Process

As evidenced by my preceding study, and consistent with prior research (e.g., Jimerson, 2014), teachers often access interim assessment data to gather specific types of information. Teachers may be looking to identify students with above grade level achievement to recommend for enrichment activities or the specific skills and content special education students are ready to learn to revise their Individualized Education
Programs. Furthermore, research suggests influential school stakeholders may frame how teachers notice and interpret data by establishing a common problem of interest, desired solution, and impetus for action (e.g., Coburn, Toure, & Yamashita, 2009; Park, Daly, & Wishard Guerra, 2012). For example, teachers who participate in instructional management-oriented workgroups may frame data use toward a focus on underperforming students whereas teachers who participate in instructional improvement-oriented workgroups may frame data use toward understand students’ thinking (Horn et al., 2015). Although teachers’ initial understanding of students may be shaped by social and organizational factors, we do not know how such understandings frame the specific types and features of data teachers notice or how teachers individually reinforce or challenge such understandings based on their personal interpretation of that data. Before we can connect shared frames of understanding to differences in student outcomes and identify best practices, we need to theoretically and empirically understand how teachers’ individual enactment of such frames may confound the relationship between frames and student outcomes.

In my third study, I develop a model of the recursive relationship between how teachers frame, notice, and interpret interim assessment data by synthesizing two perspectives: conceptualizations of teachers’ interpretive process (Coburn & Turner, 2011; Spillane & Miele, 2007) and the data-frame theory of sensemaking (Klein, Moon, & Hoffman, 2006; Klein, Philips, Rall, & Peluso, 2007). Then, I code transcripts from open-ended interviews to gather evidence of how teachers interpret interim assessment reports and use eye tracking data to identify the specific types and features of data on which they cognitively focus. Finally, I integrate these results within a complex mixed methods framework and recode interview transcripts to
explore emergent patterns in the frames teachers evoke when interpreting interim assessment reports, how those frames shape the raw data teachers notice and the information they gather, as well as how that information in turn shapes prevailing frames through three processes: elaboration, preservation, and reframing. This study not only provides researchers a theoretical framework for modeling the recursive relationship between teachers frames and interpretive process, but also provides a novel methodological approach for transcending abstract conceptualizations of how teachers notice data. Additionally, this study has direct implications for how school stakeholders can inform and support teachers’ understanding of students through interim assessment data use.

1.2 Significance to Research, Practice, and Policy

Taken together, the three studies that comprise my dissertation inform and advance how we understand nuanced variation in teachers’ practice of data use. As such, my dissertation represents a necessary first step toward understanding the systematic variation in how teachers choose between, combine, and make sense of assessment data that presently confounds the relationship between teachers’ data use and their students’ learning outcomes. In so doing, my dissertation advances the field of research on data use in education and informs both education practice and policy. From a research perspective, my dissertation provides new theoretical and methodological directions to inform the broader field of study. Theoretically, I synthesize conceptual and sociological perspectives on data use to develop a comprehensive framework for understanding the processes through which teachers’ frames shape, and are in turn shaped by, their interpretation of assessment data. Methodologically, I present new ways to measure the interconnectedness of data
sources within teachers’ practice and use eye tracking to transcend abstract conceptualizations of how teachers notice data. From a practice perspective, my work has significance for influential school stakeholders and assessment developers. First, I identify two unique dimensions of data use that may be used as markers of comprehensiveness by influential school stakeholders to support development of teachers’ data literacy and effective data use. Second, I provide evidence of how teachers interpret interim assessment data reports that may be used by assessment developers to create systems that support teachers’ capacity to interpret and meaningfully synthesize interim assessment data with other data sources and develop more nuanced instructional responses. From a policy perspective, my dissertation creates a foundation for understanding, and informs the continued study of, nuanced variation in teachers’ practice of data that may ultimately support identifying best practices that address the substandard and inequitable student achievement underlying prominent education policy.
Chapter 2

PREFERENCES, SUBSTITUTES, AND COMPLEMENTS

Prominent education policies such as the Every Student Succeeds Act codify expectations that teachers collect, analyze, and use student achievement data to inform their decision making. Aligned with related increases in the centralization of school accountability, states and districts have designed and implemented comprehensive assessment systems comprised of formative, interim, and summative assessments (Perie, Marion, & Gong, 2009; Troy, 2011). Accordingly, teachers’ assessment practice encompasses an array of tools and processes (Riggan & Nabors Oláh, 2011).

Contemporary research on data use in education highlights teachers’ need for a variety of data sources to meaningfully understand and respond to student learning needs (Hamilton et al., 2009; Young & Kim, 2010). Each type of assessment and resulting data source has distinguishing characteristics and implications for teachers’ instructional practice (Farrell & Marsh, 2016; Perie et al., 2009; Supovitz, 2012). While a growing body of research situates individual data sources within teachers’ instructional practice, there remain gaps in our collective understanding of how teachers choose between and combine data sources for instructional purposes (Herman, Osmundson, Ayala, Schneider, & Timms, 2006; Jennings, 2012; Riggan & Nabors Oláh, 2011).
2.1 Literature Review

Teachers’ practice of data use is a fundamentally interpretive process (Coburn & Turner, 2011, 2012). Consistent with a sensemaking theoretical perspective (see Weick, 1995), conceptualizations of teachers’ interpretive process contend teachers use existing knowledge to construct personally relevant understandings of raw data that shape their subsequent instructional responses (Ackoff, 1989; Mandinach, Honey, Light, & Brunner, 2008; Marsh, 2012; Marsh, Pane, & Hamilton, 2006; Spillane & Miele, 2007). That is, teachers’ interpretive process has implications for how they notice, understand, and act upon assessment data. Such models have been employed to understand how teachers make sense of an array of data sources within their instructional practice (see e.g., Farrell & Marsh, 2016; Park & Datnow, 2017).

Data sources are positioned along a spectrum ranging from short- to long-cycle assessment (Supovitz, 2012; Wiliam & Leahy, 2006). Short-cycle assessment (e.g., classroom assessment) is designed to elicit immediate feedback on student understanding within lessons. Such moment-to-moment assessments are embedded in learning activities, narrow in scope, and administered frequently (Black & Wiliam, 1998; Perie et al., 2009). By contrast, medium-cycle assessment (e.g., homework, writing, and curriculum-based assessment) is designed to provide feedback on student understanding across lessons within a common unit (Supovitz, 2012). In a meta-analysis of the relationship between assessment and student achievement, Kingston and Nash (2011) found K-12 teachers practice of short- and medium-cycle assessment data use ranges from planning and differentiation to monitoring and evaluation.

Interim-cycle assessment is designed to provide monthly to bi-annual feedback on student understanding relative to unit, semester, or grade level learning objectives (Supovitz, 2012). Compared to short- and medium-cycle assessment, interim
assessments are externally-constructed, have a broader scope, are administered less frequently, and provide data that can be meaningfully aggregated at the classroom-, school-, and district-levels (Datnow & Hubbard, 2015; Perie et al., 2009). Research indicates K-12 teachers’ practice of interim assessment data use includes pacing (Hoover & Abrams, 2013), evaluating instructional strategies (Horn, Kane, & Wilson, 2015), grouping (Park & Datnow, 2017; Shepard, Davidson, & Bowman, 2011), identifying “bubble kids” (Blanc et al., 2010; Christman et al., 2009), reteaching (Farrell & Marsh, 2016; Goertz, Nabors Oláh, & Riggan, 2009; Nabors Oláh, Lawrence, & Riggan, 2010), and differentiation (Park & Datnow, 2017; Hoover & Abrams, 2013).

Long-cycle assessment (e.g., end-of-year state assessment) is designed to provide annual feedback on student understanding relative to grade level academic standards (Supovitz, 2012). Long-cycle assessments have a broad scope, infrequent administration, and are typically intended to inform course grades, school accountability, and education policy (Perie et al., 2009). However, teachers may also use long-cycle assessment data to learn about and support students’ learning progression (Black & Wiliam, 2009). Specifically, research indicates K-12 teachers’ practice of long-cycle data use includes curricular alignment (Beaver & Weinbaum, 2013), identifying students for supplemental instruction (Diamond & Cooper, 2007), and grouping (Beaver & Weinbaum, 2013; Farrell & Marsh, 2016; Park & Datnow, 2017).

Despite a growing body of literature on formative uses of assessment data, there remains a gap in our collective understanding of how data sources are situated and interact within teachers’ instructional practice (Herman et al., 2006; Riggan &
Nabors Oláh, 2011). However, notable contributions have begun to shape a more nuanced understanding of teachers’ practice of data use.

Goertz and colleagues (2009) approach this gap by exploring the role of interim assessment within teachers’ practice of data use. The authors developed data use profiles for 39 teachers based on their collection, interpretation, and response to three types of assessment data: short-cycle practices, medium-cycle tools, and interim benchmark assessments. Then, the authors analyzed each profile with respect to the degree to which teachers’ instructional responses were associated with each data source. The authors found teachers used short-cycle assessment to elicit student thinking, medium-cycle assessment to determine student content mastery, and interim assessment to identify student weaknesses and inform reteaching. Although the authors situate each data source within teachers’ broader practice, they provide limited insight into the interaction between data sources within any given instructional practice.

Relatedly, Farrell and Marsh (2016) explore teachers’ instructional response to five data sources: classroom assessment, student work, common grade assessment, district benchmark assessment, and state assessment. The authors found teachers most frequently use classroom assessment data and student work to inform instructional delivery; common grade and district benchmark assessment data to inform reteaching and retesting; as well as district benchmark and state assessment data to inform grouping. These findings suggest teachers typically use data from two different assessment cycles to inform each identified practice. However, like Goertz and colleagues (2009), Farrell and Marsh (2016) focus on how teachers use each data
source independently instead of how teachers choose between and combine commonly used data sources to inform a given practice.

Other research approaches this gap from the perspective of instructional practices, as opposed to data sources. For example, Park and Datnow (2017) explore how teachers, administrators, and district leaders use data to inform grouping within and across classrooms as well as to differentiate instruction. The authors found teachers use data from all assessment cycles to group and provide individual support to students. However, like Farrell and Marsh (2016), Park and Datnow (2017) do not provide insight into how teachers choose between and combine commonly used data sources to inform each practice.

2.2 Purpose

Taken together, emerging literature provides preliminary evidence of how data sources are situated within teachers’ instructional practice. In exploring the relationship between short- and interim-cycle assessment, Riggan and Nabors Oláh (2011) assert future research should directly attend to the interaction between different assessments within teachers’ practice of data use. As a first step toward this understanding, researchers must uncover how teachers choose between and combine data sources within and across instructional practices. Accordingly, the present study addresses two guiding research questions:

RQ1. What data sources do upper elementary school teachers use to inform their instructional practice?

RQ2. What is the relationship between data sources within and across instructional practices? Specifically:
a. To what extent do upper elementary school teachers combine data sources to inform a common instructional practice?

b. How can we characterize patterns in the extent to which teachers choose between and combine data sources within and across instructional practices?

2.3 Methods

The objective of this survey research study is to explore and characterize patterns in teachers’ use of data sources for instructional purposes. Survey research is descriptive in nature, designed to elicit quantitative data about respondents’ beliefs, perceptions, and behaviors relative to qualitative inquiry (Fowler, 2014; Lodico, Spaulding, & Voegtle, 2010). In the present study, I use survey data to map teachers’ use of seven data sources across 36 instructional practices and uncover multifaceted relationships between data sources within teachers’ practice of data use.

2.3.1 Participants

The present study is situated in a larger project exploring upper elementary school teachers’ practice of interim assessment data use. Accordingly, participating districts were selected based on common use of MAP Growth (hereafter, MAP) in all upper elementary school classrooms. The two medium-sized districts reside in neighboring Mid-Atlantic states with varied demographic profiles. Elementary school students in Apothem School District were predominantly White, African American, and Latina/o (respectively, school range: 50-65%; 15-35%; 5-10%), with limited

1 I round and present school descriptive statistics in ranges to limit reverse look-up.
eligibility for free or reduced-price meals (school range: 10-35%). Elementary school students in Cevian School District were also predominantly White, African American, and Latina/o (respectively, school range: 45-95%; 1-25%; 5-15%), with moderate eligibility for free or reduced-price meals (school range: 30-70%).

The present study frame includes all Grade 3-5 mathematics and/or English language arts (ELA) teachers of record at five schools in each district. This eligibility criterion ensures participants have common access to MAP data and a shared opportunity to incorporate data within the scope of their professional responsibilities. Of 118 eligible teachers, 88 participated in the present study (response rate = 75%), most of whom were female (95%) and White (92%). Teachers were distributed across both grade (35% Grade 3, 36% Grade 4, 28% Grade 5) and content area specialization (23% math-only, 32% ELA-only, 45% math and ELA). Teachers averaged 13.44 years of teaching experience (range: 1-42 years), an average of 7.30 of which was at their current grade level (range: 1-30) and 6.58 at their current school (range: 1-37).

2.3.2 Survey Instrument

The present study focuses on participants’ response to a 36-item measure of teachers’ practice of data use, adapted from Farley-Ripple and Buttram (2017), within a broader survey on teachers’ data use attitudes, perceptions, beliefs, and practices. Each survey item corresponded with one of the authors’ 36 identified instructional practices (see Table 2.1). I presented each item in a matrix consisting of two response categories: engagement and data use (see Figure 2.1). For each survey item, teachers identified whether they engage in the identified practice and, if so, the data sources they typically use to inform their instructional response. Teachers could choose from eight data sources: formative assessment (form), curriculum-based assessment (curr),
interim assessment (specifically, MAP; map), other school- or district-wide common assessment (schdist), course grades (course), state assessment (state), attendance or behavioral data (attbeh), and other data. Consistent with research on teachers’ practice of data use (e.g., Farrell & Marsh, 2016), I exclude “other data” in the present study due to infrequent use.

Note. Survey item matrices were divided into three columns: (1) instructional practices, (2) teacher engagement, and (3) data sources. To capture engagement, participants identified practices in which they do not engage. To capture data use, participants identified the data sources they typically use to inform each practice in which they engage.

Figure 2.1: Sample Data Use Survey Item Stem and Response Options
<table>
<thead>
<tr>
<th>Instructional Action</th>
<th>Instructional Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruction</strong></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>(plan1) Plan instruction prior to school year</td>
</tr>
<tr>
<td></td>
<td>(plan2) Specify learning objectives for a lesson or unit</td>
</tr>
<tr>
<td></td>
<td>(plan3) Plan instruction for a lesson/unit</td>
</tr>
<tr>
<td>Strategies</td>
<td>(strat1) Design intervention for students</td>
</tr>
<tr>
<td></td>
<td>(strat2) Identify activities to match student RIT scores</td>
</tr>
<tr>
<td></td>
<td>(strat3) Talk with other teachers about MAP data implications for instruction</td>
</tr>
<tr>
<td></td>
<td>(strat4) Develop/choose appropriate instructional strategies</td>
</tr>
<tr>
<td>Grouping and</td>
<td>(group1) Use data to group students for classroom activities</td>
</tr>
<tr>
<td>differentiation</td>
<td>(group2) Inform differentiated lesson plans</td>
</tr>
<tr>
<td></td>
<td>(group3) Focus on students who are borderline predicted to pass the state test (&quot;bubble kids&quot;)</td>
</tr>
<tr>
<td></td>
<td>(group4) Identify students for interventions in the classroom</td>
</tr>
<tr>
<td></td>
<td>(group5) Identify students for enrichment in the classroom</td>
</tr>
<tr>
<td>Content</td>
<td>(content1) Identify content/concepts that need to be retaught</td>
</tr>
<tr>
<td></td>
<td>(content2) Identify skills that students are instructionally ready to learn</td>
</tr>
<tr>
<td></td>
<td>(content3) Guide selection of classroom materials</td>
</tr>
<tr>
<td></td>
<td>(content4) Choose or develop appropriate content/curriculum</td>
</tr>
<tr>
<td>Placement</td>
<td>(place1) Recommend students for gifted programs</td>
</tr>
<tr>
<td></td>
<td>(place2) Recommend students for special education</td>
</tr>
<tr>
<td>Learning about</td>
<td>(learnStud1) Evaluate student progress</td>
</tr>
<tr>
<td>students</td>
<td>(learnStud2) Identify students’ strengths and weaknesses</td>
</tr>
<tr>
<td></td>
<td>(learnStud3) Learn about incoming student performance</td>
</tr>
<tr>
<td>Learning about</td>
<td>(learnTch1) Evaluate what strategies are working</td>
</tr>
<tr>
<td>teaching</td>
<td>(learnTch2) Conduct action research or professional inquiry about teaching</td>
</tr>
<tr>
<td>Gather information</td>
<td>(gatherInfo1) Re-test or administer another assessment to gather more information</td>
</tr>
<tr>
<td></td>
<td>(gatherInfo2) Compare MAP to other assessment data</td>
</tr>
<tr>
<td>Learning about</td>
<td>(learnSys1) Align classroom or other assessments with MAP questions</td>
</tr>
<tr>
<td>system</td>
<td>(learnSys2) Look at curricular alignment across grades</td>
</tr>
<tr>
<td></td>
<td>(learnSys3) Look at curricular coverage in current grade</td>
</tr>
<tr>
<td></td>
<td>(learnSys4) Evaluate curriculum content or pacing</td>
</tr>
<tr>
<td></td>
<td>(learnSys5) Predict state test performance for individual students</td>
</tr>
<tr>
<td>Goal setting</td>
<td>(goalset1) Having students set personal goals for MAP scores/growth</td>
</tr>
<tr>
<td></td>
<td>(goalset2) Developing IEP goals for special education students</td>
</tr>
<tr>
<td></td>
<td>(goalset3) Setting individual, group, or classroom-wide student performance goals</td>
</tr>
<tr>
<td></td>
<td>(goalset4) Setting team (grade level, PLC, etc.) goals</td>
</tr>
<tr>
<td>Celebrate</td>
<td>(celebrate1) Celebrating students’ improvements and/or scores</td>
</tr>
<tr>
<td></td>
<td>(celebrate2) Celebrating team and/or school successes</td>
</tr>
</tbody>
</table>

*Note. Adapted from Farley-Ripple and Buttram (2017); instructional practice-specific variable codes in parentheses.*

### 2.3.3 Practice of Data Use Network Structure

Networks are defined by a system of connected nodes that map the relationship between actors and events (Hanneman & Riddle, 2011). As depicted in Figure 2.2a, I
conceptualize teachers’ practice of data use as a complex network inclusive of the relationship between three sets of nodes: teachers, instructional practices, and data sources. This network connects teachers to practices in which they engage, practices to data sources that inform teachers’ engagement, and data sources to teachers who use them to inform their practice. To address my guiding research questions, I decompose this multipartite network into two subnetworks: bipartite and co-affiliation.

Note. Frame (a) depicts the multipartite network between teachers, instructional practices, and data sources. Frame (b) depicts an instructional practice-specific bipartite network between teachers and data sources. Frame (c) depicts an instructional practice-specific co-affiliation network between data sources across teachers. Frame (d) depicts an instructional practice-specific pairwise relationship between data sources across teachers.

Figure 2.2: Data Use Network Structures
2.3.3.1 Bipartite Networks

I transformed participants’ survey responses into bipartite affiliation networks to analyze teachers’ use of data to inform individual instructional practices. Bipartite networks provide a structure for exploring the relationship between actors and events within a common environmental constraint (Borgatti & Halgin, 2011). As applied to the present study, bipartite networks represent teachers’ (actors) use of data sources (events) to inform a common instructional practice (environmental constraint). That is, as depicted in Figure 2.2b, each instructional practice served as a unique frame of analysis. Within that analytic frame, each teacher was connected to all data sources he or she uses to inform the identified instructional practice. I used bipartite networks to address my first research question, situating teachers’ use of seven data sources across a comprehensive set of instructional practices.

2.3.3.2 Co-Affiliation Networks

I transformed bipartite networks into co-affiliation networks to analyze the relationship between data sources within teachers’ practice of data use. Co-affiliation matrices provide a structure for exploring the relationship between events across actors, or vice versa, within a common environmental constraint (Borgatti & Halgin, 2011). As applied to the present study, co-affiliation networks represent teachers’ choice between and combination of data sources (event across actors) to inform a common instructional practice (environmental constraint). That is, as depicted in Figure 2.2c, each instructional practice served as a unique frame of analysis. Within that analytic frame, two data sources were connected if at least one teacher uses them together and each teacher was attributed to the data sources he or she uses as well as the connections between them. I used co-affiliation networks to address my second
research question, characterizing patterns in teachers’ choice between and combination of data sources within and across instructional practices.

Bipartite and co-affiliation matrices are mathematical representations of the corresponding networks that support subsequent statistical analysis. When transforming a bipartite matrix into a co-affiliation matrix, researchers must choose a mathematical algorithm with implications for subsequent statistical analysis. In the present study, I transformed matrices based on two algorithms: sum of cross products and Jaccard normalization.

Sum of cross product matrix elements represent the number of node co-occurrences (Hanneman & Riddle, 2005). That is, sum of cross products matrices indicate how many teachers use each data source and pairwise data source combination. For example, as depicted in Figure 2.2d, five teachers use formative and/or interim assessment data to evaluate curriculum content or pacing: four use formative assessment data, four use interim assessment data, and three use both data sources. In the present study, I used sum of cross products matrices to visualize the relationship between data sources within teachers’ instructional practice.

Jaccard normalized matrix elements represent the proportion of node co-occurrences relative to unique node occurrences (Jaccard, 1901). That is, Jaccard

---

2 Sum of cross products matrices, $S$, contain elements $s_{ij}$ that represent the number of co-occurrences of nodes $i$ and $j$ (Hanneman & Riddle, 2005). In the present study, matrix elements represent the number of teachers who use each individual or pair of data sources to inform the identified practice.

3 Jaccard normalized matrices, $A$, contain elements $a_{ij}$ that represent the intersection of nodes $i$ and $j$ relative to the union (Jaccard, 1901). In the present study, matrix elements represent the proportion of teachers who use each pair of data sources to inform the identified practice, contingent on using at least one of the two data sources.
normalized matrices indicate how many teachers use two data sources together relative
to how many teachers use at least one of the two data sources. For example, as
depicted in Figure 2.2d, five teachers use interim and/or summative assessment data to
evaluate curriculum content or pacing: two use just interim assessment data, one uses
just summative assessment data, and two use both data sources. Accordingly, 40% of
teachers who use interim and/or summative data to evaluate curriculum content or
pacing use both data sources. In the present study, I analyzed Jaccard normalized
matrices to identify and characterize statistically significant patterns in teachers’
choice between and combination of data sources.

2.3.4 Data Analysis Strategy

I addressed my guiding research questions via statistical and network analysis
using SPSS version 25 (IBM Corp., 2017), UCINET version 6.648 (Borgatti, Everett,
& Freeman, 2002), and Gephi version 0.9.2 (Bastian, Heymann, & Jacomy 2009).
Data analysis products include instructional practice-specific descriptive statistics,
measures of network structure, network diagrams, and significance tests.

To address my first research question, I analyzed the proportion of participants
who use each data source to engage in the identified instructional practices. Analyses
provide insight into not only the prevalence with which teachers engage in each
instructional practice but the specific data sources they use within and across those
practices. Taken together, these analyses characterize the complexity of upper
elementary school teachers’ practice of data use. However, these analyses do not
directly attend to the connection between data sources within teachers’ practice.

To address my second research question, I began by analyzing bipartite
network density to explore the general interconnectedness of data sources within
participants’ practice of data use. Density, the proportion of possible ties present in a network (Borgatti, Everett, & Johnson, 2013), is a broad measure of the extent to which participants combine multiple data sources to inform a common instructional practice. That is, high network density indicates the average teacher uses multiple data sources to inform that practice whereas low network density indicates the average teacher uses relatively few data sources.

Then, I analyzed Jaccard normalized co-affiliation network centrality to narrow my focus on the connection between pairs of data sources within and across instructional practices. Degree centrality, a measure of the structural importance of a node within a network (Borgatti et al., 2013; Freeman, 1979), represents the average proportion of teachers who use two data sources together, contingent on using at least one. That is, a data source with high network centrality indicates the average teacher commonly uses it with other data sources whereas low network centrality indicates the average teacher does not.

Finally, I analyzed statistically significant differences in participants’ use of data sources to characterize patterns in the extent to which teachers choose between and combine pairs of data sources for a common instructional purpose. Specifically, I compared the proportion of participants who use each pair of data sources together and separately via McNemar’s exact test (McNemar, 1947), adjusted for multiple comparisons via Benjamini-Hochberg procedure to maintain a 5% false discovery rate (Benjamini & Hochberg, 1995). Then, I classified statistically significant pairwise tests by type of relationship: preferential, substitute, and complementary.

In the present study, I operationalize preferential relationships as those for which significantly more participants use two data sources separately than together.
and use one significantly more than the other. By contrast, I operationalize substitute relationships as those for which significantly more participants use two data sources separately than together but do not use either significantly more than the other. Lastly, I operationalize complementary relationships as those for which significantly more participants use two data sources together than separately. Taken together, these analyses characterize and develop a typology for understanding the complex relationship between data sources within upper elementary school teachers’ practice of data use.

2.4 Results

To address my first research question, I analyzed the proportion of participants who use each data source to engage in the 36 identified instructional practices (see Table 2.2). On average, about 89% of participants indicated engaging each practice (range: 47-100%). Alternately, the average participant uses data to inform about 32 different instructional practices. All 88 participants engage in two practices: evaluating student progress and celebrating students’ achievement. Conversely, less than half of participants use data to conduct action research or professional inquiry about teaching ($n_{learnTch2} = 41$).

Patterns across teachers’ practice of data use suggest three tiers of data source prevalence. More than half of engaged teachers used the first tier of data sources – comprised of formative, MAP, and curriculum-based assessment – to inform the average instructional practice ($\hat{p}_{form} = .67; \hat{p}_{map} = .66; \hat{p}_{curr} = .62$). Between a quarter and a half of engaged teachers used the second tier of data sources – comprised of common assessment, course grades, and state assessment – to inform the average instructional practice ($\hat{p}_{schdist} = .45; \hat{p}_{course} = .36; \hat{p}_{state} = .34$). Finally, less than a quarter
of teachers used the third tier of data sources – comprised of only attendance and behavioral data – to inform the average instructional practice ($\hat{\text{attbeh}} = .22$).

Table 2.2: Instructional Practice-Specific Data Use Descriptive Statistics

<table>
<thead>
<tr>
<th>Instructional Practice</th>
<th>n</th>
<th>Proportion using indicated data source</th>
<th>Density</th>
<th>Average Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>form</td>
<td>curr</td>
<td>map</td>
</tr>
<tr>
<td>plan1</td>
<td>77</td>
<td>.39</td>
<td>.55</td>
<td>.62</td>
</tr>
<tr>
<td>plan2</td>
<td>79</td>
<td>.81</td>
<td>.77</td>
<td>.27</td>
</tr>
<tr>
<td>plan3</td>
<td>87</td>
<td>.91</td>
<td>.78</td>
<td>.39</td>
</tr>
<tr>
<td>strat1</td>
<td>87</td>
<td>.79</td>
<td>.59</td>
<td>.72</td>
</tr>
<tr>
<td>strat2</td>
<td>76</td>
<td>.36</td>
<td>.25</td>
<td>.87</td>
</tr>
<tr>
<td>strat3</td>
<td>82</td>
<td>.38</td>
<td>.28</td>
<td>.89</td>
</tr>
<tr>
<td>strat4</td>
<td>85</td>
<td>.93</td>
<td>.71</td>
<td>.42</td>
</tr>
<tr>
<td>group1</td>
<td>84</td>
<td>.88</td>
<td>.60</td>
<td>.73</td>
</tr>
<tr>
<td>group2</td>
<td>87</td>
<td>.89</td>
<td>.59</td>
<td>.55</td>
</tr>
<tr>
<td>group3</td>
<td>81</td>
<td>.64</td>
<td>.52</td>
<td>.90</td>
</tr>
<tr>
<td>group4</td>
<td>87</td>
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<td>group5</td>
<td>82</td>
<td>.78</td>
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<td>.91</td>
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<td>content1</td>
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<td>.96</td>
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<td>content2</td>
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<td>.68</td>
</tr>
<tr>
<td>content3</td>
<td>69</td>
<td>.86</td>
<td>.75</td>
<td>.32</td>
</tr>
<tr>
<td>content4</td>
<td>62</td>
<td>.89</td>
<td>.68</td>
<td>.42</td>
</tr>
<tr>
<td>place1</td>
<td>74</td>
<td>.57</td>
<td>.58</td>
<td>.96</td>
</tr>
<tr>
<td>place2</td>
<td>86</td>
<td>.90</td>
<td>.90</td>
<td>.92</td>
</tr>
<tr>
<td>learnStud1</td>
<td>88</td>
<td>.93</td>
<td>.92</td>
<td>.85</td>
</tr>
<tr>
<td>learnStud2</td>
<td>87</td>
<td>.90</td>
<td>.84</td>
<td>.87</td>
</tr>
<tr>
<td>learnStud3</td>
<td>83</td>
<td>.25</td>
<td>.29</td>
<td>.89</td>
</tr>
<tr>
<td>learnTch1</td>
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<td>.92</td>
<td>.83</td>
<td>.24</td>
</tr>
<tr>
<td>learnTch2</td>
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<td>.66</td>
<td>.56</td>
<td>.56</td>
</tr>
<tr>
<td>gatherInfo1</td>
<td>81</td>
<td>.85</td>
<td>.63</td>
<td>.17</td>
</tr>
<tr>
<td>gatherInfo2</td>
<td>79</td>
<td>.34</td>
<td>.49</td>
<td>.61</td>
</tr>
<tr>
<td>learnSys1</td>
<td>66</td>
<td>.80</td>
<td>.68</td>
<td>.59</td>
</tr>
<tr>
<td>learnSys2</td>
<td>64</td>
<td>.45</td>
<td>.75</td>
<td>.53</td>
</tr>
<tr>
<td>learnSys3</td>
<td>74</td>
<td>.61</td>
<td>.84</td>
<td>.49</td>
</tr>
<tr>
<td>learnSys4</td>
<td>74</td>
<td>.70</td>
<td>.78</td>
<td>.31</td>
</tr>
<tr>
<td>learnSys5</td>
<td>82</td>
<td>.27</td>
<td>.34</td>
<td>.96</td>
</tr>
<tr>
<td>goalset1</td>
<td>76</td>
<td>.28</td>
<td>.25</td>
<td>.95</td>
</tr>
<tr>
<td>goalset2</td>
<td>57</td>
<td>.93</td>
<td>.89</td>
<td>.67</td>
</tr>
<tr>
<td>goalset3</td>
<td>79</td>
<td>.51</td>
<td>.58</td>
<td>.82</td>
</tr>
<tr>
<td>goalset4</td>
<td>66</td>
<td>.44</td>
<td>.55</td>
<td>.94</td>
</tr>
<tr>
<td>celebrate1</td>
<td>88</td>
<td>.51</td>
<td>.61</td>
<td>.90</td>
</tr>
<tr>
<td>celebrate2</td>
<td>81</td>
<td>.30</td>
<td>.37</td>
<td>.85</td>
</tr>
</tbody>
</table>

Taken together, these findings suggest upper elementary school teachers use a variety of data sources for an array of instructional purposes. Although there is
variation in teachers’ engagement, the average teacher makes sense of data in the context of 32 unique instructional practices. Across practices, patterns in teachers’ attention toward individual data sources suggest differential influence on teachers’ instructional decision making. Most teachers use formative, curriculum-based, and interim assessment data to inform the average practice. By contrast, less than half of teachers use common and state assessment data, course grades, as well as attendance and behavioral data to inform the average practice. While this finding identifies the data sources to which teachers most commonly attend, it does not attend to patterns in how teachers choose between and combine data sources for instructional purposes.

To address my second research question, I began by analyzing the extent to which participants synthesize data sources to inform a common instructional practice. On average, participants use 47% of the identified data sources (range: 29-84%) when engaging in instructional practices. That is, teachers in the present study attend to more than three different data sources to inform their average instructional practice. However, there is considerable between-practice variation in the number of data sources to which teachers attend.

Figure 2.3 depicts variation in the interconnectedness of data sources within teachers’ practice of data use. On the low end, the average participant uses about 30% of data sources to inform three practices: having students set personal MAP growth goals, identifying activities to match students’ MAP scores, and talking with other teachers about MAP data ($CD_{(goalset)} = 2.03$; $CD_{(strat2)} = 2.12$; $CD_{(strat3)} = 2.23$). Of note, each practice specifically pertains to the use of MAP data. On the high end, the average participant uses more than 70% of data sources to inform three instructional practices: recommending students for special education, developing Individualized
Education Program (IEP) goals, and evaluating student progress ($C_{D(place2)} = 5.87$; $C_{D(goalset2)} = 5.21$; $C_{D(learnStud1)} = 4.99$).

Note. Nodes in the left-hand column represent teachers and nodes in the right-hand column represent data sources; edges connecting nodes represent a teacher’s use of that data source to inform the identified instructional practice; nodes are scaled by the number of edges by which they are connected. Frame (a) depicts content2, a low-density network in which the average teacher uses 2.52 of 7 data sources. Frame (b) depicts learnStud1, a high-density network in which the average teacher uses 4.99 of 7 data sources.

Figure 2.3: Low- and High-Density Participant-by-Data Source Bipartite Networks

Whereas the preceding analysis characterizes the general interconnectedness of data sources within teachers’ practice, it does attend to teachers’ choice between and combination of specific data sources within and across practices. To this end, Table 2.3 presents average pairwise Jaccard normalized degree centrality across the 36 instructional practices. Each cell represents the average number of participants who use both indicated data sources, contingent on using at least one to inform a given
instructional practice. As such, data sources with high centrality are most commonly used with other data sources whereas data sources with low centrality are not. For example, 68% of participants who use either formative or curriculum-based assessment data to inform the average instructional practice use both data sources together (range: 44-91%). By contrast, only 27% of participants who use either formative or state assessment data to inform the average instructional practice use both data sources together (range: 4-71%).

Table 2.3: Jaccard Normalized Data Source Network Centrality

<table>
<thead>
<tr>
<th>Data Source</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
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<td>(.02, .76)</td>
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</tbody>
</table>

Note. Average Jaccard normalized degree centrality across the 36 instructional practices; minimum and maximum Jaccard normalized degree centrality in parentheses, respectively.

Figure 2.4 depicts variation in teachers’ use of formative assessment data with other data sources in the context of two instructional practices. As depicted in Figure 2.4a, 96% of participants use formative assessment data to identify content/concepts that need to be retaught. However, only 34% of participants who use formative assessment or another data source use both together. This ranges from 11% of
participants who use formative or state assessment data to 77% of participants who use formative or curriculum-based assessment data. By contrast, 59% of participants who use formative assessment or the average data source to identify students' strengths and weaknesses use both data sources together (see Figure 2.4b). This ranges from 29% of participants who use formative assessment or attendance and behavioral data to 82% of participants who use formative or curriculum-based assessment data.

![Diagram](image)

**Note.** Nodes represent data sources, scaled by the number of teachers who use that data source to inform the identified instructional practice; edges connecting nodes represent teachers’ combination of the two data sources, scaled by the number of teachers who use both data sources together. Frame (a) depicts content1, a low-centrality network in which formative assessment data has high use ($\hat{p} = .96$) but is not frequently used with other data sources ($C_D = .34$). Frame (b) depicts learnStud2, a high-centrality network in which formative assessment data has high use ($\hat{p} = .90$) and is frequently used with other data sources ($C_D = .59$).

**Figure 2.4:** Low and High Within-Network Data Source Centrality

Taken together, these findings suggest a complex relationship between data sources within upper elementary school teachers’ practice of data use. The average teacher makes sense of more than two data sources to inform all 36 identified
instructional practices, with an average of more than three data sources. Across practices, about 67% of teachers use formative assessment data to inform the average practice and about 41% of teachers who use formative assessment data or the average data source use both together. Additionally, such relationships vary by data source both within and across instructional practices. Subsequent analyses decompose and characterize patterns in this interconnectedness between data sources.

Figure 2.5 presents the number of instructional practices for which there is a significant relationship between participants’ use of each pair of data sources, decomposed by type of relationship: preference (dark grey), substitute (light grey), or complement (white). A preferential relationship exists when participants use two data sources separately significantly more than together and use one data source significantly more than the other. A substitute relationship exists when participants use two data sources separately significantly more than together but do not use either data source significantly more than the other. A complementary relationship exists when participants use two data sources together significantly more than separately.

On the low end, there is a statistically significant relationship between participants’ use of formative and common assessment data in only four identified instructional practices. Of those differences, two are attributable to participants’ preference for one data source over the other, one is attributable to use as substitutes, and one is attributable to use as complements. In the remaining 32 practices, there was no significant relationship between participants’ use of these two data sources. By contrast, there is a statistically significant relationship between participants’ use of formative and state assessment data in 25 of 36 identified instructional practices. Of those differences, 20 are attributable to participants’ preference for one data source
over the other, four are attributable to use as substitutes, and one is attributable to use as complements.

Note. Columns represent the number of instructional practices for which there is a statistically significant pairwise relationship between teachers’ use of the two indicated data sources. Of statistically significant differences: dark gray represents the proportion for which participants prefer one data source to the other; light gray represents the proportion for which participants use the data sources as substitutes; white represents the proportion for which participants use the data sources as complements.

Figure 2.5: Decomposed Significant Pairwise Differences in Use of Data Sources

2.5 Discussion

The objective of this study was to explore and characterize patterns in teachers’ choice between and combination of data sources for instructional purposes.
Findings highlight the complexity of upper elementary school teachers’ practice of data use. Consistent with Hamilton and colleagues’ (2009) as well as Young and Kim’s (2010) contention, teachers use a variety of data sources for instructional purposes. Teachers used varying combinations of all seven data sources to inform each of the 36 instructional practices comprising Farley-Ripple and Buttram’s (2017) classificatory framework. Furthermore, the average teacher uses at least two data sources to inform each practice with some practices garnering the average use of more than five different data sources (i.e., recommending students for special education and developing IEP goals).

This study suggests data sources fall into three tiers based on the prevalence of teachers’ use across instructional practices. Over half of teachers used the first tier of data sources – comprised of formative, curriculum-based, and interim assessment – to inform the average instructional practice. This is largely consistent with prior research suggesting teachers use short-, medium-, and interim-cycle assessment data to inform a broad range of instructional practices (Datnow & Hubbard, 2015; Kingston & Nash, 2011). One quarter to half of teachers used the second tier of data sources – comprised of school- and district-wide common assessment, state assessment, and course grades – to inform the average instructional practice. This is consistent with literature on long-cycle assessment, suggesting although teachers may use summative data for formative purposes (Black & Wiliam, 2009), it is designed to be analyzed in the aggregate and used to inform accountability programs and education policy (Perie et al., 2009). Finally, less than a quarter of teachers used the third tier of data sources – comprised of attendance and behavioral data – to inform the average instructional practice.
Findings also highlight the diverse interconnectedness of data sources within teachers’ instructional practice. I discuss results in relation to three adjacent sets of data sources within Supovitz’s (2012) assessment typology. With respect to short- and medium-cycle assessment, a relatively equal proportion of teachers in the present study use formative and curriculum-based assessment to inform the average instructional practice. Furthermore, formative and curriculum-based assessment data had the highest interconnectedness of any pair of data sources and were one of only two pairs of data sources to be used exclusively as complements within teachers’ instructional practice. That is, teachers in the present study typically combine formative and curriculum-based assessment data to inform 14 different practices and never use them more frequently apart than together. This finding is consistent with Farrell and Marsh (2016), who find similar profiles in teachers’ use of classroom assessments and student work, with both data sources most frequently informing changes in instructional delivery.

Short- (i.e., classroom assessment), medium- (i.e., curriculum-based assessment), and interim-cycle assessment (i.e., MAP) comprise the tier of data sources teachers in the present study use most prevalently. However, consistent with conceptual (e.g., Perie et al., 2009), theoretical (e.g., Supovitz, 2012), and applied analyses (e.g., Goertz et al., 2009; Farrell & Marsh, 2016), patterns in teachers’ choice between and combination of these data sources suggest they fill unique roles within teachers’ instructional practice. On average, only 44% of teachers in the present study who use either formative assessment or MAP data and 43% who use either curriculum-based assessment or MAP data to inform a given instructional practice use both data sources together. Teachers’ use of formative and curriculum-based
assessment data was more predominant in practices such as specifying learning objectives, selecting classroom materials, as well as evaluating instructional strategies, content, and pacing. Conversely, teachers’ use of MAP data was more predominant in practices such as planning prior to the school year, learning about incoming student performance, goal-setting, predicting state assessment performance, focusing on “bubble kids,” and celebrating achievement.

Despite evidence of teachers’ preference for either formative and curriculum-based assessment or MAP data, there is some evidence supporting Riggan and Nabors Oláh’s (2011) finding that teachers’ use of interim assessment informs their use of short- and medium-cycle assessment. In the present study, teachers used formative assessment and MAP data as complements in four instructional practices, three of which included an additional complementary use of curriculum-based assessment data. Specifically, teachers use all three data sources as complements to evaluate student progress, identify students' strengths and weaknesses, and recommend students for special education.

Finally, with respect to interim- and long-cycle assessment data, teachers demonstrated a preference toward MAP data as opposed to course grades and state assessment data across 14 and 12 instructional practices, respectively. Within this relationship, there is some evidence supporting Perie and colleagues’ (2009) assertion that interim assessments are valued in part based on the degree to which they are predictive of students’ summative assessment performance. Consistent with this notion, teachers use MAP data more than any other data source when predicting students’ achievement on the end-of-year state assessment and focusing on “bubble kids.” Although long-cycle assessments rarely complement teachers’ use of MAP
data, with the exception of evaluating student progress as well as recommending students for gifted programs and special education, teachers may perceive MAP and course grades as substitutes across four instructional practices. Specifically, teachers use MAP and course grades as substitutes to specify learning objectives, plan and differentiate instruction, as well as identify content for reteaching.

### 2.6 Conclusion and Implications

Upper elementary school teachers’ practice of data use incorporates a broad array of data sources, each with distinguishing characteristics and instructional implications. Across instructional practices, most teachers in the present study attend to formative, curriculum-based, and interim assessments. However, teachers are not making sense of these data sources in isolation. On average, teachers in the present study use more than two data sources to inform every instructional practice and more than five data sources to recommend students for special education and develop IEP goals. This interconnectedness has important implications for future research on teachers’ practice of data use.

Although contemporary research has begun to situate individual data sources across teachers’ broader practice of data use, such studies do not delineate patterns in how teachers choose between and combine these data sources. The present study uncovers significant patterns in teachers’ attention toward different types of data both within and across instructional practices. In some cases, teachers demonstrate a strong preference toward a single data source. For example, significantly more teachers in the present study use MAP data separate from every other data source, as opposed to together, to predict students’ performance on end-of-year statewide assessments. Accordingly, future research on how teachers make sense of only interim assessment
data in this capacity may be warranted. However, such extreme instances are a stark exception to the general interconnectedness of data sources within teachers’ practice.

In general, teachers’ practice of data use comprises a complex network of preferential, substitute, and complementary relationships between data sources. In such cases, it is imperative that research not only attends to how teachers use different data sources, but how their interpretive process differs when integrating multiple and varied data sources. For example, teachers in the present study use formative, curriculum-based, and MAP assessment data as complements to evaluate student progress and identify students’ strengths and weaknesses. Accordingly, future research should address the unique contribution of each data source to teachers’ understanding, how teachers make sense of different combinations of these data sources, and how teachers’ instructional response is related to the specific combination of data sources they use.

2.7 Limitations

The present study is subject to three primary limitations. First, findings are limited in generalizability beyond the current sample of upper elementary school teachers. Research on data use in education suggests teachers’ interpretive process is influenced by a variety of individual, social, and organizational contextual factors. Future studies should continue to expand our collective understanding of the relationship between data sources within and across instructional practices among increasingly generalizable samples. Second, findings are limited by the degree to which participants had a shared understanding of the meaning of each data source and instructional practice. Toward this end, future studies should employ qualitative methods to analyze similarities and differences in how teachers perceive survey items
and response options. Third, findings are limited by constraints inherent in the comprehensive, though not exhaustive, list of data sources and instructional practices included in the present survey. Future work may expand on either or both to develop an even more comprehensive understanding of teachers’ practice of data use.
Chapter 3

COMPREHENSIVE AND SUPERFICIAL DATA USERS

Aligned with prominent education policies, most recognizably the Every Student Succeeds Act, teachers are expected to collect, analyze, and use student achievement data to inform their instructional decision making. In this capacity, teachers require an array of assessment tools and processes to meaningfully understand and respond to diverse student learning needs (Hamilton et al., 2009; Young & Kim, 2010). Wiliam and Leahy (2006) organize such assessment practices along a continuum ranging from short- to long-cycle. The authors define short-cycle assessment as eliciting immediate feedback on student understanding within lessons, medium-cycle assessment as eliciting feedback on across lessons within a common unit, and long-cycle assessment as eliciting feedback beyond the scope of a single instructional unit.

Supovitz (2012), recognizing Wiliam and Leahy’s (2006) medium- and long-cycle encompass disparate assessment practices, added a fourth category – interim-cycle assessment – which occupies a “middle ground” in teachers’ system of assessment practices (Bulkley, Nabors Oláh, & Blanc, 2010; Datnow & Hubbard, 2015; Perie, Marion, & Gong, 2009; Supovitz, 2012). Interim assessments are typically externally-constructed, administered monthly to bi-annually, linked to unit, semester, or grade-level curriculum objectives, and provide data that may be used at the student-level or meaningfully aggregated at the classroom-, school-, and district-levels.
Research suggests teachers use interim assessment data to inform a broad range of instructional practices (e.g., Blanc et al., 2010; Christman et al., 2009; Goertz, Nabors Oláh, & Riggan, 2009; Hoover & Abrams, 2013; Nabors Oláh, Lawrence, & Riggan, 2010; Shepard, Davidson, & Bowman, 2011). While such studies begin to situate interim assessment data within teachers’ instructional practice (see Datnow & Hubbard, 2015), my preceding study provides evidence teachers do not make sense of interim assessment data in isolation. Instead, teachers draw on different combinations of data sources to inform their instructional decision making. Accordingly, it is imperative to begin understanding where and how interim assessment data fits within teachers’ broader practice of data use.

3.1 Literature Review

Teachers’ practice of data use, or use of assessment data for instructional purposes, is a fundamentally interpretive process (Coburn & Turner, 2011, 2012). Consistent with a sensemaking theoretical perspective (see Weick, 1995), conceptualizations of teachers’ interpretive process contend teachers use existing knowledge to make sense of raw data, resulting in personally relevant interpretations and shaping subsequent instructional responses (Ackoff, 1989; Mandinach, Honey, Light, & Brunner, 2008; Marsh, 2012; Marsh, Pane, & Hamilton, 2006; Spillane & Miele, 2007). That is, teachers’ interpretive process has implications for how they notice, understand, and act upon assessment data. Such conceptualizations have been employed to understand how teachers use interim assessment data to evaluate instructional strategies (Horn, Kane, & Wilson, 2015), reteach skills and instructional content (Farrell & Marsh, 2016), identify “bubble kids” (Blanc et al., 2010; Christman
et al., 2009), as well as group students and differentiate instruction (Park & Datnow, 2017).

Research at the intersection of teachers’ interpretive process and practice of data use indicates individual, social, and organizational factors mediate how teachers understand and respond to assessment data (Coburn, Toure, & Yamashita, 2009; Coburn & Turner, 2011). As it pertains to interim assessment data, research suggests teachers’ interpretive process is influenced by personal beliefs, knowledge, and perceptions (e.g., Farrell & Marsh, 2016; Jimerson, 2014), social interactions (e.g., Cosner, 2011; Farley-Ripple & Buttram, 2015; Schildkamp & Poortman, 2015), school and district leadership (e.g., Blanc et al., 2010; Park, Daly, & Wishard Guerra, 2012), as well as education policy (e.g., Datnow & Hubbard, 2015; Hubbard, Datnow, & Pruyn, 2014). While a growing body of research explores how contextual factors shape teachers’ interpretive process, there remains a gap in our collective understanding of whether and how teachers’ practice of interim assessment data use is related to the degree to which they synthesize interim assessment data with other data sources (Riggan & Nabors Oláh, 2011). However, notable contributions have begun to situate interim assessment data within teachers’ broader practice of data use.

Park and Datnow (2017) approach this gap through a qualitative case study of data use to inform grouping and differentiation in four elementary schools. The authors found teachers used a variety of data sources to inform both practices. Teachers used interim assessment data to homogeneously group students by ability to support targeted instruction of skills and content. However, teachers also commonly used formative and common grade assessments to inform such grouping. With respect to differentiation, teachers commonly used interim assessment data alongside
formative, common grade, and summative assessment data to meet individual students’ goals and needs. Although the authors provide insight into the prevalence with which teachers draw on different data sources and logics underlying their instructional responses, the authors do not directly attend to whether and how teachers synthesize interim assessment data the other commonly used data sources.

Relatedly, Farrell and Marsh (2016) situate interim assessment data within teachers’ instructional practice through a qualitative comparative case study of teachers’ engagement in four instructional practices: changes in instructional delivery, reteaching and retesting, grouping, and student reflection. The authors found teachers used five types of data to varying degrees across the identified practices, recognizing interim assessment data as the most predominantly used data source. While teachers most frequently referenced interim assessment data in the context of reteaching and retesting, a similar amount of evidence supported teachers’ use of common grade assessments for the same purpose. In comparing the two data sources, the authors note some teachers did not trust interim assessment data due to external construction, whereas common grade assessment data was widely valued due to internal construction. However, the authors did not attend to similarities and differences in the instructional responses of teachers who used just one or both data sources to inform reteaching and retesting.

As part of the larger project within which the present study is situated, I built on the preceding studies through statistical and network analyses of disaggregated patterns in teachers’ use of seven data sources across 36 instructional practices. While two-thirds of teachers used interim assessment data to inform the average instructional practice, teachers typically synthesized two to six data sources per practice. That is,
most teachers used interim assessment data to inform their typical instructional response, while simultaneously drawing on up to five additional data sources. For example, I found 96% of teachers use interim assessment data to recommend students for gifted programs. However, the average teacher simultaneously used about three other data sources, with 72% using state assessment data and about 60% using each of formative assessment data, curriculum-based assessment data, and course grades. Further highlighting the interconnectedness of data sources within teachers’ practice of data use, I found teachers perceived interim assessment data as complementary to each of the six other data sources within the context of individual instructional practices.

Whereas the preceding studies situate interim assessment data within teachers’ broader practice of data use, studies of how teachers make sense of interim assessment data typically do so in isolation of other data sources. In a notable exception, Riggan and Nabors Oláh (2011) explored the intersection of formative, teacher-developed, and interim assessment data within teachers’ instructional practice. The authors found all teachers used interim assessment data to some degree, with most teachers using it to identify students’ areas of weakness in the context of instructional planning. Consistent with my preceding study, Riggan and Nabors Oláh (2011) found teachers’ use of interim assessment data complemented their collection and analysis of both formative and teacher-developed assessment. Most frequently, teachers used formative assessment to learn about patterns in students’ responses to interim assessment items and teacher-developed assessment to learn about students’ problem-solving processes, measure students’ mastery of retaught content, and inform instructional pacing.
3.2 Purpose

Taken together, contemporary research on data use in education suggests teachers’ constructed understandings of interim assessment data should be considered within the context of their broader practice of data use. In exploring how teachers make sense of interim assessment data in relation to other data sources, contemporary research on data use in education suggests future research should directly attend to how the interaction between different assessments within teachers’ practice of data use affects their micro-processes of interpretation (Farrell & Marsh, 2016; Riggan & Nabors Oláh, 2011). Toward this end, the present study addresses two guiding research questions:

RQ1. How do upper elementary school teachers attend to interim assessment data within their broader practice of data use? Specifically:
   a. How do teachers use and combine interim assessment data with other data sources across instructional practices?
   b. How do teachers vary in the degree to which they use interim assessment data for instructional purposes?

RQ2. How do upper elementary school teachers make sense of interim assessment data in relation to dimensions of their broader practice of interim assessment data use?

3.3 Methods

The objective of this convergent mixed methods (MM) study is to explore similarities, differences, and patterns in how teachers make sense of interim assessment data in relation to dimensions of their broader practice of interim assessment data use (see Figure 3.1). Convergent MM designs supports the integration
Figure 3.1: Convergent Mixed Methods Design
of quantitative (QUAN) and qualitative (QUAL) analyses to develop a more complete understanding of phenomena (Creswell & Plano Clark, 2018). In the present study, I analyzed QUAN survey data to develop multidimensional, teacher data use profiles and QUAL interview transcripts to gather evidence of how teachers make sense of interim assessment data. Then, I integrated QUAN and QUAL results and recoded interview transcripts to develop a nuanced perspective on the similarities, differences, and patterns in teachers practice of interim assessment data use.

3.3.1 Participants

The present study is situated in a larger project exploring how upper elementary school teachers’ use MAP Growth (hereafter, MAP) interim assessment data for instructional purposes. Accordingly, I recruited teachers from 10 schools in two medium-sized districts that administer MAP in all Grade 3-5 classrooms. The two districts reside in neighboring Mid-Atlantic states with varied demographic profiles.4 Elementary school students in Apothem School District were predominantly White, African American, and Latina/o (respectively, school range: 50-65%; 15-35%; 5-10%), with limited eligibility for free or reduced-price meals (school range: 10-35%). Elementary school students in Cevian School District were also predominantly White, African American, and Latina/o (respectively, school range: 45-95%; 1-25%; 5-15%), with moderate eligibility for free or reduced-price meals (school range: 30-70%).

The study frame includes all Grade 3-5 mathematics and/or English language arts (ELA) teachers of record at five schools in each participating district. This eligibility criterion ensures teachers have common access to MAP data and a shared

4 I round and present school descriptive statistics in ranges to limit reverse look-up.
opportunity to incorporate such data within the scope of their professional responsibilities. The present study draws on two samples: 88 teachers who participated in a data use survey (response rate = 75%) and a subsample of 23 teachers referred by school principals who participated in a data use interview (participation rate = 79%).

Table 3.1 presents participant descriptive statistics. Both samples were predominantly female and white. Survey respondents were evenly distributed across grade level whereas three times more interviewees taught Grade 3 than Grade 4. Teachers in both samples were distributed across content area specialization, with interviewees having slightly more teaching experience than the average survey respondent.

Table 3.1: Participant Descriptive Statistics

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<th>Interviewees</th>
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<td>.96</td>
</tr>
<tr>
<td>White</td>
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<td>.96</td>
</tr>
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<td>Grade level</td>
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<td>Grade 4</td>
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</tr>
<tr>
<td>Grade 5</td>
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<td>.35</td>
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<tr>
<td>Content area specialization</td>
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<td></td>
</tr>
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<td>Math-only</td>
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<td>.35</td>
</tr>
<tr>
<td>ELA-only</td>
<td>.32</td>
<td>.30</td>
</tr>
<tr>
<td>Math and ELA</td>
<td>.45</td>
<td>.35</td>
</tr>
<tr>
<td>Teaching experience (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13.44 (range: 1-42)</td>
<td>14.96 (range: 1-35)</td>
</tr>
<tr>
<td>Current grade level</td>
<td>7.30 (range: 1-30)</td>
<td>7.57 (range: 1-18)</td>
</tr>
<tr>
<td>Current school</td>
<td>6.58 (range: 1-37)</td>
<td>8.30 (range: 1-34)</td>
</tr>
</tbody>
</table>

a Statistics include the subsample of teachers who also participated in the interview
b Survey respondent proportions sum to less than 1 due to rounding
3.3.2 QUAN Data Collection

QUAN data collection includes participants’ response to a 36-item measure of teachers’ practice of data use adapted from Farley-Ripple and Buttram (2017). Each survey item corresponded with one of the authors’ 36 identified instructional practices (see Table 3.2) presented in a matrix consisting of two response categories: engagement and data use (see Figure 3.2a). For each survey item, teachers identified whether they engage in the identified practice and, if so, the data sources they typically use to inform their instructional response. Teachers could choose from eight data sources: formative assessment (form), curriculum-based assessment (curr), interim assessment (specifically, MAP; map), other school- or district-wide common assessment (schdist), course grades (course), state assessment (state), attendance or behavioral data (attbeh), and other data. Consistent with research on teachers’ practice of data use (e.g., Farrell & Marsh, 2016), I exclude “other data” in the present study due to infrequent use.

As part of an extended survey on teachers’ data use attitudes, perceptions, beliefs, and practices, interviewees also rated the extent to which MAP informs each instructional response for which they indicated using it (see Figure 3.2b). Teachers responded along a 5-point Likert scale ranging from “very small extent” to “very great extent.”
Table 3.2: Classification Framework of Instructional Actions and Practices

<table>
<thead>
<tr>
<th>Instructional Action</th>
<th>Instructional Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td></td>
</tr>
<tr>
<td>(plan1)</td>
<td>Plan instruction prior to school year</td>
</tr>
<tr>
<td>(plan2)</td>
<td>Specify learning objectives for a lesson or unit</td>
</tr>
<tr>
<td>(plan3)</td>
<td>Plan instruction for a lesson/unit</td>
</tr>
<tr>
<td>Strategies</td>
<td></td>
</tr>
<tr>
<td>(strat1)</td>
<td>Design intervention for students</td>
</tr>
<tr>
<td>(strat2)</td>
<td>Identify activities to match student RIT scores</td>
</tr>
<tr>
<td>(strat3)</td>
<td>Talk with other teachers about MAP data implications for instruction</td>
</tr>
<tr>
<td>(strat4)</td>
<td>Develop/choose appropriate instructional strategies</td>
</tr>
<tr>
<td>Grouping and differentiation</td>
<td></td>
</tr>
<tr>
<td>(group1)</td>
<td>Use data to group students for classroom activities</td>
</tr>
<tr>
<td>(group2)</td>
<td>Inform differentiated lesson plans</td>
</tr>
<tr>
<td>(group3)</td>
<td>Focus on students who are borderline predicted to pass the state test (“bubble kids”)</td>
</tr>
<tr>
<td>(group4)</td>
<td>Identify students for interventions in the classroom</td>
</tr>
<tr>
<td>(group5)</td>
<td>Identify students for enrichment in the classroom</td>
</tr>
<tr>
<td>Content</td>
<td></td>
</tr>
<tr>
<td>(content1)</td>
<td>Identify content/concepts that need to be retaught</td>
</tr>
<tr>
<td>(content2)</td>
<td>Identify skills that students are instructionally ready to learn</td>
</tr>
<tr>
<td>(content3)</td>
<td>Guide selection of classroom materials</td>
</tr>
<tr>
<td>(content4)</td>
<td>Choose or develop appropriate content/curriculum</td>
</tr>
<tr>
<td>Placement</td>
<td></td>
</tr>
<tr>
<td>(place1)</td>
<td>Recommend students for gifted programs</td>
</tr>
<tr>
<td>(place2)</td>
<td>Recommend students for special education</td>
</tr>
<tr>
<td>Learning about students</td>
<td></td>
</tr>
<tr>
<td>(learnStud1)</td>
<td>Evaluate student progress</td>
</tr>
<tr>
<td>(learnStud2)</td>
<td>Identify students’ strengths and weaknesses</td>
</tr>
<tr>
<td>(learnStud3)</td>
<td>Learn about incoming student performance</td>
</tr>
<tr>
<td>Learning about teaching</td>
<td></td>
</tr>
<tr>
<td>(learnTch1)</td>
<td>Conduct action research or professional inquiry about teaching</td>
</tr>
<tr>
<td>(learnTch2)</td>
<td>Evaluate curriculum content or pacing</td>
</tr>
<tr>
<td>Gather information</td>
<td></td>
</tr>
<tr>
<td>(gatherInfo1)</td>
<td>Re-test or administer another assessment to gather more information</td>
</tr>
<tr>
<td>(gatherInfo2)</td>
<td>Compare MAP to other assessment data</td>
</tr>
<tr>
<td>Learning about system</td>
<td></td>
</tr>
<tr>
<td>(learnSys1)</td>
<td>Align classroom or other assessments with MAP questions</td>
</tr>
<tr>
<td>(learnSys2)</td>
<td>Look at curricular alignment across grades</td>
</tr>
<tr>
<td>(learnSys3)</td>
<td>Look at curricular coverage in current grade</td>
</tr>
<tr>
<td>(learnSys4)</td>
<td>Evaluate curriculum content or pacing</td>
</tr>
<tr>
<td>(learnSys5)</td>
<td>Predict state test performance for individual students</td>
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<tr>
<td>Goal setting</td>
<td></td>
</tr>
<tr>
<td>(goalset1)</td>
<td>Having students set personal goals for MAP scores/growth</td>
</tr>
<tr>
<td>(goalset2)</td>
<td>Developing IEP goals for special education students</td>
</tr>
<tr>
<td>(goalset3)</td>
<td>Setting individual, group, or classroom-wide student performance goals</td>
</tr>
<tr>
<td>(goalset4)</td>
<td>Setting team (grade level, PLC, etc.) goals</td>
</tr>
<tr>
<td>Celebrate</td>
<td></td>
</tr>
<tr>
<td>(celebrate1)</td>
<td>Celebrating students’ improvements and/or scores</td>
</tr>
<tr>
<td>(celebrate2)</td>
<td>Celebrating team and/or school successes</td>
</tr>
</tbody>
</table>

*Note.* Adapted from Farley-Ripple and Buttram (2017); instructional practice-specific variable codes in parentheses.
Note. Frame (a) depicts the initial survey item, divided into three columns: (1) instructional practices, (2) teacher engagement, and (3) data sources. Participants responded by identifying practices in which they do not engage or the data sources they typically use to inform each practice in which they engage. Frame (b) depicts the follow-up question for those practices in which interviewees indicated using MAP data. Participants responded by indicating the extent to which MAP data informs their instructional response for each practice informed by MAP data.

Figure 3.2: Sample Data Use Survey Item Stem with Data Source and Extent of Use Response Options

3.3.3 QUAL Data Collection

QUAL data collection includes teachers’ engagement in an open-ended interview recorded with Camtasia 3 (TechSmith, 2016) to synchronously capture how teachers access (computer monitor recording) and make sense of (audio recording) MAP data. An experienced ethnographic researcher initiated each interview with a grand tour question (Brenner, 2006; Spradley, 1979) prompting teachers to describe personally relevant features of their interim assessment data use. Specifically, the interviewer asked teachers to access the MAP report(s) they find most useful and explain how they use them for instructional purposes. Thereafter, the interviewer focused on building a rapport with the teacher, only interjecting to clarify her understanding of teachers’ interim assessment data use within the broader scope of the
project. Each interview concluded when the teacher indicated having expressed all personally relevant uses of MAP data.

3.3.3.1 Interview Setting

Interview location is an integral interview component with implications for constructed understandings (Elwood & Martin, 2000; Herzog, 2005). In the present study, all teachers elected to conduct the interview in their classroom during non-instructional time. This supported teachers’ contextualization of data use practices via direct access to non-electronic assessment documentation and displays throughout the interview.

3.3.3.2 Interviewer Positionality

Interviewers’ subjectivity is an essential interview component with implications for the process and results of interpretive inquiry (Lincoln, 1995; Peshkin, 1988). The interviewer is female, White, has both K-12 and post-secondary teaching experience, as well as experience as an ethnographic researcher in elementary school classrooms. The interviewer was cognizant that her experience as a teacher and researcher may connote specific dispositions about, or judgements regarding, how teachers use data. To this end, both the researcher and interviewer explicitly informed teachers they did not represent NWEA (the MAP interim assessment developer) or have preconceived views about how teachers should use MAP data. The open-ended interview structure with minimal interviewer influence further supported teachers’ natural activation of constructed understandings (Fontana & Frey, 1994).
3.3.4 Data Analysis Strategy

I addressed my guiding research questions via sequential QUAN, QUAL, and integrated analyses. Proximal data analysis products include instructional practice-specific descriptive statistics, teacher data use profiles, and evidence of how teachers use interim assessment data. Distal data analysis products include a discussion of the similarities, differences, and patterns in teachers’ use of MAP data for instructional purposes.

3.3.4.1 QUAN Data Analysis Strategy

To address my first research question, I situated interim assessment data within upper elementary school teachers’ broader practice of data use and created teacher data use profiles via statistical and network analysis using SPSS version 25 (IBM Corp., 2017), UCINET version 6.648 (Borgatti, Everett, & Freeman, 2002), and Gephi version 0.9.2 (Bastian, Heymann, & Jacomy 2009). QUAN data analysis products include descriptive statistics, measures of network structure, and network diagrams.

3.3.4.1.1 Instructional Practice-Specific Data Profiles

I situated interim assessment data within teachers’ broader practice of data use via two-step analysis. First, I analyzed the number of teachers who engage in each instructional practice and the proportion of whom use MAP data to inform their instructional response. This analysis provides insight into the degree to which teachers engage in 36 different instructional practices as well as prevalence of MAP data use. However, this analysis does not address the prevalence with which teachers combine MAP with other data sources to inform a common instructional practice.

To address the interconnectedness of data sources within teachers’ practice of interim assessment data use, I analyzed the Jaccard normalized co-affiliation network.
centrality of MAP data. In general, networks are defined by relationships between a system of connected nodes (Hanneman & Riddle, 2011). Co-affiliation networks specifically represent the relationship between events across actors, or vice versa, within a common environmental constraint (Borgatti & Halgin, 2011). In the present study, co-affiliation networks represent teachers’ choice between and combination of data sources (event across actors) to inform a common instructional practice (environmental constraint). As depicted in Figure 3.3a, each instructional practice served as a unique frame of analysis within which two data sources were connected if at least one teacher uses them together and each teacher was attributed to the data sources he or she uses as well as the connections between them.

Note. Frame (a) depicts an instructional practice-specific co-affiliation network between data sources across teachers. Nodes represent data sources; edges between nodes represent the use of pairwise data source combinations; teachers are attributed to each data source they use and the connections between them. Figure (b) depicts an instructional practice-specific pairwise relationship between data sources across.

Figure 3.3: Co-Affiliation Data Use Network and Matrix Structures
I created co-affiliation matrices – mathematical representations of the corresponding networks – via Jaccard normalization algorithm such that matrix elements represent the proportion of node co-occurrences relative to unique node occurrences (Jaccard, 1901). In the context of the present study, Jaccard normalized matrices indicate how many teachers use two data sources together relative to how many teachers use at least one of the two data sources. For example, as depicted in Figure 3.3b, eight teachers use formative and/or interim assessment data to evaluate student progress: three use just formative assessment data, two use just interim assessment data, and three use both data sources. The resulting Jaccard normalized matrix element would be .38, indicating about 38% of teachers who use formative and/or interim assessment data to evaluate student progress use both data sources.

Finally, I analyzed instructional practice-specific pairwise Jaccard indices between MAP and the six other data sources as well as average MAP degree centrality across data source pairs. As previously described, pairwise Jaccard indices represent the proportion of teachers who synthesize MAP with another data source relative to those who use at least one of the two data sources. Degree centrality, a measure of the structural importance of a node within a network (Borgatti, Everett, & Johnson, 2013; Freeman, 1979), may be interpreted as the extent to which teachers use MAP and the average data source together, contingent on using at least one. That is, high MAP

\[ A_{ij} = \frac{a_{ij}}{a_i + a_j - a_{ij}} \]

In the present study, matrix elements represent the proportion of teachers who use each pair of data sources to inform the identified practice, contingent on using at least one of the two data sources.

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5 Jaccard normalized matrices, $A$, contain elements $a_{ij}$ that represent the intersection of nodes $i$ and $j$ relative to the union (Jaccard, 1901). In the present study, matrix elements represent the proportion of teachers who use each pair of data sources to inform the identified practice, contingent on using at least one of the two data sources.
centrality suggests teachers frequently use MAP in combination with other data sources whereas low MAP centrality suggests teachers do not.

Taken together, these analyses provide insight into how teachers attend to and synthesize interim assessment data with other data sources within their broader practice of data use. I merged instructional practice profiles with teacher data use profiles in my integrated analysis to further explore patterns in QUAL evidence of teachers’ MAP data use.

3.3.4.1.2 **Teacher Data Use Profiles**

I developed teacher data use profiles based on three dimensions: prevalence of MAP data use, synthesis of MAP with other data sources, and perceived informative value of MAP data. Toward the first dimension (*prevalence*), I analyzed the frequency with which each teacher uses MAP data to inform those practices in which he or she engages. This statistic ranges from 0 (the teacher does not use MAP data to inform any instructional response) to 1 (the teacher uses MAP data to inform every instructional response). While this analysis captures teachers’ prevalence of MAP use, it does not address how teachers synthesize MAP with other data sources or the extent to which MAP data informs their instructional responses.

Toward the second dimension (*synthesis*), I analyzed the average bipartite affiliation network density of practices for which each teacher uses MAP data. Bipartite affiliation networks represent the relationship between events within a common environmental constraint (Borgatti & Halgin, 2011). In the present study, bipartite affiliation networks represent each teacher’s (environmental constraint) use of data sources (events) to inform instructional practices (events). As depicted in Figure 3.4, each teacher served as a unique frame of analysis. Within that analytic
frame, each data source was connected to all instructional practices for which the teacher uses that data source to inform his or her instructional response.

Note. Nodes represent data sources and instructional practices; edges between nodes represent the teacher’s use that data source to inform the connected instructional practice.

Figure 3.4: Bipartite Affiliation Data Use Network Structure

I analyzed bipartite network density, the proportion of possible ties present in a network (Borgatti et al., 2013), to determine the how may data sources each teacher uses to inform his or her average instructional response, contingent on using interim assessment data. That is, high density suggests a teacher frequently uses MAP in combination with a lot of other data sources whereas low density suggests the teacher does not. For example, as depicted in Figure 3.4, the teacher uses interim assessment
data to inform five instructional practices of which: she also uses formative assessment data for three practices and summative assessment data for two practices. Accordingly, the teacher uses 67% of available data to inform her average instructional practice, contingent on using interim assessment data. In the present study, this statistic ranges from .14 (when using MAP, the teacher does not use any other data source) to 1 (when using MAP, the teacher also uses all six other data sources).

Toward the third dimension (*informative value*), I analyzed the extent to which each teacher uses MAP data to inform his or her average instructional response, contingent on using MAP data. This statistic ranges from .20 (when used, MAP data informs the teacher’s practice to a “very small extent”) to 1 (when used, MAP data informs the teacher’s practice to a “very great extent”). Taken together, these three dimensions provide a context within which to explore similarities, differences, and patterns in teachers’ practice of interim assessment data use.

To ensure unique contributions to final data use profiles, I narrowed profiles to two dimensions based on partial correlation analysis. Partial correlations measure the independence of two variables conditional on at least one additional variable (Baba, Shibata, & Sibuya, 2004). In the present study, I used this analysis to restrict data use profiles to two conditionally independent dimensions: synthesis and informative value. Then, I compared each dimension to its within-sample mean to divide teachers into four distinct data use profile groups: high synthesis and informative value, low synthesis and high informative value, high synthesis and low informative value, as well as low synthesis and informative value.
3.3.4.2 QUAL Data Analysis Strategy

To bridge my first and second research questions, I gathered evidence of how upper elementary school teachers use MAP data for instructional purposes via grammatical and elemental coding methods using NVivo 12 (QSR International, 2018). QUAL data analysis products include evidence of how teachers attend to and use MAP data to inform their instructional practice as well as the selection of units for subsequent integrated analysis.

3.3.4.2.1 Interview Coding

Grammatical coding methods add organizational structure and nuance to qualitative data (Saldaña, 2013). In the present study, I used attribute coding to identify the specific MAP reports each teacher accessed throughout his or her interview. Each MAP report formats raw data differently, with potential implications for teachers’ cognitive focus and constructed understandings (Farley-Ripple, Jennings, & Jennings, 2018). Toward this end, I developed a priori report-level codes based on MAP documentation (NWEA, 2017) and used computer monitor recordings to code the portions of interview transcripts during which each teacher accessed a given MAP report. Consistent with models of teachers’ interpretive process, a teacher’s constructed understanding of assessment data is inextricably linked to the specific raw data he or she accesses. Accordingly, attribute coded passages served as the set of analyzable segments for subsequent elemental coding.

Elemental coding methods filter qualitative data for subsequent coding cycles (Saldaña, 2013). In the present study, I used two-stage descriptive coding to identify evidence of how teachers use MAP data for instructional purposes. First, I coded each analyzable segment for evidence of teachers’ MAP data use in the context of 11 a
priori action-level codes. Each action represents a category of instructional activities, comprised of two to five finer-grained instructional practices (see Table 3.2 for the nested structure of instructional practices within actions). Then, I recoded action-level coded passages for evidence of the 36 component instructional practices. Practice-level coded passages served as the set of analyzable segments for subsequent selection of units for integrated analysis.

3.3.4.2.2 Units of Integrated Analysis

In the present study, instructional actions serve as units for subsequent integrated analysis. Owing to the nature of my open-ended interview structure and grand touring question, I expected considerable variation in evidence of teachers’ MAP data use at both the action- and practice-level. To ensure adequate evidence for insightful integrated analysis, I quantitized elemental codes and applied a two-stage screening criterion to select units of integrated analysis.

First, to ensure adequate evidence across teachers, I restricted units of analysis to only those actions for which more than three-fifths of interviewees explained how they use MAP data. That is, at least 60% teachers explained personally relevant understandings of MAP data to inform the broader instructional action. Second, to ensure adequate evidence within instructional actions, I further restricted units of analysis to only those actions that comprise at least two practices for which more than two-fifths of interviewees explained how they use MAP data. That is, actions comprised of at least two practices for which at least 40% of teachers explained personally relevant understandings of MAP data.
3.3.4.3 Integrated QUAN and QUAL Analysis Strategy

To address my second research question, I merged and reanalyzed my preliminary QUAN and QUAL results to explore patterns in how teachers use interim assessment data based on differences in two conditionally independent dimensions of data use – synthesis and informative value – via sequential First and Second Cycle coding using NVivo 12 (QSR International, 2018). Data analysis products include evidence of the similarities, differences, and patterns in how teachers make sense of MAP data in relation to dimensions of their broader practice of interim assessment data use.

First Cycle coding methods describe units of analysis based on a set of emergent or a priori codes (Saldaña, 2013). By contrast, Second Cycle coding methods reanalyze First Cycle codes to develop nuanced categorizations, themes, and insight. Within the scope of First Cycle methods, I used initial coding to examine within-teacher patterns of MAP data use. Consistent with Marsh and colleagues’ (2006) conceptual framework, initial codes capture characteristics of teachers’ individual synthesis, judgement, and prioritization of MAP data. Furthermore, I maintained analytic memos to record emergent, between-teacher patterns.

Within the scope of Second Cycle methods, I used pattern coding across teachers within each data use profile group and unit of analysis to develop and refine meta-codes by integrating initial codes with analytic memos. That is, I identified the major themes of teachers’ MAP data use by profile grouping and instructional action. Finally, I reanalyzed instructional action-specific pattern codes across groups to identify similarities and differences in how upper elementary school teachers with varying data use profiles use MAP data for instructional purposes.
3.4 Results

Consistent with my convergent MM design, I analyzed QUAN and QUAL data independently. Final QUAN products include data use profiles based on the extent to which teachers synthesize MAP with other data sources and perceive the informative value of MAP data. Final QUAL products include evidence of how teachers use MAP data for instructional purposes. Then, I merged my QUAN and QUAL results to explore how teachers’ use of MAP data is related to their data use profile.

3.4.1 QUAN Instructional Practice Profiles

To address my first research question, I analyzed the frequency with which participants engage in and use MAP data to inform each instructional practice (see Table 3.3). On average, about 89% of teachers engage in each instructional practice (range: 47-100%), about 66% of whom use MAP data to inform their instructional response (range: 17-96%). Of note, survey respondents and the subsample of interviewees engage in a comparable number of instructional practices (respectively, $M = 31.89$; $M = 31.91$) and use MAP data to inform a comparable proportion of their instructional responses (respectively, $M = .66$; $M = .65$). Taken together, these findings suggest upper elementary school teachers engage in and use MAP data to inform a broad range of instructional practices. However, this does not attend to the complex interaction between MAP and other data sources within teachers’ practice of data use.
Table 3.3: Instructional Practice-Specific Descriptive Statistics

<table>
<thead>
<tr>
<th>Instructional Practice</th>
<th>N</th>
<th>Proportion using map</th>
<th>Pairwise Jaccard index with map</th>
<th>Average map Centrality</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>curr</td>
<td>schdist</td>
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</tr>
<tr>
<td>celebrate2</td>
<td>81</td>
<td>.85</td>
<td>.31</td>
<td>.36</td>
</tr>
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</table>

To address this limitation, I analyzed the extent to which participants synthesize MAP with other data sources to inform a common instructional response.

To this end, Table 3.3 presents pairwise Jaccard normalized indices and the average
network centrality of MAP data. Each Jaccard index represents the proportion of teachers who use MAP with the other identified data source to inform their instructional response, contingent on using at least one of the two data sources. As such, data sources with high Jaccard indices are commonly used with MAP data to inform teachers’ instructional response whereas data sources with low Jaccard indices are not. For example, 62% of teachers who use either MAP or state assessment data to learn about incoming student performance use both data sources together. By contrast, only 19% of teachers who use either MAP or formative assessment data to inform that practice use both data sources together.

Average MAP centrality extends this analysis to capture the proportion of teachers who use MAP with other data sources to inform their instructional response, contingent on engagement. Figure 3.5 depicts variation in the frequency with which teachers use MAP in combination with other data sources to inform a common instructional response. As depicted in Figure 3.5a, about 24% of teachers who use MAP or another data source to predict state test performance for individual students use both data sources together. This ranges from 9% of teachers who use MAP and/or attendance or behavioral data to 34% of teachers who use MAP and/or curriculum-based assessment data. By contrast, as depicted in Figure 3.5b, about 80% of teachers who use MAP or another data source to recommend students for special education use both data sources together. This ranges from 72% of teachers who use MAP and/or attendance or behavioral data to 87% of teachers who use MAP data and/or course grades.
Note. Nodes represent data sources, scaled by the number of teachers who use that data source to inform the identified instructional practice; edges connecting nodes represent teachers’ combination of the two data sources, scaled by the number of teachers who use both data sources together. Frame (a) depicts learnSys5, a low-centrality network in which MAP data has high use (\( \hat{p} = .96 \)) but is not frequently used with other data sources (\( \overline{C_D} = .24 \)). Frame (b) depicts place2, a high-centrality network in which MAP data has high use (\( \hat{p} = .92 \)) and is frequently used with other data sources (\( \overline{C_D} = .80 \)).

Figure 3.5: Low and High Average MAP Centrality

3.4.2 QUAN Teacher Data Use Profiles

While the preceding analyses characterize between-practice variation in teachers’ practice of interim assessment data use, there is considerable variation between teachers as well. To characterize this variation, I developed multidimensional data use profiles based on teachers’ prevalence of MAP data use, synthesis of MAP with other data sources, and perceived informative value of MAP data. With respect to prevalence, the average interviewee uses data to engage in about 32 different instructional practices (range: 23-36), about 21 of which are informed by MAP data (range: 6-31). That is, teachers use MAP data to inform about 65% of the instructional responses that comprise their broader practice of data use.
When using MAP data, the average interviewee simultaneously attends to slightly more than two additional data sources to inform his or her instructional response ($M_{synthesis} = .48$). Specifically, teachers frequently attend to formative and curriculum-based assessment data when using MAP (respectively, $\hat{p} = .63; \hat{p} = .56$). By contrast, teachers infrequently attend to common assessment and attendance or behavioral data (respectively, $\hat{p} = .26; \hat{p} = .15$). Figure 3.6 depicts two teachers with varying network density who each use MAP data to inform 30 different instructional responses. At one extreme, the low-synthesis teacher uses MAP data with an average of less than two additional data sources (density = .39), including eight practices for which he or she only uses MAP data. By contrast, the high-synthesis teacher uses MAP data with an average of four additional data sources (density = .71), including only two practices for which he or she uses only MAP data.

Teachers also vary in the extent to which they perceive MAP data informs their instructional responses. On average, interviewees perceive MAP as having moderate-to-great informative value ($M_{value} = .68$; range: .49-.82). Partial correlation analysis suggests perceived informative value is not conditionally independent from the prevalence with which teachers use MAP data. Controlling for synthesis, the extent to which teachers perceive MAP data as informative is moderately correlated with the prevalence with which teachers attend to MAP data ($\rho = .55$, $p = .009$). This suggests teachers who perceive MAP data as more informative tend to use it more frequently within their broader practice of data use. Given conditional dependence on perceived informative value, I excluded prevalence of MAP data use as a determinant of final profile groupings for integrated analysis.
Note. Nodes in the left-hand column represent instructional practices for which the teacher uses MAP data and nodes in the right-hand column represent data sources; edges connecting nodes represent the teacher’s use of a data source to inform that instructional practice; nodes are scaled by the number of edges by which they are connected. Frame (a) depicts a low-density network in which the teacher uses slightly less than two data sources in combination with MAP to inform his or her average instructional response. Frame (b) depicts a high-density network in which the teacher uses about four data sources in combination with MAP to inform his or her average instructional response.

Figure 3.6: Low- and High-Density Practice-by-Data Source Bipartite Networks

Figure 3.7 depicts teacher data use profiles. Controlling for frequency of MAP use, the relationship between perceived informative value and synthesis with other data sources was not statistically significant ($\rho = -0.12$, $p = .60$). That is, the extent to which teachers perceive MAP data informs their average instructional practice is conditionally independent from the number of other data sources they use to inform a common instructional response, suggesting teachers are meaningfully distributed across these two dimensions of data use. Accordingly, I divided teachers into four groups demarcated by average synthesis and perceived informative value. Teachers
are relatively evenly distributed across profile groupings, with four (low synthesis and informative value) to seven (high synthesis, low informative value) teachers per group.

![Graph showing dimensions of teachers' MAP data use](image)

*Note.* Data points represent interviewees, labeled by ID used in my integrated analysis and scaled by the prevalence of MAP use, contingent on engagement. Dark and light grey data points are above and below the mean prevalence, respectively ($M_{prevalence} = .65$). The light grey vertical line represents the mean of teachers’ average synthesis of MAP with other data sources across instructional practices ($M_{synthesis} = .48$). The light grey horizontal line represents the mean of teachers’ average perceived informative value of MAP data across instructional practices ($M_{value} = .68$).

Figure 3.7: Dimensions of Teachers’ MAP Data Use

### 3.4.3 QUAL Evidence of Teachers’ MAP Data Use

To bridge my first and second research questions, I coded interview transcripts for evidence of how teachers use MAP data for instructional purposes. Consistent with
QUAN results, QUAL evidence encompasses an array of instructional responses. On average, teachers explained more than eight different instructional responses to MAP data ($M = 8.22$, range: 3-18). However, variation in the frequency with which teachers referenced each of the 36 instructional practices suggests a bimodal distribution of QUAL evidence. Specifically, more than half of teachers explained how they use MAP data to inform the 10 most frequently referenced instructional practices. By contrast, only one-tenth of teachers explained how they use MAP data to inform the remaining 26 instructional practices.

I applied two frequency-based criteria to select illustrative units of integrated analysis. First, to ensure enough evidence across teachers, I narrowed my focus to only those instructional actions for which more than three-fifths of interviewees explained how they use MAP data. As depicted in Figure 3.8a, six instructional actions met this criterion: grouping and differentiation, instructional content, learning about students, gathering information, learning about the system, and goal-setting. Then, to ensure enough evidence across practices, I further narrowed my focus to only those instructional actions that comprise at least two practices for which more than two-fifths of interviewees explained how they use MAP data. As depicted in Figure 3.8b, two of six instructional actions that met the first criterion did not meet this criterion. Gathering information was excluded as few teachers explained how they use MAP to re-test or administer other assessments to gather additional information; learning about the system was excluded as no more than six teachers explained how they use MAP data to inform four of five component practices. Accordingly, my integrated QUAN and QUAL analysis focused on teachers’ use of MAP data within
the context of four instructional actions: grouping and differentiation, instructional content, learning about students, and goal-setting.

Note. Frame (a) depicts the proportion of interviewees who described using MAP to inform at least one instructional response within each action-level category. The light gray horizontal line represents the first criterion for inclusion in the integrated QUAN and QUAL analysis. Frame (b) depicts the proportion of interviewees who described using MAP data to inform their instructional response within each practice-level category. The light gray horizontal line represents the second criterion for inclusion in the integrated QUAN and QUAL analysis.

Figure 3.8: Proportion of Teachers Who Explain Using MAP Data by Instructional Action and Practice

### 3.4.4 Integrated QUAN and QUAL Evidence of Teachers’ MAP Data Use

To address my second research question, I merged and reanalyzed my QUAN and QUAL results. First, I present broad data use profile-based patterns in upper elementary school teachers’ MAP data use. Then, I focus on each unit of integrated analysis to draw nuanced insight into the similarities, differences, and patterns in teachers use of MAP data to inform four instructional actions: grouping and differentiation, developing instructional content, learning about students, and goal-setting.
3.4.4.1 Informative Value and Authenticity of Data Use

Across instructional actions, teachers who perceive MAP as having above average informative value (hereafter, comprehensive data users) consistently provided authentic evidence of how they use MAP data to inform specific instructional practices. For example, Teacher 3 (low synthesis, high informative value) explained how she uses MAP data to design developmentally-appropriate instructional content:

I look and I say, “Okay, could he do all of these things within the normal every day lessons that are provided in our math curriculum?” And all of these are, except for we don’t really talk about dollars and cents specifically in our decimal conversations. So, what I do is I put that awareness in my mind that I’m going to pick decimals that have two digits after the place value and just normalize it to be money. So that I can say that I’ve hit that. So, if I have a decimal like 7.25, I don’t necessarily say “seven and twenty-five hundredths.” So, I might use that example of $7.25.

In this example, Teacher 3 provided a specific example of how she used MAP data to address an individual student’s learning progression within the scope and sequence of her math curriculum. Teacher 3 interpreted MAP data as indicating those skills and concepts her student was ready to learn and recognized one skill, working with dollars and cents, was not reflected in her existing curriculum. Teacher 3 then provided a concrete example of how she planned to integrate that skill within her curriculum, representing two-digit decimals values as money.

Similarly, Teacher 7 (high synthesis and informative value) explained how she uses MAP data to group students for classroom activities:

I take a look at their Lexile range. So, we test them also through (an external reading program) and so we get which group they would be in if its vocab and comp, or fluency and comp, or if they need to do word recognition. And then I take their MAP score and I group them closer together in those tiny groups based on Lexile.

To clarify her synthesis of MAP with other data sources, Teacher 7 further explained:
I take those smaller groups and then I sort them out even tighter I guess you could say by Lexile. So, anybody who’s close to this range, I would pull in that same group. I might have two or three fluency and comp groups. So, then I break them apart by Lexile. And MAP is really good about that because they give me all of that information, what their range is and what I can give them to push them a little where they’d be really comfortable.

Like Teacher 3, Teacher 7 provided a specific example of how she uses MAP data to meaningfully group students based on reading ability. Consistent with her data use profile, Teacher 7 also explained how she synthesizes MAP data with other reading data. First, Teacher 7 uses a reading program to identify developmentally-appropriate reading skills for each student: comprehension, fluency, vocabulary, and word recognition. Then, she fine-tunes these groups by creating subgroups of students with similar general reading ability. This process allows her to challenge each student within the scope of a common reading skill.

By contrast, with one exception, teachers who perceive MAP as having below average informative value (hereafter, superficial data users) consistently provided broad, hypothetical examples of how they might use MAP data or how they have done so in the past. For example, Teacher 2 (high synthesis, low informative value) explained how she uses MAP data to set growth goals:

I try to meet with students and help them set goals. Then I would pull this out and say, “Well, look. Here’s where you are,” and kinda talk through that with them a little bit. And say, “We’re working towards – we’d like to see you increase this number,” or whatever I’m saying to them.

Whereas Teachers 3 and 7 provided authentic examples of how they use MAP with specific students and strategies, Teacher 2 did not. Instead, she provided a hypothetical student conference dialogue demonstrating a shallow understanding of MAP data. That is, Teacher 2 tries to use MAP to determine students’ current achievement score.
and implied a desire to increase that number over time. However, she did not provide concrete evidence of using MAP data to develop a more nuanced understanding of students’ achievement scores or evidence of using MAP to support students’ development of specific skills or content understandings.

Similarly, Teacher 5 (low synthesis and informative value) explained how she approaches MAP data at the beginning of the year to learn about her incoming students:

So, the first thing I do is I look to see – I know kind of where students are as far as grade level and not grade level and seeing – on grade level and not on grade level and seeing where they’re clustered.

Comparing students’ math and ELA achievement, Teacher 5 further explained:

I also like that it has the math on here though because you can see a difference with kids just at a glance if they’re scoring higher in math or reading, not that I do anything with that anyway, but it is cool to be able to see if they are around the same scores with the math and reading of if they’re higher in one area.

Like Teacher 2, Teacher 5 did not provide a specific example of how she uses MAP data to inform her instructional response. Instead, she provided a general description of using MAP data to determine whether or not students begin the year on grade level. Teacher 5 proceeded to explain a personal interest in the difference between students’ math and ELA achievement scores that, however, does not contribute to her understanding of students at the beginning of the school year.

With one exception, evidence of MAP data use and related themes were consistent across teachers within each data use profile group. Unlike other teachers in her initial profile group, Teacher 19 (low synthesis and informative value) provided authentic evidence of how she uses MAP to inform three instructional actions: grouping and differentiation, learning about students, and goal-setting. Upon further
inspection, Teacher 19 was only slightly below the threshold for above average perceived informative value. Based on this comparison of QUAN and QUAL results, I reclassified Teacher 19 as low synthesis and high informative value for the purposes of subsequent integrated analysis.

### 3.4.4.2 Grouping and Differentiation

When grouping students and differentiating instruction, comprehensive data users provided consistent evidence of how they use MAP data to inform instructional strategies and work with specific students. For example, Teacher 12 (low synthesis, high informative value) explained how she uses MAP data to group students for classroom activities:

> I like that it’s broken down into the four categories because when I plan my centers for my kids, I try to tell them which goal area it meets. And then, that way, if they have – not that they can’t do it if they’re in the green, but if it’s an area of relative strength – I tell them that that’s not really where they should be putting their practice time because they’re already good at it. So that would be where they could go help a friend who maybe is in the yellow, who needs that assistance. But that they should really for this student, they should really be focusing on working through some geometry activities because that’s an area they need additional support.

In this example, Teacher 12 explained how she uses MAP data to direct students to specific centers based on their areas of relative strength and weakness. Teacher 12 aligns her centers with MAP-defined instructional areas and ensures her students know their areas of relative strength (“green”) and weakness (“yellow”). Then, she helps redirect students to centers that address developmentally-appropriate skills and content or pairs students with a peer tutor based on relative proficiencies.

Unlike low-synthesis comprehensive data users, who predominantly discussed grouping students for classroom activities and identifying students who are borderline
predicted to pass the end-of-year state assessment, high-synthesis teachers consistently explained how they use MAP with other data sources to identify students for in-class intervention and enrichment. For example, Teacher 9 (high synthesis and informative value) explained:

When I’m starting a new topic, it gives me a good starting point. That if they really struggled on MAP and this, then even though they might’ve already been in my on or above sometimes, I might need to pull them and do more activities with manipulatives and stuff so that they get the manipulative base and then get them to drawing and then getting them to apply or – the concrete model and then apply stage.

In relation to a specific student, Teacher 9 further explained:

We need to come up with a plan so that we can help Charlie to become successful and – even though he may not have qualified, maybe we need to go back and look because even in the classroom with supports that he’s not supposed to be getting, he’s still really struggling.

In the first quote, Teacher 9 indicated she uses other data to initially determine where students are in relation to grade-level standards. Then, she uses MAP data to fine-tune these categorizations based on specific areas where each student struggles. Furthermore, she described how she may scaffold instruction to support students’ content understanding through manipulatives, drawing, and concrete models. Teacher 9 expanded on this idea, explaining how she used MAP data recognize Charlie may benefit from potential in-class instructional supports despite not initially qualifying for such services.

By contrast, superficial data users provided broad generalizations about using MAP to group students and differentiate instruction. For example, Teacher 21 (high synthesis, low informative value) explained how her grade level team uses MAP data to group students by reading ability:
We use this chart to look at their RIT scores. And then for reading, we use it to find their Lexile and then their accelerated reading levels. And then we also use this to group them based – kinda do ability groupings, so that we can focus on and give them reading materials that are on their reading level.

While comprehensive data users explained personally relevant understandings of MAP data, Teacher 21 explained how her grade level team uses MAP data to group students, raising uncertainty about the extent to which she personally uses MAP to engage in this practice. However, consistent with her data use profile, Teacher 21 referenced the synthesis of MAP-based Lexile ranges with other data – accelerated reading levels – attending to both data sources when grouping students by reading ability, although it is uncertain how much each data source ultimately informs her instructional response.

Unlike high-synthesis superficial data users, low-synthesis teachers almost exclusively focused on how they use MAP to identify students for classroom interventions and those who are borderline predicted to pass the end-of-year state assessment. For example, Teacher 22 (low synthesis and informative value) explained:

We really need to kind of focus in on these guys also to make sure that we’re doing everything we can in our small group intervention and instruction to push them to make sure they kind of get over that hump into this three and four range.

In this example, Teacher 22 identified a general group of students who were predicted to fall close to but below proficient on the end-of-year state assessment (below the “three and four range”). Then, like Teacher 21, he explained how his grade level team could use that information to inform a potential in-class intervention. However, Teacher 22 did not expand on how he or his grade level team may use data to develop a more nuanced understanding of specific skills, content, or strategies that might
support students’ learning progression and achievement on the end-of-year state assessment.

### 3.4.4.3 Developing Instructional Content

When discussing how they use MAP data to develop instructional content, comprehensive data users provided specific evidence of how they use MAP data to connect instructional content and strategies with constructed understandings of individual students’ learning progression. For example, Teacher 3 (low synthesis, high informative value) explained how she uses MAP data to identify skills and content students are instructionally ready to learn:

I look here, and so I’ll match it with the standard. So, let’s say we’re *Numbers in base 10*, and so I’ll find her. And she is ready for all of these things. So even though the grade level standard is *Multiplying and dividing whole numbers and decimals*, none of those things are on here for her, other than she could multiply a one-digit number times ten, or a two-digit number times a two-digit number. So, most of her things that she’s ready for is adding and subtracting.

Like the other teachers in her data use profile group, Teacher 3 focused on the Learning Continuum, a MAP report that links each student with developmentally-appropriate learning objectives within pre-defined instructional areas. Specifically, Teacher 3 explained how she uses MAP data to determine the skills and content students are ready to learn within the scope of her math curriculum. For example, she understood the identified student may not be ready to multiply and divide by decimal values. Based on this information, she planned to develop the student’s ability to multiply one- and two-digit numbers and potentially introduce decimals in the context of addition and subtraction.
Similarly, high-synthesis comprehensive data users discussed how they use MAP data to identify skills and content students are ready to learn in relation to their existing curriculum and pacing. However, unlike low-synthesis teachers, high-synthesis teachers consistently focused on students below and above grade level. For example, Teacher 7 (high synthesis and informative value) explained:

We did *Key Ideas and Details*. We did – we focused on pulling text from – or yeah, pulling evidence from text. All right. So, for example, these guys fell in the 191 to 200 which is in the higher ranges of that. So, these students, we would decide to push them what was in the next bracket I can call it. So, *Compares and contrasts ideas presented in multiple literary text*. So, a lot of the time, we’re just taking a look at one text but in (the end-of-year state assessment), they’re taking a look at two texts and putting them together. So, these higher groups, we’re pushing them towards that goal, this – for winter is being able to take two texts and pull examples from that to be able to move it together.

In this example, Teacher 7 discussed how she used MAP data to identify and develop content to support the learning progression of two students above grade level. Teacher 7 understood the students’ overall MAP achievement score as above grade level and explored the specific skills and content they should be ready to learn within the scope of her ELA curriculum. For example, she indicated they may be ready to compare key ideas and details between multiple texts. Accordingly, while she focused on a single text with most students, she planned to extend this to two texts for these students by having them identify and merge examples across texts in preparation for the end-of-year state assessment.

Consistent with their use of MAP data to group students and differentiate instruction, superficial data users provided broad generalizations and referred to past or collective uses of MAP data to develop instructional content. For example, Teacher
I (high synthesis, low informative value) broadly explained how she uses MAP data to develop instructional content:

So, I can kinda backwards map. Like, all right, well, I’m teaching addition of decimals. But, based on this, they’re still looking at regular addition. Do you know what I mean? I can backwards map in my standards and say, “Alright, well, they can’t do what I need them to do.”

Whereas Teacher 7 explained how she uses MAP to tailor instructional content to students’ unique learning progression, Teacher 1 explained how she uses MAP to develop a general understanding about her students’ collective learning progression. When approaching addition with decimal values in her math curriculum, Teacher 1 recalled using MAP to explore students’ instructional readiness. She understood her students were generally ready for “regular addition” and, thus, unable to “do what I need them to do.” Furthermore, unlike comprehensive data users who use the Learning Continuum to further diagnose students’ instructional readiness, Teacher 7 did not explain how she might use MAP data to identify individual differences in her students’ instructional readiness or bridge her students’ current learning progression and curriculum-based expectations.

Compared to high-synthesis superficial data users, who may use the Learning Continuum to focus on a current learning objective, low-synthesis teachers focused on broader instructional areas. For example, Teacher 5 (low synthesis and instructional value) explained how she might use MAP data to choose appropriate instructional content:

So, if I see that there’s a lot of them struggling with Informational Text, I might pick more informational text to use with that group. So, we’re still working on the vocabulary and the comprehension but they’re also seeing assorted text that they might not be as strong in. So, for those two groups I use it, especially that group I guess I should say, for my
fluency group. I pick books that are good for fluency to practice fluency.

In this example, Teacher 5 indicated she might use MAP data to choose texts for a group of students focusing on reading fluency but provided little authentic evidence. Teacher 5 framed her explanation in a hypothetical example about a group of students with a relative weakness related to informational text. However, unlike teachers in other data profile groups, Teacher 5 did not use the Learning Continuum to explore developmentally-appropriate skills or content for the identified students. Furthermore, she did not explain how fluency practice would directly address students’ learning progression in the identified instructional area.

### 3.4.4.4 Learning About Students

When using MAP data to learn about students, comprehensive data users consistently discussed constructing understandings of incoming students’ achievement over time. For example, Teacher 17 (low synthesis, high informative value) explained how she uses MAP data at the beginning of the year to learn about her incoming students:

This student, Daisy, she scored a 190 in first grade and – in the springtime, by the end of first grade. So, when she returned to school, you notice that in the fall, she dropped a few points. And then, as the year progresses, you see the trend – as you can see here, she went from a 183 to 196 to 198, which is nice to see.

In this example, Teacher 17 identified a specific student and tracked her achievement from the end of first grade to the beginning of third grade. Teacher 17 understood Daisy’s achievement dropped between the end of first grade and the beginning of second grade. When tracking her progress through second grade, Teacher 17 recognized Daisy’s achievement increased between each successive assessment term.
Within the same data use profile group, Teacher 20 (low synthesis, high informative value) discussed a student whose achievement declined over time:

And now, see, and this is the exact opposite. So, fall for third grade, but then steadily declining the entire year. So – and that tells me that that’s – this is a student, which we already know – but this is a student that we have to watch really closely, because obviously there’s something about either the way he’s taking the test or there’s something changed. There’s something that changed with his learning.

Like Teacher 17, Teacher 20 looked at her student’s achievement trajectory leading into fourth grade and recognized his achievement decreased between each successive assessment term. Compared to Teacher 17, who was encouraged by her student’s prior achievement, Teacher 20 understood her student’s declining achievement as a concern to be monitored at the beginning of the school year.

Consistent with low-synthesis comprehensive data users, high-synthesis teachers use MAP data to develop initial understandings of their students’ achievement based on prior year MAP scores. Although teachers provided limited evidence of synthesizing MAP with other data sources for this purpose, this is consistent with empirical and conceptual expectations. As noted by Teacher 18 (high synthesis and informative value), MAP data is uniquely useful for learning about students prior to meeting them:

So, you can see not only – you can compare it to the end of last school year and into this school year. And the same with the fall, winter and then, spring. So, you can look at the amount of the achievement and the growth in the areas. I like the fact that it breaks it down, math or reading. And you can look at that. And it also shows as far as if they’ve met their projected goals. So, I was able to look at this from last year to see my students. So, I pulled this up before – when I got my class list, I pulled this up, so I already had a – kind of a picture of where my students were, prior to even starting meeting with them.

Teacher 18 further explained:
So, what I looked at at the beginning of the year is did they meet their projected growth goal? So, from fall to spring, did they meet that goal? So, I looked at that to have an idea of how many of them met it. And then, I also, looked at their RIT range and where they ended.

In the first quote, Teacher 18 indicated she specifically uses MAP data prior to meeting students to understand their math and ELA achievement levels at the start and end of the preceding school year. She then expanded on this idea, explaining how she compares each student’s projected and actual growth in addition to processing their overall achievement level. To this end, projected growth provides Teacher 18 a personally relevant metric for understanding each student’s achievement trajectory.

In stark contrast with comprehensive data users, high-synthesis superficial data users focused on a single prior achievement score and consistently expressed uncertainty about interpreting metrics. For example, Teacher 8 (high synthesis, low informative value) explained:

Sometimes, in the fall, I’m trying to look at what they did in the previous spring. And then, what they’ve done in the fall, and then, of course, when we give it in the winter, I wanna look at fall to winter.

In an illustrative internal dialogue, Teacher 8 commented:

It’s difficult, I think, to find some kind of benchmark. Like, when I look at this, I think, “Okay, well, what does that mean? So, are you on track as a fifth grader? Are you not on track as a fifth grader?”

Whereas comprehensive data users consistently attended to students’ prior achievement trajectory, Teacher 8 isolated her focus on students’ most recent achievement score. At the beginning of fifth grade, Teacher 8 may look at her students’ fourth grade spring achievement score. Then, although she looks at her students’ fifth grade fall achievement, she is uncertain how to interpret it. Accordingly, consistent with her data use profile group, MAP data does not meaningfully inform her understanding of incoming students.
As when using MAP data to group students and differentiate instruction, low-synthesis superficial data users consistently referred to past or collective MAP data use with limited evidence of how constructed understandings inform their instructional practice. For example, Teacher 11 (low synthesis and informative value) explained:

We looked at the different – I don’t even know, skill sets or the different concepts within our math curriculum. And we actually went through each one and looked at where – this one, I haven’t looked at since last year. So, we looked at where they were – yeah, there it is, the suggested area of focus. So, we looked at where they might not be as strong.

In this example, Teacher 11 described how her grade level team used MAP data to identify students’ relative weaknesses during a prior school year. However, she had not engaged in this practice again during the current school year and did not explain how she had used related understandings for instructional purposes. Like other teachers in her data use profile group, and more broadly among superficial data users, this raises uncertainty about the extent to which she personally uses MAP data to meaningfully learn about her incoming students.

3.4.4.5 Goal-Setting

When setting goals, all teachers focused on the Student Goal Setting Worksheet, a MAP report that identifies a student’s achievement score, projected growth, as well as relative strengths and weaknesses. Consistent with their general approach to MAP data use, comprehensive data users provided authentic evidence of how they use MAP data to establish specific action plans and support students’ attainment of their personal growth goal. For example, Teacher 19 (reclassified as low synthesis, high informative value) explained how she works with students to set and pursue achievement goals:
So, we talk about this being their – the – it’s kinda like treading water to get to there at the end of the school year and you’re about the same place you were at the end of second grade. And so, our goal is to get above that line to make improvement. And then we talk about our best areas and why that might be. And then this is teeny. So, I have them list two or three goals and action plan down at the bottom here because there’s so much room and then they share it with family at the parent conferences.

Teacher 19 meets with each student individually to discuss his or her fall achievement score and projected growth for the year. Teacher 19 contextualizes this based on normative data, explaining students will be in about the same place relative to their peers at the end of the year if they simply meet their projected growth. Then, she focuses on students’ relative strengths before working with them to develop goals to address their relative weaknesses and guide them toward exceeding their projected growth by the end of third grade.

In an almost identical process, Teacher 18 (high synthesis and informative value) explained:

And then, what I do with the kids if I sit with them individually, and then, we go over where they were at the beginning of the year, what their goal is and then, we come up with a student action plan for them to assess their goal.

Like Teacher 19, Teacher 18 meets with each student individually to discuss his or her fall achievement score and projected growth for the year. Then, she co-develops a more detailed action plan with each student to support his or her goal attainment.

In contrast to comprehensive data users, who extend beyond the information explicitly included on the Student Goal Setting Worksheet, superficial data users appeared to engage in cursory goal-setting to comply with school or district requirements. For example, Teacher 13 (high synthesis, low informative value) explained:
So, you write down how they did, what their goal is and just say that, “We’re looking for you to make growth.”

Within the same data use profile group, Teacher 14 explained:

So, basically, all we really do with it is, here’s where you scored in the fall. Here’s your goal. And then, we’ll record it and check it off, “Yep, you met it,” or, “No, you didn’t.”

Both Teachers 13 and 14 explained adhering to a common two-step process. First, they show each student his or her fall achievement score. Then, they tell the student his or her projected growth goal. Neither teacher delves into the significance of students’ growth goal, relative strengths and weaknesses, or develops a meaningful action plan to guide students toward their prescribed growth goal.

In nearly the same process, Teacher 22 (low synthesis and informative value) explained how he uses MAP to set student achievement goals:

It gives them their projected growth of where they’re supposed to end in the spring. That way there’s kind of no surprises if they do or don’t make it. We kind of lay the ground work in November. This is where we would like them to be.

Like low-synthesis superficial data users, Teacher 22 framed students’ projected growth goal as an end-of-year objective for his students to achieve. Consistent with Teacher 14’s compliance-oriented process of recording projected growth and checking off whether each student meets his or her goal, Teacher 22 returns to students’ projected growth goals at the end of the year to see “if they do or don’t make it.”

Furthermore, consistent with his data use profile group, Teacher 22 does not extend beyond the information explicitly included on the Student Goal Setting Worksheet to guide students toward their prescribed growth goal.
3.5 Integrated Findings

Figure 3.9 depicts my convergent MM joint display, a visual representation of my integration of QUAN and QUAL results (Creswell & Plano Clark, 2018). Quantitatively, I used survey data to group teachers into four data use profiles based on two conditionally independent dimensions of data use: synthesis of MAP with other data sources and perceived informative value of MAP data. When using MAP data, the average teacher uses slightly more than two additional data sources to inform his or her instructional response. Furthermore, the average teacher perceives MAP data as having moderate-to-great informative value when used. While QUAN results provide valuable insight into how teachers attend to MAP data for instructional purposes, integration with QUAL results provides a more nuanced perspective on teachers’ interpretive process.
Note. Italics and numerical values represent QUAN results; regular text represents QUAL results; bold text represents integrated findings. On average, teachers synthesized MAP data with slightly more than two additional data sources ($M_{density} = .48$) and perceived MAP as having moderate-to-great informative value ($M_{extent} = .68$).

Figure 3.9: Joint Display Integration of QUAN and QUAL Results

Qualitatively, I used interview data to explore how teachers use MAP data in the context of four instructional actions: grouping and differentiation, instructional content, learning about students, and goal-setting. With the exception of one teacher, whom I reclassified to a neighboring data use profile group, evidence of how teachers
use MAP data for instructional purposes was remarkably consistent within each group. Teachers who perceived MAP as having relatively high informative value consistently provided evidence of how they understand MAP data and authentic examples of how those understandings translate into specific instructional responses. Furthermore, consistent with QUAN results, comprehensive data users with above average synthesis provided extensive evidence of how they use MAP with other data sources when grouping students, differentiating instruction, and learning about students. These findings are generally consistent with QUAN instructional practice profiles, suggesting a large portion of teachers synthesize MAP with the average data source to group students, identify “bubble kids,” identify students for in-class intervention and enrichment, evaluate student progress, as well as identify students’ strengths and weaknesses (practice-specific range: 40-63%). By contrast, with the exception of developing IEP goals, few teachers synthesize MAP with the average data source to develop instructional content and set goals (practice-specific range: 16-38%).

Teachers who perceived MAP as having relatively low informative value consistently provided generic or hypothetical examples of how they might use MAP data. Such applications lacked the depth necessary to develop insight into how these teachers understand MAP data. Whereas high synthesis superficial data users expressed uncertainty in interpreting raw MAP data, low synthesis teachers frequently repeated MAP terminology without contextualizing expressed understandings. Unlike high synthesis authentic data users, high synthesis superficial data users provided sparse evidence of how they synthesize MAP with other data sources. Examples of data synthesis were predominantly restricted to grouping and differentiation, where a
few teachers compared students’ fall MAP achievement scores to pre-existing ability
groups based on other data sources.

3.6 Discussion and Implications

Interim assessment data is indelibly interwoven within upper elementary
school teachers’ broader practice of data use. Two-thirds of teachers use interim
assessment data to inform the average instructional practice with more than half of
teachers using MAP data in the context of 26 different instructional practices.
However, teachers rarely interpret interim assessment data in isolation. When using
MAP, interviewees simultaneously attend to about two additional data sources, most
frequently formative and curriculum-based assessments. Within this context, teachers
vary in the extent to which they perceive MAP data informs their broader instructional
practice, ranging from a small-to-moderate to great extent. Furthermore, similarities
and differences in how teachers use MAP data for instructional purposes are consistent
with patterns in their synthesis of MAP with other data sources and perceived
informative value of MAP data.

Across instructional actions, teachers who perceive MAP as having above
average informative value described authentic data uses. Comprehensive data users
consistently provided evidence of how they understand MAP data in relation to
specific students and instructional strategies. Among such teachers, those who engage
in higher data synthesis occasionally discussed specific data sources they used with
MAP and how each source contributed to their instructional response, most
specifically within the context of grouping and differentiation. This finding is
consistent with Park and Datnow (2017), who found teachers process a broad range of
data sources when grouping students and differentiating instruction. Furthermore,
high-synthesis comprehensive data users provided considerably more evidence of using MAP to develop in-class interventions and enrichment opportunities. Taken together, these findings suggest teachers who meaningfully synthesize MAP data with more data sources may develop more nuanced grouping and differentiation strategies.

By contrast, teachers who perceive MAP as having below average informative value described vague, hypothetical data uses. Superficial data users frequently expressed difficulty interpreting MAP data, described past or collaborative data use experiences, engaged in cursory uses of MAP data, or explicitly used MAP data to comply with professional expectations. Consistent with Farrell and Marsh (2016), superficial data users expressed limited to no evidence of meaningful shifts in pedagogy based on MAP data. Evidence of these teachers’ use of MAP data to develop instructional content was sparse and lacked the analytic rigor necessary to connect instructional content and strategies with constructed understandings of individual students’ learning progression.

Taken together, the concordance of QUAN and QUAL evidence suggests implications for instructional support coaches, administrators, interim assessment developers, and researchers. From instructional support coach and administrative perspectives, the present study affirms teachers’ practice of data use as multidimensional with at least two key markers of comprehensiveness: synthesis and informative value. When discussing data use with prospective and in-service teachers, instructional support coaches and administrators should seek authentic evidence of how teachers use and combine data sources to develop more nuanced understandings of students and related instructional responses. Furthermore, instructional support coaches and administrators should be aware of the distinction between frequency and
depth of MAP data use. When superficial data users explained how they set goals, they consistently described compliance-oriented data use efforts – teachers prescribed each student a target achievement score without a meaningful action plan to guide his or her development. Toward this end, instructional support coaches and administrators should be cautious of data use requirements as they are likely insufficient to meaningfully impact teachers’ instructional responses and improve student learning outcomes without practice-aligned data literacy supports and professional development.

From interim assessment developers’ perspective, the present study affirms teachers’ need for data literacy and synthesis support systems. Across instructional practices, superficial data users consistently used MAP terminology without evidence of personally relevant constructed understandings. Furthermore, such teachers frequently expressed self-doubt in the accuracy of their data interpretations. As a core component of the interpretive process, teachers’ construction of individual and collective understandings of raw data underpins their ability to develop actionable knowledge. Simultaneously, assessment developers should note teachers do not use interim assessment data in isolation. Toward this end, in addition to supporting teachers’ general interim assessment data literacy, assessment developers should focus on developing systems to support teachers’ capacity to meaningfully synthesize interim assessments with other data sources to develop more nuanced instructional responses.

From a research perspective, the present study affirms the need to understand teachers’ use of any given data source as integrated within their broader practice of data use. The present study introduces a unique method of quantifying data integration
via measures of data source synthesis as well as a key distinction when describing data integration via perceived informative value. Future research should further explore the multidimensionality of teachers’ data use as a means of identifying additional markers of comprehensive data use. Future research could also support teacher preparation, professional development, and evaluation through the development of data use rubrics based on markers of comprehensive data use. Toward this end, research could provide teacher educators, instructional support coaches, and administrators concrete methods of identifying individualized strengths and areas of support in pre- and in-service teachers’ ability to collect, analyze, and use student achievement data to support instructional decision making. Finally, research should continue to explore the unique contribution of individual data sources to comprehensive data users’ instructional responses as a means of supporting and developing superficial data users’ capacity to meaningfully synthesize data.

3.7 Limitations

The present study is subject to three primary limitations. First, findings are limited in generalizability beyond the current sample of upper elementary school teachers. Contemporary data use research in education suggests teachers’ process of data use is influenced by a variety of individual, social, and organizational contextual factors. Future studies should continue to expand our collective understanding of teachers’ practice of interim assessment data use among increasingly generalizable samples. Second, findings are limited by the nature of my open-ended interview structure and grand touring question. While the interview structure promoted teachers’ inclusion of personally relevant MAP data uses, it resulted in considerable between-practice variation in evidence of teachers’ MAP data use. Toward this end, future
studies may develop more nuanced insight into teachers’ practice of interim assessment data use by narrowing the scope of analysis and focusing on a pre-defined subset of instructional practices. Finally, findings are limited by constraints inherent in my list of data sources and instructional practices. Future work may focus on a more exhaustive list of available data sources or broader array of practices within a given instructional action to develop a more comprehensive understanding of teachers’ practice of data use.
STUDENTS AS ACHIEVERS AND LEARNERS

In accordance with prominent education policies such as the Every Student Succeeds Act, teachers are expected to collect, analyze, and use student achievement data to inform their instructional decision making. Contemporary research on data use in education suggests teachers use assessment data to inform practices ranging from curriculum and instructional design (e.g., Means, Gallagher, & Padilla, 2007; Nabors Oláh, Lawrence, & Riggan, 2010; Wayman, Cho, & Johnston, 2007) to student grouping (e.g., Dieterle, Guarino, Reckase, & Wooldridge, 2015; Hoover & Abrams, 2013; Park & Datnow, 2017) and educational resource allocation (e.g., Booher-Jennings, 2005; Blanc et al., 2010; Diamond & Cooper, 2007; Ikemoto & Marsh, 2007). Despite this growing body of literature, there remain gaps in our theoretical and empirical understanding of how teachers make sense of assessment data (Coburn & Turner, 2012; Datnow & Hubbard, 2015; Little, 2012; Mandinach & Jimerson, 2016; Spillane, 2012).

interpreting and transforming raw data, developing and revising understandings, and retaining personally relevant information as opposed to the raw data itself.

Teachers’ interpretive process is central to conceptualizations of data use in education, with implications for what data is noticed and how it is understood (Coburn & Turner, 2011; Jimerson, 2014; Spillane & Miele, 2007). From this perspective, teachers experience data through unique schemas – comprised of assumptions, beliefs, and prior understandings – that support their ability to cognitively focus on, contextualize, and draw inferences about data. Relatedly, teachers develop and apply mental representations, process models that structure personally relevant understandings of data. Although teachers’ interpretive process is at the core of theoretical frameworks for data use in education, few studies meticulously attend to the intricate relationships between teachers’ schema, mental representations, and how they make sense of data (Farrell & Marsh, 2016).

4.1 Literature Review

Contemporary research on data use in education has begun to shape our collective understanding of schema and mental representations within conceptualizations of teachers’ interpretive process. For example, Jimerson (2014) explored how teachers conceptualize, construe, and develop mental representations of data use with foci ranging from achievement and accountability to learning about and meeting student needs. Jimerson found teachers used forms of data consistent with their overarching mental representation, suggesting process models guide teachers’ selective attention toward data. For example, teachers with accountability-oriented mental representations often equated “data” with test scores. Furthermore, Jimerson
found teachers’ mental representations were shaped by individual, social, and organizational contextual factors.

Like Jimerson (2014), Horn, Kane, and Wilson (2015) explored how teachers developed and applied mental representations of data use with foci ranging from instructional management to instructional improvement. Horn and colleagues found teacher workgroups shaped prevailing mental representations, guiding teachers’ attention toward and opportunities to learn from interim assessment data. For example, teachers who engaged in instructional management-oriented workgroups focused on monitoring qualities of data to identify underperforming students for additional attention. Alternately, teachers who engaged in instructional improvement-oriented workgroups focused on diagnostic qualities of data to draw inferences about their students’ thinking.

Whereas the preceding studies characterize teachers’ development and application of mental representations, other research focuses on more nuanced schema of data use including those related to student outcomes, data sources, and instructional practices. Bertrand and Marsh (2015) found patterns in teachers practice of data use consistent with four schema, attributing student outcomes to: instruction, student understanding, nature of the assessment, or student characteristics. For example, teachers with student characteristic-oriented schema were more likely to attribute student outcomes to perceived capability, focusing on the distribution of “low,” “high,” and “resource” students across classrooms.

Consistent with Bertrand and Marsh’s (2015) attribution of student outcomes to the nature of assessments, Farrell and Marsh (2016) found teachers’ perception of data sources has important implications for their practice of data use. For example,
teachers used classroom assessment to support pedagogical changes due in part their trust in and perceived timeliness of the data. By contrast, teachers used interim, common-grade, and state assessments to support non-pedagogical changes such as grouping and reteaching due in part to the scope of the data.

Relatedly, Park and Datnow (2017) found patterns in teachers’ assessment data use based on schema related to grouping and differentiated instruction. Specifically, the authors found teachers’ beliefs about heterogenous versus homogeneous grouping and differentiated instruction have important implications for their practice of data use. For example, teachers with heterogeneous grouping schema used formative assessment data to assign high-performing students to groups with low-performing students. By contrast, teachers with homogeneous grouping schema used interim assessment data to support targeted instruction and reteaching of specific skills and content.

Taken together, emerging literature provides evidence of how teachers’ schema and mental representations shape their use of assessment data. However, such research does not account for the reciprocal relationship between teachers’ mental representations and interpretive process (Jimerson, 2014) – that is, how teachers’ interpretation of assessment data in turn shapes their overarching schema and mental representations. Toward this end, I turn to framing theory.

4.2 Theoretical Framework

Framing theory is a socio-cognitive perspective on the processes through which individuals understand stimuli and events (Goffman, 1974). Frames are conceptualized as existing understandings that guide individuals’ data-gathering efforts and interpretation of new stimuli (Klein, Philips, Rall, & Peluso, 2007).
Framing theory delineates two types of frames: frames in communication and frames in thought (Druckman, 2001).

### 4.2.1 Frames in Communication and Thought

Frames in communication refer to the social construction of understandings through which organizational leaders enable and constrain their audience’s interpretation of new stimuli (Druckman, 2001; Scheufele, 1999). From this perspective, individuals engage in three foundational framing processes: diagnostic, prognostic, and motivational (Snow & Benford, 1988). Individuals identify and define a problem of interest via diagnostic framing, establish a set of related solutions via prognostic framing, and cultivate an impetus for action via motivational framing. With respect to data use in education, researchers draw on frames in communication to understand how school and district leaders shape teachers’ practice of data use (e.g., Coburn, Toure, & Yamashita, 2009; Park, Daly, & Wishard Guerra, 2012).

By contrast, frames in thought refer to the individual-level enactment of interpretive schemata – the stories, maps, or scripts that simultaneously inform, and are in turn informed by, individuals’ understanding of new information (Goffman, 1974; Klein et al., 2007). Frames in thought (hereafter, *frames*) are consistent with both schema and mental representations in conceptualizations of teachers’ interpretive process. Like schema (Neisser, 1976; Piaget, 1954; Spillane & Miele, 2007), frames are organized systems of assumptions and beliefs that shape how individuals perceive and respond to new information. For example, Farrell and Marsh (2016) found teachers’ perceptions of trust, timeliness, and scope of assessment data was related to patterns in pedagogical and non-pedagogical instructional responses. Furthermore, consistent with mental representations (Johnson-Laird, 1983, 2001; Senge, 1990;
frames are filters through which individuals search for, interpret, and organize understandings of new information. For example, Jimerson (2014) found teachers with accountability-oriented mental representations sought and interpreted standardized test scores in the context of end-of-year state assessments.

Whereas conceptualizations of teachers’ interpretive process account for how teachers notice, make sense of, and respond to assessment data, they do not explicitly account for the processes through which new information alters teachers’ existing understandings (Jimerson, 2014). For this, I turn to Klein and colleagues’ (2006, 2007) data-frame theory of sensemaking – a framework for understanding how individuals make sense of both data in relation to frames and frames in relation to data.

4.2.2 Processes of Frame Alignment

Frame alignment refers to the processes through which individuals bridge, amplify, extend, and transform frames (Snow, Rochford, Worden, & Benford, 1986). Though initially developed to explain the social alignment of frames in communication, Klein and colleagues (2006, 2007) extend such processes to include frames in thought. Specifically, the authors describe three processes – elaboration, preservation, and reframing – through which individuals extend, maintain, and revise existing understandings based on their interpretation of data.

Individuals elaborate existing understandings by integrating new information to develop more nuanced frames (Klein, Moon, & Hoffman, 2006). Elaboration is consistent with Piaget’s (1954) conceptualization of assimilation, the cognitive process through which individuals fit new information into existing schemas. In education contexts, teachers may elaborate frames by seeking and inferring data consistent with existing understandings. For example, Horn and colleagues (2015)
found teachers in instructional improvement-oriented workgroups engaged in collaborative learning opportunities based on diagnostic data. In so doing, teachers extended prior understandings by drawing inferences about their students’ thinking.

Individuals preserve existing understandings by explaining away, or otherwise diverting attention from, information that is inconsistent with established frames (Klein et al., 2006). In education contexts, teachers may preserve frames by discarding data that is inconsistent with their existing understandings of students. For example, Farrell and Marsh (2015) found teachers discounted the accuracy and reliability of interim assessment data based on a perceived inauthenticity relative to classroom assessment data and student work. In so doing, teachers preserved existing understandings of the relationship between their instruction and student achievement.

Individuals reframe existing understandings by revising or developing concurrent frames based on new information (Klein et al., 2006). Reframing is consistent with Piaget’s (1954) conceptualization of accommodation, the cognitive process through which individuals revise existing schemas to incorporate new information. In education contexts, teachers may reframe understandings by comparing alternate explanatory structures. For example, Bertrand and Marsh (2015) found teachers often employed two seemingly incongruent models of data use to accommodate inconsistent data. In so doing, teachers used an instruction-oriented model to explain personal efforts to address student needs while simultaneously evoking a student characteristic-oriented model to explain impediments to student achievement.
4.2.3 Toward a Synthesis of Perspectives

Conceptualizations of teachers’ interpretive process and the data-frame theory of sensemaking contribute complementary perspectives on the relationship between teachers’ existing understandings and how they make sense of assessment data. Accordingly, I synthesize these perspectives to develop a raw data-information-frame model of teachers’ interpretive process, situated in three propositions (see Figure 4.1). First, teachers engage with data through an interpretive process. That is, teachers collect, organize, and make sense of raw data, resulting in personally relevant information that informs their instructional decision making (Ackoff, 1989; Mandinach, Honey, Light, & Brunner, 2008; Marsh, 2012; Marsh, Pane, & Hamilton, 2006; Spillane & Miele, 2007). Second, teachers’ frames shape their interpretive process. That is, teachers’ existing understandings of students guide both their cognitive focus on and interpretation of raw data (Bertrand & Marsh, 2015; Jimerson, 2014; Marsh, 2012). Third, teachers’ interpretation of raw data in turn shapes their frames. That is, teachers’ existing understandings evolve in response to their interpretation of raw data (Jimerson, 2014).

![Figure 4.1: Raw Data-Information-Frame Model of Teachers’ Interpretive Process](image)

Figure 4.1: Raw Data-Information-Frame Model of Teachers’ Interpretive Process
4.3 Purpose

Taken together, contemporary research on data use in education suggests teachers’ existing understandings of students shape how they interpret and respond to assessment data. While such research explores teachers’ selection of data sources, it does not provide insight into the types and features of raw data teachers notice. Furthermore, such research does not explore how teachers elaborate, preserve, and reframe existing understandings based on new information (Farrell & Marsh, 2016; Jimerson, 2014). Toward this end, I use a raw data-information-frame theoretical lens to explore how teachers’ frames shape, and are in turn shaped by, how they notice and make sense of interim assessment data. Specifically, the present study addresses three guiding research questions:

RQ1. What frames do upper elementary school teachers evoke when using interim assessment data?

RQ2. How do the frames upper elementary school teachers evoke shape their interpretive process? Specifically:
   a. How do teachers’ existing understandings of students shape their cognitive focus on types and features of interim assessment data?
   b. How do teachers’ existing understandings of students shape their interpretation of types and features of interim assessment data?

RQ3. How does upper elementary school teachers’ interpretive process in turn shape prevailing data use frames via elaboration, preservation, and reframing?
4.4 Methods

The objective of this complex mixed methods (MM) study is to explore the recursive relationship between how teachers frame, notice, and interpret interim assessment data (see Figure 4.2). Complex MM designs support the integration of a core MM design with additional methodologies and theoretical frameworks (Creswell & Plano Clark, 2018). The core, convergent MM design supports the integration of qualitative (QUAL) and quantitative (QUAN) analyses to develop a more complete understanding of phenomena. I approached this convergent MM design through a raw data-information-frame theoretical lens, with direct implications for QUAL and QUAN data analysis. First, I analyzed QUAL interview transcripts to gather evidence of how teachers interpret raw interim assessment data. This supports subsequent QUAN analysis by narrowing the scope to only those portions of interviews during which teachers are actively interpreting interim assessment data reports. Then, I analyzed QUAN eye tracking recordings to gather evidence of the specific types and features of data on which teachers focus when interpreting interim assessment data reports. Finally, I integrated QUAL and QUAN results to explore how teachers’ existing understandings of students structure their interpretive process and how they elaborate, preserve, and reframe these understandings based on their interpretation of interim assessment data.
Figure 4.2: Complex Mixed Methods Design
4.4.1 Participants

The present study is situated within a larger project exploring how upper elementary school teachers use MAP Growth (hereafter, MAP) interim assessment data for instructional purposes. Accordingly, I recruited teachers from 10 schools in two medium-sized districts that administer MAP in all Grade 3-5 classrooms. The two districts reside in neighboring Mid-Atlantic states with varied demographic profiles. Elementary school students in Apothem School District were predominantly White, African American, and Latina/o (respectively, school range: 50-65%; 15-35%; 5-10%), with limited eligibility for free or reduced-price meals (school range: 10-35%). Elementary school students in Cevian School District were also predominantly White, African American, and Latina/o (respectively, school range: 45-95%; 1-25%; 5-15%), with moderate eligibility for free or reduced-price meals (school range: 30-70%).

The study frame includes Grade 3-5 mathematics and/or English language arts (ELA) teachers of record referred by their school principal as potential interviewees. This eligibility criterion ensures teachers have common access to MAP data and a shared opportunity to incorporate such data within the scope of their professional responsibilities. Of 29 eligible teachers, 23 participated in the present study (participation rate = 79%), most of whom were female (96%) and White (96%). Teachers were distributed across both grade (52% Grade 3, 13% Grade 4, 35% Grade 5) and content area specialization (35% math-only, 30% ELA-only, 35% math and ELA). Teachers averaged 14.96 years of teaching experience (range: 1-35 years), an average of 7.57 of which was at their current grade level (range: 1-18) and 8.30 at their current school (range: 1-34).

6 I round and present school descriptive statistics in ranges to limit reverse look-up.
4.4.2 QUAL Data Collection

QUAL data collection includes teachers’ engagement in an open-ended interview recorded with Camtasia 3 (TechSmith, 2016) to synchronously capture how teachers access (computer monitor recording) and interpret (audio recording) MAP data. An experienced ethnographic researcher initiated each interview with a grand tour question (Brenner, 2006; Spradley, 1979) prompting teachers to describe personally relevant features of their interim assessment data use. Specifically, the interviewer asked teachers to access the MAP report(s) they find most useful and explain how they use them within their instructional practice. Thereafter, the interviewer focused on building a rapport with the teacher, only interjecting to clarify her understanding of teachers’ interim assessment data use within the broader scope of the project. Each interview concluded when the teacher indicated having expressed all personally relevant uses of MAP data.

4.4.2.1 Interview Setting

Interview location is an integral interview component with implications for constructed understandings (Elwood & Martin, 2000; Herzog, 2005). In the present study, all teachers elected to conduct the interview in their classroom during non-instructional time. This supported teachers’ contextualization of data use practices via direct access to non-electronic assessment documentation and displays throughout the interview.

4.4.2.2 Interviewer Positionality

Interviewers’ subjectivity is an essential interview component with implications for the process and results of interpretive inquiry (Lincoln, 1995; Peshkin, 1988). The interviewer is female, White, has both K-12 and post-secondary
teaching experience, as well as experience as an ethnographic researcher in elementary school classrooms. The interviewer was cognizant that her experience as a teacher and researcher may connote specific dispositions about, or judgements regarding, how teachers use data. To this end, both the researcher and interviewer explicitly informed teachers they did not represent NWEA (the MAP interim assessment developer) or have preconceived views about how teachers should use MAP data. The open-ended interview structure with minimal interviewer influence further supported teachers’ natural activation of constructed understandings (Fontana & Frey, 1994).

4.4.3 QUAN Data Collection

QUAN data includes eye tracking and computer monitor recordings collected during teachers’ engagement in an open-ended interview. I used Tobii Pro Glasses 2 to record teachers’ field of view, eye position, and gaze. Pro Glasses 2 are equipped with a gyro, accelerometer, and five cameras – one forward-facing, high-definition camera recording participants’ field of view and four cameras recording participants’ eyes (two per eye) to support three-dimensional eye modeling. To support eye tracking data analysis, I used Camtasia 3 (TechSmith, 2016) to record stable images of the specific MAP reports each teacher accessed throughout his or her interview.

4.4.4 Data Analysis Strategy

I addressed my guiding research questions via sequential QUAL, QUAN, and integrated analyses. Proximal data analysis products include evidence of how teachers notice and interpret interim assessment data. Distal data analysis products include a discussion of teachers’ data use frames, how those frames shape teachers’ MAP data
use, and how teachers’ interpretation of MAP data in turn shapes the frames teachers evoked.

4.4.4.1 QUAL Data Analysis Strategy

I analyzed teachers’ interpretation of MAP data via First Cycle coding methods using NVivo 12 (QSR International, 2018). First Cycle coding methods describe analyzable segments based on a set of a priori or emergent codes (Saldaña, 2013). Specifically, I engaged in sequential grammatical, initial, and descriptive coding. QUAL data analysis products include First Cycle codes and the selection of subunits for subsequent QUAN and integrated analyses.

Grammatical coding methods add organizational structure and nuance to qualitative data (Saldaña, 2013). In the present study, I used attribute coding to identify the specific MAP reports each teacher accessed throughout his or her interview. Each MAP report formats raw data differently, with potential implications for teachers’ interpretive process (Farley-Ripple, Jennings, & Jennings, 2018). Toward this end, I developed a priori report-level codes based on MAP documentation (NWEA, 2017) and used computer monitor recordings to code the portions of interview transcripts during which each teacher accessed a given MAP report. Consistent with conceptualizations of teachers’ interpretive process, a teacher’s constructed understanding of assessment data is inextricably linked to the specific raw data he or she accesses. Accordingly, attribute-coded passages served as the set of analyzable segments for subsequent initial coding.

Initial coding methods decompose QUAL data into discrete elements to explore the content and nuances of phenomena (Saldaña, 2013). In the present study, I iteratively recoded analyzable segments via initial coding for evidence of the specific
information teachers developed – operationalized as teachers’ personally relevant interpretations of data. Then, I used descriptive coding methods to gather evidence of the raw data teachers interpreted – operationalized as the types and features of stimuli teachers referenced when explaining how they use MAP reports. Specifically, I developed a priori data-level codes based on MAP documentation (NWEA, 2017) and recoded each analyzable segment for the specific types and features of data teachers interpreted. Taken together, raw data-information dyads served as subunits for subsequent QUAN and integrated analyses.

4.4.4.2 QUAN Data Analysis Strategy

I analyzed how teachers notice types and features of MAP data within raw data-information dyads via eye tracking and statistical analysis using Tobii Pro Lab version 1.86 (Tobii AB, 2018). QUAN data analysis products include evidence of the specific raw data teachers interpret when using MAP data for instructional purposes.

Tobii’s Real-World Mapping tool automatically detects an individual’s eye position relative to fixed image when it is in their field of view and computes related eye tracking statistics. In the present study, I evaluated teachers’ cognitive focus on raw data within MAP reports via four-step process. First, I created stable images of all unique MAP reports accessed by teachers within QUAL subunits. Specifically, I exported and aligned computer monitor recording images to create non-bounded versions of the MAP reports each teacher accessed. This step is essential to ensuring Tobii analytic software can reliably track teachers’ eyes relative to each MAP report regardless of the specific portion visible on their computer monitor at any given time.

Second, I demarcated MAP report-specific areas of interest (AOIs) – regions within a stimulus containing information pertinent to a researcher (Holmqvist et al.,
108 (2011) – based on a priori data-level QUAL codes. As depicted in Figure 4.3, each component type and feature of MAP data served as a unique AOI for eye tracking analysis. For example, the Student Progress Report report contains five distinct types and features of data: achievement scores, percentiles, growth, instructional areas, and a visual representation. Each AOI encompassed all individual raw data within the overarching type or feature. For example, when analyzing achievement scores within the Student Progress Report, I designated a single AOI encompassing all timepoints as opposed to a separate AOI for each assessment term. Although this precludes analysis of transitions between timepoints within a common student, it decreases noise in analyses of dwell – the time during which an individual cognitively focuses on designated stimuli (Holmqvist et al., 2011).

Note. Image excerpted from the MAP Growth Student Progress Report; transparent gray rectangles demarcate report-specific areas of interest.

- visual representation of achievement over time
- overall achievement score with standard error
- observed and projected achievement growth
- achievement percentile relative to national norm sample
- math instructional area-specific achievement

Figure 4.3: MAP Report-Specific Areas of Interest
Third, I demarcated QUAL subunits within Tobii Pro Lab (Tobii AB, 2018) to bound the Real-World Mapping tool. Pro Glasses 2 simultaneously record both eye tracking and audio data. Accordingly, I aligned Tobii audio recordings with interview transcripts to identify the beginning and end of all interview segments including evidence of raw data-information dyads. Finally, I used the Real-World Mapping tool to compute the amount of time teachers cognitively focused on each type and feature of data while explaining personally relevant interpretations of MAP reports. As a measure of eye tracking reliability, Tobii analytic software correctly identified teachers’ eye positioning in 91.94 of 100 frames every second (SD = 3.32).

4.4.4.3 Integrated QUAL and QUAN Analysis Strategy

To address my guiding research questions, I merged and analyzed my preliminary QUAL and QUAN results to explore how teachers evoked data use frames, interpreted MAP data within those frames, and engaged in the three processes of frame alignment via First and Second Cycle coding methods using NVivo 12 (QSR International, 2018) and statistical analysis using SPSS version 25 (IBM Corp., 2017). Whereas First Cycle coding methods describe analyzable segments, Second Cycle coding methods reanalyze those segments to develop nuanced categorizations, themes, and insight (Saldaña, 2013). Specifically, I engaged in descriptive (First Cycle) and pattern coding (Second Cycle). Data analysis products include a discussion of the recursive relationship between teachers’ frames and interpretive process.

Pattern coding methods develop explanations and inferences that support the identification of emergent themes (Saldaña, 2013). To address my first research question, I iteratively recoded raw data-information dyads for emergent patterns in teachers’ data use frames – operationalized as the stories, maps, or scripts within
which teachers explained personally relevant interpretations of MAP reports. Furthermore, I maintained analytic memos to record similarities and differences in teachers’ interpretations of MAP data within emergent frames.

To address my second research question, I reanalyzed eye tracking data within emergent frames to explore the relationship between the frames teachers evoked and how they noticed types and features of raw data within prominent MAP reports. Then, I refined pattern codes by integrating QUAL initial codes with analytic memos. Specifically, I recoded teachers’ interpretations of MAP data to identify subthemes in the types of information teachers gathered within each frame. Finally, to address my third research question, I recoded raw data-information dyads based on three a priori frame alignment processes: elaboration, preservation, and reframing. I operationalize elaboration as extending prior understandings, preservation as conserving prior understandings, and reframing as revising prior understandings or developing concurrent understandings.

4.5 Results

I present integrated QUAL and QUAN results in relation to my three guiding research questions. First, I delineate the two data use frames teachers evoked when interpreting interim assessment data. Then, describe how teachers noticed and interpreted types and features of MAP data within each frame. Finally, I describe how teachers elaborated, preserved, and reframed their existing understandings based on their interpretation of interim assessment data.
4.5.1 Teachers’ Data Use Frames

Upper elementary school teachers evoked two overarching frames when interpreting MAP data: *students-as-achievers* and *students-as-learners*. When understanding students as achievers, teachers used MAP reports to develop insight into students’ level of achievement. For example, Ms. Riley explained how she uses MAP data to compare two dimensions of student achievement:

> You kinda got a visual of – so these kids in the green are high achievement and their scores have gone up. So, when I go to target kids, I try to get the ones on the lines. It’s just a quick visual of who I need. So, I understand he grew a lot, but he’s still low. Where these guys are low and they’re not growing as much as they need to be.

In this example, Ms. Riley described a graph depicting her students based on their fall achievement and conditional growth percentiles. Ms. Riley uses this graph to identify students whose achievement and growth is above/below the 50th percentile. Then, she combines these dimensions to differentiate between groups of students with high achievement and growth (“kids in the green”), low achievement but high growth, as well as low achievement and growth.

By contrast, teachers used MAP reports to develop insight into students’ learning progression when understanding students as learners. For example, Ms. Douglas explained how she uses MAP data to support students’ individual learning progression during flexible group time:

> If I have kids that are above grade level, I use the county progressions to help me figure out, “Okay, well, if they’re really good with this, what else can I do to make their group time or their flextime valuable for them?”

To further exemplify how she uses MAP data in this context, Ms. Douglas explained:

> So, because I have a lot of students there, I can pull them in groups and help them with what they’re ready for. Because this kinda tells me,
“Okay, this kid is ready to add three or more whole numbers with sums within 100. And then 1000, no regrouping; 1000 using models.”

In this example, Ms. Douglas initially evoked a students-as-achievers frame to identify a group of students whose achievement scores were “above grade level.” Then, she identified the specific mathematics skills and content an individual student was ready to learn. In this capacity, Ms. Douglas evoked a students-as-learners frame to understand how she could tailor flexible group time to support a high-achieving student’s personal learning progression.

As exemplified by Ms. Douglas, teachers typically evoked both frames when making sense of MAP data. However, each frame had distinct implications for how teachers noticed and interpreted raw data within MAP reports. In the subsequent sections, I present the relationship between each frame and teachers’ interpretive process in relation to my second and third research questions. First, I discuss the types and features of MAP data teachers notice when evoking each frame. Then, I discuss how teachers interpret MAP data within the scope of each overarching frame. Finally, I describe how teachers’ interpretation of MAP data in turn shaped their understandings of students as achievers and learners.

4.5.2 Framing Teachers’ Attention to MAP Data

When evoking a students-as-achievers frame, teachers primarily interpreted three MAP reports: Student Progress Report, Student Profile Report, and Achievement Status and Growth Summary with Quadrant Chart. The Student Progress Report presents an individual student’s current achievement and overall progress relative to district and national averages across all prior testing periods. The Student Profile Report is an interactive report that provides a breadth of data including a given student’s current achievement, instructional area recommendations, growth over time,
and growth goals. However, when understanding students as achievers, teachers did not use the Student Profile Report’s interactive features to access more detailed information. Unlike the prior reports, the Achievement Status and Growth Summary with Quadrant Chart simultaneously displays all students in a given class including current and prior term achievement, growth comparisons and projections, as well as a visual representation of students’ achievement and conditional growth percentile.

Figure 4.4a depicts the proportion of time teachers focused on component types and features of data when understanding students as achievers. Across all three reports, teachers primarily focused on visual representations of student achievement. When interpreting the Student Progress Report and Student Profile Report, teachers allocated over half of their cognitive focus toward a graph depicting students’ growth over time relative to district and national averages (respectively, 66.98%; 51.32%). Teachers also allocated a considerable amount of cognitive focus to interpreting instructional area achievement scores – subareas within math and reading aligned with state academic standards – when interpreting both reports (respectively, 18.88%; 20.74%). Similarly, teachers predominantly focused on a graph depicting the relationship between students’ achievement and growth when interpreting the Achievement Status and Growth Summary with Quadrant Chart (72.94%). Taken together, teachers demonstrated a preference for interpreting graphical as opposed to numerical data and focused on representations of overall achievement and growth over time when understanding students as achievers.
Cells are shaded based on the proportion of time teachers focused on each type and feature of raw MAP data when accessing the indicated report within the overarching frame. Frame (a) depicts teachers’ cognitive focus when evoking a students-as-achievers frame. Frame (b) depicts teachers’ cognitive focus when evoking a students-as-learners frame.

When evoking a students-as-learners frame, teachers primarily interpreted two MAP reports: Learning Continuum – Class View (hereafter, *Learning Continuum*) and Student Profile Report. The Learning Continuum converts students’ current achievement scores into learning statements indicating level-appropriate skills and instructional content. Whereas teachers did not use the Student Profile Report’s interactive features when evoking a students-as-achievers frame, they consistently used such features to access instructional area-specific learning statements when understanding students as learners. The learning statements are identical to those

*Note.* Cells are shaded based on the proportion of time teachers focused on each type and feature of raw MAP data when accessing the indicated report within the overarching frame. Frame (a) depicts teachers’ cognitive focus when evoking a students-as-achievers frame. Frame (b) depicts teachers’ cognitive focus when evoking a students-as-learners frame.

- achievement projections are not distinguishable from the visual representation in which they are embedded
- instructional areas are not distinguishable from the learning statements of which they are comprised

Figure 4.4: Teachers’ MAP Report-Specific Cognitive Focus on Types and Features of Raw Data
presented in the Learning Continuum, though presented for an individual student instead of all students in a given class.

Figure 4.4b depicts the proportion of time teachers focused on component types and features of data when understanding students as learners. Across both the Learning Continuum and Student Profile Report, teachers allocated most of their cognitive focus to interpreting learning statements (respectively, 77.75%; 64.69%). When using the Learning Continuum, teachers also allocated about 17% of their attention to student-specific information including achievement scores. As the Learning Continuum organizes students within achievement score ranges, this allows teachers to connect students with the skills and instructional content for which they are instructionally ready. When using the Student Profile Report, teachers devoted comparable attention to instructional and content area achievement scores (respectively, 18.23%; 17.07%). Taken together, teachers demonstrated a preference for interpreting students’ instructional readiness when understanding students as learners.

4.5.3 Understanding Students as Achievers

When evoking a students-as-achievers frame, teachers interpreted MAP data in the context of students’ level of achievement, proficiency, and growth.

4.5.3.1 Level of Achievement

When accessing overall math and reading achievement scores, teachers primarily developed an understanding of students relative to personally significant criteria. For example, Ms. Adams used MAP data to determine whether students’ achievement was below, on, or above grade level equivalency:
So, the first thing I do is I look to see – I know kind of where students are as far as grade level and not grade level and seeing – on grade level and not on grade level and seeing where they’re clustered.

In this example, Ms. Adams compared students’ fall MAP achievement scores to beginning-of-year Grade 3 normative data to determine which students started the year on and below grade level. Then, she looked for clusters of students with similar achievement scores to narrow the scope of her analysis.

Whereas Ms. Adams specifically referenced normative scores, other teachers used alternate criteria to differentiate between levels of achievement. For example, Ms. Douglas used the Achievement Status and Growth Summary with Quadrant Chart to differentiate between students with “high” and “low” achievement:

I like to see who’s in the high achievement, high growth, but I also like to look in these other areas to see, “Okay, well, who has low achievement but high growth?” And, a lot of times, what I find is the kids that have the low achievement can often make very high growth. I guess there’s nowhere to go but up sometimes. So, and then, a lot of times, what I look at is also this low achievement and low growth, because I can say, “Okay, well, who’s just not – who’s just not cutting it?”

Using the same report, Ms. Salazar explained:

Here I know that these kids will produce high growth, and they’re also higher achievers. And then this group over here are very low, but they have a history of making a lot of growth, so – and then these are the guys that I know that I really have to push a lot. And then this group is just the group I know I kinda have to keep an eye out. Even though they’re higher achievers, they haven’t shown a significant amount of growth.

Like Ms. Adams, Ms. Douglas and Ms. Salazar use personally relevant criteria (the 50th percentile) to cluster students into high and low achievement groups. Among low achievers, Ms. Douglas further differentiates between students who she perceives as
closing achievement gaps and “who’s just not cutting it.” Relatedly, Ms. Salazar identified a group of students she planned to monitor closely throughout the year.

Additionally, teachers frequently interpreted MAP achievement scores in relation to personally relevant criterion for instructional support and intervention eligibility. For example, Ms. Kennedy explained:

The ones that are down here, we know if they have not been on the radar of special education, we need to try and get them onto that radar.

Relatedly, Ms. Brooks explained:

So, for Carter, he’s one that we’re looking at for special education testing. He’s been tested but didn’t qualify and we’re going back saying we’re using all kinds of supports. He’s still struggling. And we would bring some of these reports to us – with us to (his Student Support Team meeting) so we can see where he’s really struggling. His overall is 154, so he’s well below and it’s really easy to see.

In these examples, Ms. Kennedy and Ms. Brooks compared students’ MAP achievement score to personally relevant criterion for special education eligibility. Whereas Ms. Kennedy used MAP data to identify students who may not have been considered for special education in the past, Ms. Brooks used MAP data to gather additional information related to a student about whom she was already concerned. Specifically, Ms. Brooks planned to use MAP reports to further support her case for special education testing and to “see where he’s really struggling.”

4.5.3.2 Proficiency

Teachers frequently interpreted projected spring MAP achievement scores in relation to students’ likelihood of demonstrating grade-level proficiency on the end-of-year state assessment. For example, Ms. Anderson explained the connection between MAP and students’ end-of-year state assessment:
Our newest thing now is the preparation for the (end-of-year state) assessment and then, the link with this because it has all the linking data, and so it kinda lets you know by the time they take (the end-of-year state assessment) what level they should assess in.

Here, Ms. Anderson described the relationship between students’ projected end-of-year MAP achievement score and state-specific MAP linking studies. Specifically, she interprets MAP reports to understand what proficiency level students should achieve by the end of the school year, provided typical growth.

Based on this understanding of students’ projected proficiency, teachers frequently explained using MAP data to identify and target those students close to, but below, proficiency thresholds. For example, Ms. Field used the Student Profile Report to identify a student for potential intervention:

So, if you click on that it shows you this range would be Level 1, this range would be Level 2, and this range would be a three. So, in order for him – even though for MAP he’s – they’re saying they want him to hit 210…we know that 210 is below. Okay? But that would give him (an end-of-year state assessment) Level 2. So, they’re projecting that he’s only gonna get a two. So, if we don’t hit these target areas, then we know that he’s not gonna do as well. He’ll show growth in MAP and he’ll meet this target, but he won’t meet the (end-of-year state assessment) target because those are higher. Because we want him to be a Level 3 or higher.

Relatedly, Mr. Moreno explained:

And then also it’s nice to see because we want most of our students in that three and four range at the end of the year so it’s telling me, “Okay, we really need to kind of focus in on these guys also to make sure that we’re doing everything we can in our small group intervention and instruction to push them to make sure they kind of get over that hump into this three and four range.”

In these examples, Ms. Field and Mr. Moreno used MAP data to identify students who are not projected to demonstrate proficiency on the end-of-year state assessment (“a Level 3 or higher”). Both teachers identified students in their respective classes who
were projected to end close to, but below, the proficiency threshold. In this context, Ms. Field expressed a need to focus on “target areas” to ensure her student would not only demonstrate growth on MAP but progress toward grade-level proficiency.

Similarly, Mr. Moreno expressed a need to use general, small group, and intervention instructional opportunities to “push them...over that hump into (proficiency).”

4.5.3.3 Growth

When accessing measures of growth, teachers frequently developed an understanding of students’ achievement trajectory across grade levels. For example, Ms. Elliott used the Student Profile Report to track a student’s achievement over third and fourth grade:

You look at it and you’re like, “Okay, well, you know what? She did really get it. She increased, increased, increased, and now look, she’s kind of flatlined.” And the graph’s kinda easy to be able to see that. So, she’s kind of flatlined. So, we need to make sure that she improves...if you look, here she’s a four and here she is a three.

In this example, Ms. Elliott explored a student’s growth between the beginning of third and fifth grade. Ms. Elliott noticed her student’s achievement score increased every assessment period between the fall of third and fourth grade, then plateaued through the fall of fifth grade. Based on this information, she noted the need to address this trend as end-of-year state assessment proficiency criterion had increased relative to her student’s stable achievement score between fourth and fifth grade.

When focusing on the current grade level, teachers interpreted measures of projected growth as how much a student’s achievement score should increase in response to typical instruction throughout the school year. For example, Ms. Johnson
used measures of projected growth as a benchmark for students’ spring MAP achievement score:

This is her growth, where she needs to be. She needs to increase from a 202 to a 215. That’s her projection.

Similarly, Ms. Greene explained:

But, as far as when we take MAP again at the end of the year, based on the math goal they need to meet. So, that’s why it gets a little dicey, too, because do I instruct out of grade level in order for them to meet their goals?

Both Ms. Johnson and Ms. Greene interpret projected growth as achievement scores their students “need to meet.” Whereas Ms. Johnson simply indicated her student needs to demonstrate a 13-point achievement score gain, Ms. Greene expressed concern about how to support her students’ growth. Specifically, Ms. Greene recognized the identified student is currently above grade level and may not receive the instruction she needs to achieve her projected growth. Toward this end, Ms. Greene questioned whether she should extend beyond grade-level curriculum to ensure the identified student meets her growth goal.

Like Ms. Greene, teachers frequently interpreted projected growth in relation to levels of achievement. For example, Ms. Douglas expected her low-achieving students to exceed their projected growth:

A lot of times, what I find is the kids that have the low achievement can often make very high growth. I guess there’s nowhere to go but up sometimes.

Relatedly, Ms. Weaver explained:

Ava, whose growth goal is 14 points, she’s more likely – oh, and especially the lower their percentile, the more likely they are to make that growth, just because they just need to do the learning. And they are the most likely to frog leap over their projected growth goal than the
student that’s already really high. How much higher above their grade level do you expect them to go? That’s silly.

Here, Ms. Douglas and Ms. Weaver suggested students with comparatively low achievement are more likely to exceed measures of projected growth. Ms. Weaver expanded on this idea in the context of Ava, whose fall achievement score was below grade-level criterion. Because Ava was classified as a lower-achieving student, Ms. Weaver believed she would “just need to do the learning” whereas she believed her high-achieving students’ growth would be bounded by grade-level instruction.

4.5.4 Understanding Students as Learners

When evoking a students-as-learners frame, teachers interpreted MAP data in the context of students’ strengths, weaknesses, and instructional readiness.

4.5.4.1 Strengths and Weaknesses

When accessing instructional area-specific achievement scores, teachers often developed an understanding of students’ strengths and weaknesses. For example, Ms. Easton used MAP data to select general areas of weakness among her students on which to focus during ELA instruction:

At the beginning of the year, when they first take the MAP testing, I look at, “Okay, what are the bulk of the kids struggling with? Information around literature.” And, based on that, I decide what should I do a little bit more of: Literature or Informational Text.

In this example, Ms. Easton recognized most of her students’ relative weaknesses were related to two instructional areas: Literature and Informational Text. Accordingly, she planned to emphasize these areas during ELA instruction. Relatedly, Ms. Adams described how she identifies students for instructional support within the context of her grade-level curriculum and pacing:
I have a list of – we were just doing informative text. So, I went on and saw the students who were a little bit lower with informative text because that’s what we’re reading. We have the next four is informational text. So, I had written down their names just to have a heads up of these students may need a little bit more assistance with the informational text since that’s what we’re reading in shared reading. And so, it allowed me just a heads up of they might need a little bit more support with these informational texts because they are more of a lower scale.

While Ms. Easton uses MAP data to select areas of general instructional focus, Ms. Adams uses MAP data to identify specific students who may need additional support in relation to the instructional focus of her curriculum. Given a focus on informational text during shared reading, Ms. Adams identified a group of students on “more of a lower scale” in that instructional area who may benefit from additional support.

Whereas Ms. Easton and Ms. Adams use MAP data to guide and support whole class instruction, Ms. Anderson described how she uses MAP data to guide students’ selection of independent learning activities:

As far as the mathematics, I like that it’s broken down into the four categories because when I plan my centers for my kids, I try to tell them which goal area it meets. And then, that way, if it’s an area of relative strength, I tell them that that’s not really where they should be putting their practice time because they’re already good at it.

Here, Ms. Anderson described how she interprets MAP data in the context of developing instructional centers. Ms. Anderson aligns her centers with the four math instructional areas into which MAP organizes learning statements and records each students’ area of relative strength. Then, she guides students away from selecting instructional centers that focus on their personal areas of strength in favor of alternate centers.
4.5.4.2 Instructional Readiness

Teachers frequently interpreted learning statements in relation to the skills and content their students are ready to learn. For example, Ms. Reed explained how she determines students’ instructional readiness:

So, this is important because it groups the kids based on the skills that they’re ready to learn. So, if I pull up mathematics, my grid, it’s gonna show me where each student falls in the continuum. So, Lamar’s here for these skills; here, here and here for these skills.

Similarly, Ms. Adams explained:

You know from MAP what he’s ready to develop as far as Vocabulary and then the Informational Text…if you’re looking at a specific student and where they’re struggling and where you can see, “Where should I go from here?” You can see where he’s ready to go with those skills. So, he’s ready to Analyze and support claims.

As evidenced by these examples, both Ms. Reed and Ms. Adams use the Learning Continuum to translate students’ instructional readiness into concrete learning statements. Specifically, Ms. Reed interprets the connection between students and learning statements as “the skills that they’re ready to learn.” Relatedly, Ms. Adams interprets the relationship between a student and learning statements as “where he’s ready to go” in relation to ELA instructional areas.

Whereas Ms. Reed and Ms. Adams use the Learning Continuum to explore students’ relative instructional readiness, Ms. Elliott uses MAP to learn about and address students’ personal learning progression:

I’ll match it with the standard. So, let’s say we’re Numbers in base 10, and so I’ll find her. And she is ready for all of these things. So even though the grade-level standard is Multiplying and dividing whole numbers and decimals, none of those things are on here for her, other than she could multiply a one-digit number times ten, or a two-digit number times a two-digit number. So, most of her things that she’s ready for is adding and subtracting.
Ms. Elliott continued to explain how she would use this information to support the identified student:

So, instead of assigning her the grade-level standard, I may look for a second grade standard that has the same kind of thing in where she is ready to learn. So, that what she does is...maybe all the other students might be doing the fifth grade connected skill, she may be doing the connected skill that connects with her Learning Continuum, but it’s on her grade level.

Like Ms. Reed and Ms. Adams, Ms. Elliott translates a student’s achievement score-aligned learning statements into “things that she’s ready for.” Then, Ms. Elliott integrates this information with her math curriculum to support the student’s personal learning progression. Specifically, when teaching students how to multiply and divide whole number and decimal values, Ms. Elliott planned to use MAP data to support the identified student’s development of multiplication in the context of one- and two-digit numbers.

4.5.5 Frame Alignment

Consistent with the theoretical framework within which the present study is situated, teachers’ interpretation of MAP data in turn shaped their overarching frames through three processes: elaboration, preservation, and reframing.

4.5.5.1 Frame Elaboration

Across frames, teachers primarily integrated new information into existing frames when interpreting MAP data. As discussed in the context of levels of achievement, Ms. Brooks described how she uses MAP data to develop a more nuanced understanding of students as achievers:

So, for Carter, he’s one that we’re looking at for special education testing. He’s been tested but didn’t qualify and we’re going back saying
we’re using all kinds of supports. He’s still struggling. And we would bring some of these reports to us – with us to (his Student Support Team meeting) so we can see where he’s really struggling. His overall is 154, so he’s well below and it’s really easy to see.

Within the same frame, Mr. Moreno discussed his proficiency-oriented interpretation of MAP data:

And then also it’s nice to see because we want most of our students in that three and four range at the end of the year so it’s telling me, “Okay, we really need to kind of focus in on these guys also to make sure that we’re doing everything we can in our small group intervention and instruction to push them to make sure they kind of get over that hump into this three and four range.”

In these examples, Ms. Brooks and Mr. Moreno added new information to their understanding of students as achievers through their interpretation of MAP data. For Ms. Brooks, this information included evidence of the specific skills, content, and instructional areas of concern for Carter. She planned to use this new information when working with her Student Support Team to develop and implement new methods of instructional support. For Mr. Moreno, this information included evidence of whether students were likely to demonstrate proficiency on the end-of-year state assessment (“that three and four range”). He planned to use this new information to focus on students near the proficiency threshold during general, small group, and intervention instructional time.

As discussed in the context of students’ relative strengths and weaknesses, Ms. Anderson described how she uses MAP data to expand her understanding of students as learners:

As far as the mathematics, I like that it’s broken down into the four categories because when I plan my centers for my kids, I try to tell them which goal area it meets. And then, that way, if it’s an area of relative strength, I tell them that that’s not really where they should be putting their practice time because they’re already good at it.
Within the same frame, Ms. Elliott discussed her instructional readiness-oriented interpretation of MAP data:

So, let’s say we’re *Numbers in base 10*, and so I’ll find her. And she is ready for all of these things. So even though the grade-level standard is *Multiplying and dividing whole numbers and decimals*, none of those things are on here for her, other than she could multiply a one-digit number times ten, or a two-digit number times a two-digit number. So, most of her things that she’s ready for is adding and subtracting.

Ms. Elliott concluded:

But the only way I would know that is through the Learning Continuum here.

In these examples, Ms. Anderson and Ms. Elliott added new information to their understanding of students as learners through their interpretation of MAP data. For Ms. Anderson, this information included evidence of students’ areas of relative strengths and weakness. She planned to use this new information when designing and implementing math centers in her classroom, aligning each center with a different instructional area and guiding students’ selection of independent learning activities.

For Ms. Elliott, this information included evidence of the skills and content a specific student was ready to learn in relation to grade-level curriculum and pacing. She planned to use this new information to modify instruction to meet and support the student’s personal learning progression when teaching her class how to multiple and divide whole number and decimal values. Ms. Elliott concluded by exemplifying frame elaboration, noting her interpretation of MAP data as “the only way I would know that.”
4.5.5.2 Frame Preservation

Teachers often attempted to explain away new information when their interpretation of MAP data was not consistent with existing understandings. In such instances, teachers discounted the reliability of MAP data. For example, Ms. Anderson preserved her existing understandings of students as achievers based on assessment timing and conditions:

At the beginning of the year, they’re still kind of in summer fog mode and some don’t acclimate well to using the computer because they may not have had a lot of practice in years prior.

Relatedly, Ms. Greene contextualized information in relation to test duration and perceived effort:

It’s interesting to see the duration of the test time because I can see which kids – even though Beth scored in the 26th percentile, she was at least taking her time and maybe trying harder than somebody, say Kayla, who scored the same but only did the test in 21 minutes.

Here, Ms. Anderson and Ms. Greene explained why they may not trust MAP data as much as other data sources. Specifically, Ms. Anderson suggested fall MAP data is often inaccurate as her students may be “in summer fog mode” or unfamiliar with using computers at the beginning of third grade. By contrast, Ms. Greene alluded to the relative accuracy of MAP data, suggesting one student’s score may be more representative of her true ability than her classmate’s as she took longer to complete the assessment and was thus “maybe trying harder” than her peer.

Teachers also preserved their existing understanding of students as learners by discounting the reliability of students’ math data based on grade-level curriculum and pacing. For example, Ms. Salazar explained:

The math data I don’t rely on as much as the reading data because a lot of the math data, or the math tests, I’ve noticed is stuff they’ve never seen before because it starts at third grade. There’s some second-grade
stuff, I believe. But they’ve never seen area and perimeter until this year and a lot of the shape stuff. They’ve never seen multiplication or division. So, when the parents are like, “Ah, they’re only in the 15th or 20th percentile,” I’m like, “I don’t rely on that so much because a lot of it is just they haven’t been exposed to any of that.”

In this example, Ms. Salazar explained why she does not trust the accuracy of math achievement data. Although MAP is a computer adaptive assessment designed to accurately measure what students know and are ready to learn, Ms. Salazar believes students’ lack of exposure to grade-level content invalidates MAP data. Accordingly, she did not believe her students were actually “in the 15th or 20th percentile” relative to the average third grade student and suggested they simply needed to be “exposed” to grade-level skills and content instead of elaborating or revising her understanding of students’ learning progression based on this new information.

4.5.5.3 Reframing

Although considerably less frequent than frame elaboration and preservation, teachers occasionally revised or developed concurrent understandings of students based on their interpretation of MAP data. For example, Mr. Moreno revised his understanding of a student’s learning progression based on new information:

We’ve just started multiplication and division. So, Harper obviously needs to be reinforced with his basic multiplication facts. Actually, it says he’s already developed these facts, which is great. So, it’s just interesting to see what the kids kind of know and what they don’t know.

In this example, Mr. Moreno initially believed Harper needed additional support mastering basic multiplication facts. However, Mr. Moreno revised his existing understanding based on his interpretation of Harper’s fall MAP math data. Specifically, Mr. Moreno now believes Harper “has already developed these facts” and is adequately prepared for subsequent skills and content.
Whereas Mr. Moreno revised his existing understanding of Harper, other teachers developed concurrent understandings based on disconfirming evidence. For example, Ms. Kennedy explained a discrepancy between her existing understanding of a student’s level of achievement and his fall MAP reading data:

Last year the teacher said, “Oh, they’re one of my high readers.” And – okay, they’re one of your high readers, then he is now coming out down here. Then something is not quite – either he hasn’t kicked into school yet because we gave it so early, so I need to see. Is he just not trying? Did he really put forth his best effort or was it that he’s lost that much over the summer?

Here, Ms. Kennedy recounted entering the school year believing a student was a “high” reader based on anecdotal evidence from his second-grade teacher. However, based on her interpretation of the student’s fall MAP data, Ms. Kennedy found he was performing well below grade-level expectations. When merging these two understandings, she suggested two common explanations consistent with frame preservation: the student had not “kicked into school yet” or may not have “really put forth his best effort.” However, she concluded with a third explanation – regression over the summer – and indicated a need to further explore the reason for her discrepant understandings. Toward this end, Ms. Kennedy maintained two concurrent understandings of her student as both a “high” and below grade-level reader, pending the collection and interpretation of new information.

Like Ms. Kennedy, Ms. Woolridge develops concurrent understandings of her students as achievers:

I use it in the beginning of the year before I know the kids and then I sometimes adjust them slightly, depending on their personality, work habits, et cetera. So sometimes I can see some of the kids might not necessarily test where they perform in class or their abilities. So, I kinda finagle some things around.
In this example, Ms. Woolridge explained how she uses fall MAP data to group students at the beginning of the year while gathering additional information about their personal characteristics. Then, she merges these two concurrent understandings to “finagle” her groupings to reflect her understanding of students in both instructional and assessment settings.

4.6 Integrated Findings

Figure 4.5 depicts my complex MM joint display, a visual representation of my integration of QUAL and QUAN results (Creswell & Plano Clark, 2018). I approached this complex MM study within a raw data-information-frame theoretical perspective, suggesting teachers’ frames shape, and are in turn shaped by, how notice and interpret MAP data. Qualitatively, I used interview data to explore the personally relevant stories, maps, or scripts within which teachers interpreted MAP data. Quantitatively, I used eye tracking data to identify the types and features of raw data on which teachers focused within each frame. Then, I returned to QUAL data to identify patterns in the reciprocal relationship between teachers’ frames and interpretive process.
Note. Teachers’ cognitive focus is aggregated across common types and features of MAP data and weighted by the amount of time teachers interpreted each MAP report within the indicated frame. Cells are shaded by the proportion of time teachers focused on the indicated types and features of raw MAP data.

Figure 4.5: Joint Display Integration of QUAL and QUAN Results

When evoking a students-as-achievers frame, teachers primarily accessed a subset of three MAP reports – Student Progress Report, Student Profile Report, and Achievement Status and Growth Summary with Quadrant Chart – and allocated most of their cognitive focus to visual representations of student achievement (respectively, 66.98%; 51.32%; 72.94%). Within this frame, teachers developed personally relevant information about their students’ level of achievement, proficiency, and growth. For
example, teachers used the Growth Over Time visual representation of the Student Profile Report to determine whether students were below, on, or above grade level (level of achievement), how that translates into projected proficiency on the end-of-year state assessment (proficiency), and how that relates to their achievement across grade levels (growth).

When evoking a students-as-learners frame, teachers primarily accessed two MAP reports – Learning Continuum and Student Profile Report – and allocated most of their cognitive focus to learning statements (respectively, 77.75%; 64.69%). Within this frame, teachers developed personally relevant information about students’ strengths, weaknesses, and instructional readiness. For example, teachers used the Student Profile Report to identify students’ instructional areas of relative weakness (strengths and weaknesses) and the component learning statements to determine the skills and content students were ready to learn in relation to grade-level curriculum and pacing (instructional readiness).

Across frames, teachers engaged in all three frame alignment processes: elaboration, preservation, and reframing. Teachers elaborated on existing understandings by integrating new information based on their interpretation of MAP data. Teachers preserved existing understandings by discounting or explaining away inconsistent interpretations of MAP data. Teachers reframed existing understandings by revising or developing concurrent understandings of their students based on their interpretation of MAP data.

4.7 Discussion and Implications

Teachers evoke two frames when accessing interim assessment data with implications for how they notice and interpret types and features of interim assessment
data. When understanding students as achievers, teachers interpreted MAP data in the context of students’ level of achievement, proficiency, and growth. Consistent with Jimerson (2014), teachers in the present study maintained a focus on achievement and accountability. For example, teachers categorized students as high/low and above/below grade level based on their overall achievement scores. Furthermore, teachers used projected achievement scores to predict whether students would demonstrate proficiency on the end-of-year state assessment and to focus on students near the proficiency threshold.

By contrast, teachers interpreted MAP data in the context of strengths, weaknesses, and instructional readiness when understanding students as learners. Consistent with Jimerson (2014) as well as Bertrand and Marsh (2015), teachers in the present study used MAP data to learn about and adjust instruction based on students’ personal learning progression. For example, teachers sought information about students’ relative strengths and weaknesses to inform whole class, small group, and intervention instruction. Furthermore, teachers used MAP data to determine the skills and content individual students were ready to learn as a means of informing differentiated instruction and supporting students with learning needs.

Consistent with the raw data-information-frame model of teachers’ interpretive process, evidence suggests the frames teachers evoke may shape the actionable knowledge that informs their instructional decision making. When understanding students as achievers, teachers often described how they use MAP data to identify students closest to the proficiency threshold for intervention and small group instruction. By contrast, teachers frequently described how they use MAP data to support students furthest from proficiency thresholds – both above and below grade
level – when understanding students as learners. Accordingly, evidence suggests the relationship between how teachers frame, notice, and interpret data may further shape the distribution of student learning opportunities.

When using MAP data, teachers primarily engaged in frame elaboration, developing more nuanced understandings of their students based on new information. This is consistent with Jimerson’s (2014) finding that teachers often equated the concept of “data” with specific types and features of raw data that were consistent with their overarching mental representation. In the present study, teachers typically expressed unique uses for each type and feature of MAP data within their broader practice of data use. For example, Ms. Elliott equated MAP learning statements with the skills and content her student is “ready for” and identified access to MAP data as “the only way (she) would know” this information. That is, Ms. Elliott specifically uses MAP reports to elaborate her understanding of students as learners based on unique information.

Teachers in the present study also engaged in varying degrees of preservation and reframing. Consistent with Bertrand and Marsh (2015) as well as Farrell and Marsh (2016), teachers in the present study preserved existing understandings of their students as achievers and learners by discounting evidence based on the nature of MAP assessments and student characteristics. For example, Ms. Salazar questioned the accuracy and reliability of math MAP data based on a perceived disconnect between test questions and her grade-level curriculum and pacing. Alternately, numerous teachers explained away inconsistencies between MAP data and existing understandings based on perceptions of student effort.
Teachers occasionally engaged in reframing, developing concurrent understandings of their students for further analysis. For example, Ms. Woolridge explained how she develops two understandings of her students based on interim and classroom assessment data, respectively. Limited evidence of reframing in the present study may be attributable to two facets of teachers’ practice of data use. First, consistent with Jimerson (2014) as well as Farrell and Marsh (2016), teachers demonstrated a predisposition toward focusing on confirmatory data. That is, data use patterns suggest teachers in the present study cognitively focused on different MAP reports, and component types and features of data, for different purposes. Toward this end, teachers were unlikely to encounter types and features of data that would cause them to reconsider existing understandings of their students’ achievement and learning. Second, when faced with disconfirming information, teachers tended to preserve existing understandings by explaining away their interpretation of MAP data.

Taken together, integrated QUAL and QUAN findings suggest implications for instructional support coaches, administrators, interim assessment developers, and researchers. From the perspective of instructional support coaches and administrators, the present study provides insight into the recursive relationship between teachers’ frames and interpretive process. Drawing on the broader literature related to frames in communication (e.g., Coburn et al., 2009; Park et al., 2012), school and district leaders may enable and constrain teachers’ collective practice of data use by defining a problem of interest, establishing a desired solution, and motivating teachers’ action. Toward this end, the present study provides a framework to support influential school stakeholders’ understanding of how teachers individually enact, reinforce, and challenge these frames when making sense of assessment data.
With respect to interim assessment developers, the present study provides insight into the types and features of data teachers interpret in relation to overarching understandings of their students. Furthermore, the present study provides insight into how teachers preserve existing understandings when confronted with otherwise disconfirming evidence of their students’ achievement and learning. Interim assessment developers may use this information to support teachers by restructuring reports to highlight and support their interpretation of prominent types and features of data. Additionally, interim assessment developers may develop systems to support schools’ engagement of teachers in collaborative, critical thinking about disconfirming evidence they might otherwise discount as inaccurate or unreliable.

Finally, from a research perspective, the present study provides a theoretical framework for exploring not only how frames shape teachers’ interpretative process, but how teachers’ interpretation of assessment data in turn shapes existing understandings. Toward this end, the raw data-information-frame model of teachers’ interpretive process provides insight into three frame alignment processes: elaboration, preservation, and reframing. Future research should further explore how teachers’ interpretation of data affects the stories, maps, or scripts they evoke about their students. Furthermore, future research should extend the present study by exploring the relationship between teachers’ frames and observable instructional responses. Such research will contribute to a more nuanced understanding of teachers’ practice of data use and the development of systems to meaningfully support teachers’ collection, analysis, and use of student achievement data.
4.8 Limitations

The present study is subject to three primary limitations. First, findings are limited in generalizability beyond the current sample of upper elementary school teachers. Contemporary research on data use in education suggests teachers’ interpretive process is subject to a variety of individual, social, and organizational contextual factors. Specifically, as it pertains to frames in communication, influential school stakeholders may enable and constrain teachers’ interpretation of assessment data by establishing common frames of understanding in response to factors such as school district initiatives and education policy. Future studies should continue to expand our collective understanding of how frames shape, and are in turn shaped by, teachers’ interpretation of assessment data among increasingly generalizable samples. Second, findings are limited in generalizability beyond teachers’ interpretation of MAP data. Prior research suggests teachers’ perception of data sources has implications for how they notice, interpret, and respond to assessment data. Toward this end, future research should explore the relationship between teachers’ frames and practice of data use when interpreting other data sources (e.g., classroom assessment, curriculum-based assessment) as well as forms of interim assessment with different types and features of data. Finally, findings are limited by the open-ended interview structure and timing. In the present study, teachers participated in a single interview conducted outside the scope of their typical professional responsibilities. Future studies may enhance the raw data-information-frame model of teachers’ interpretive process by observing teachers’ natural practice of data use in both independent and collaborative settings as well as attending to similarities and differences in teachers’ frame alignment when interpreting assessment data at multiple timepoints throughout an academic year.
CONCLUSION

My dissertation addresses three nuances of data use in education that presently confound the relationship between variation in teachers’ practice of data use and student outcomes: (1) the relationships between different data sources within and across instructional practices; (2) the dimensionality of teachers’ practice of interim assessment data use; and (3) the reciprocal relationship between teachers’ existing understandings and interpretive process. Figure 5.1 summarizes the primary findings of each study in relation to my respective guiding research questions.

5.1 Summary of Findings

In my first study, I mapped and characterized patterns in teachers’ use of seven data sources across 36 instructional patterns. On average, teachers indicated using at least two data sources to inform each practice with some practices garnering the integration of up to six data sources. Across practices, I found data sources fell into three tiers based on the prevalence of teachers’ use. Whereas over half of teachers used formative, curriculum-based, and interim assessment data to inform their average instructional response, less than a quarter used attendance and behavioral data.
Table 5.1: Dissertation Findings by Study

<table>
<thead>
<tr>
<th>Participants</th>
<th>Data</th>
<th>Study 1 Preferences, Substitutes, and Complements</th>
<th>Study 2 Comprehensive and Superficial Data Users</th>
<th>Study 3 Students as Achievers and Learners</th>
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<tbody>
<tr>
<td>Survey Respondents</td>
<td>Data Use Survey</td>
<td>Findings Teachers use between two and six data sources to inform each of 36 different instructional practices Teachers most commonly use formative, curriculum-based, and interim assessment data to inform their average instructional response Teachers’ practice of data use comprises a complex network of preferential, substitute, and complementary relationships between data sources</td>
<td>Findings Teachers vary across two dimensions of data use: synthesis of MAP with other data sources and perceived informative value of MAP data On average, teachers use about two additional data sources when using MAP to inform their instructional response On average, teachers perceive MAP as having moderate-to-great informative value Across dimensions of data use, teachers described consistent patterns how they use MAP data to group students and differentiate instruction, develop instructional content, learn about students, and set goals Teachers who perceive MAP as having above average informative value described authentic data uses (comprehensive data users) Teachers who perceive MAP as having below average informative value described vague, hypothetical data uses (superficial data users)</td>
<td>Findings Teachers existing understandings shape, and are in-turn shaped by, how they notice and interpret MAP data (raw data-information-frame model of teachers’ interpretive process) Teachers interpret MAP data within two frames: Students as Achievers and Students as Learners Teachers interpreted MAP in the context of students’ level of achievement, proficiency, and growth when understanding students as achievers, Teachers interpreted MAP data in the context of strengths, weaknesses, and instructional readiness when understanding students as learners Teachers consistently described their practice of MAP data use in the context of three, theoretically-aligned frame alignment processes: elaboration, preservation, and reframing</td>
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<tr>
<td>n = 88</td>
<td>36-item measure of teachers’ practice of data use</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>response rate = 75%</td>
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<tr>
<td>Interviewees'</td>
<td>Extended Data Use Survey</td>
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<tr>
<td>n = 23</td>
<td>Multi-scale measure of teachers’ data use attitudes, perceptions, beliefs, and practices</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>participation rate = 79%</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Data Use Interview</td>
<td>Findings</td>
<td></td>
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<tr>
<td></td>
<td>Open-ended interview initiated with a grand tour question</td>
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<tr>
<td></td>
<td>Eye Tracking</td>
<td>Findings</td>
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<tr>
<td></td>
<td>Record field of view, eye position, and gaze</td>
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<td></td>
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<tr>
<td>*subsample of survey respondents</td>
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</table>
With respect to the interaction of data sources, I uncovered a complex network of preferential, substitute, and complementary relationships between data sources. In preferential relationships, significantly more teachers use two data sources separately than together and use one data source significantly more than the other. For example, teachers preferred interim assessment data to all six other data sources to predict students’ performance on end-of-year statewide assessments. In substitute relationships, significantly more teachers use two data sources separately more than together but use both data sources equally. For example, teachers typically used either interim assessment data or course grades to specify learning objectives and guide reteaching. In complementary relationships, significantly more teachers use two data sources together than separately. For example, teachers’ typically synthesized insight from formative, classroom-based, and interim assessment data to identify students' relative strengths and weaknesses.

In my second study, I built on my preceding findings to develop multidimensional teacher data use profiles and explore how teachers make sense of interim assessment data within the context of their broader practice of data use. Toward the first objective, teachers varied across two dimensions of data use: synthesis of MAP with other data sources and perceived informative value of MAP data. When using MAP data, the average teacher used slightly more than two additional data sources to inform their instructional response and perceived MAP data as having moderate-to-great informative value. Toward the second objective, I found consistent patterns in how teachers with varying data use profiles used MAP to group students and differentiate instruction, develop instructional content, learn about students, and set goals.
Across instructional actions, teachers who perceived MAP as having above average informative value described authentic data uses (comprehensive data users). Among such teachers, those who engaged in higher data synthesis occasionally discussed specific data sources they used with MAP and how each source contributed to their instructional response. By contrast, teachers who perceived MAP as having below average informative value described vague, hypothetical data uses (superficial data users). Such teachers frequently expressed difficulty interpreting MAP data, described past or collaborative data use experiences, engaged in cursory uses of MAP data, or explicitly used MAP data to comply with professional expectations.

In my third study, I developed and applied a raw data-information-frame model of teachers’ interpretive process to explore the recursive relationship between teachers’ existing understandings of students and their interpretation of interim assessment data. I found teachers interpreted MAP data within two prevailing frames – students-as-achievers and students-as-learners – with implications for their cognitive focus on and interpretation of raw data. When understanding students as achievers, teachers interpreted MAP data in the context of students’ level of achievement, proficiency, and growth. By contrast, teachers interpreted MAP data in the context of strengths, weaknesses, and instructional readiness when understanding students as learners.

Across frames, I found teachers consistently engaged in three theorized frame alignment processes: elaboration, preservation, and reframing. Teachers primarily engaged in frame elaboration, developing more nuanced understandings of their students based on new information. For example, one teacher explained how MAP learning statements were “the only way (she) would know” the specific skills and
content her students were ready to learn. Teachers also preserved existing understandings by discounting or explaining away inconsistent interpretations of MAP data. For example, teachers explained away inconsistencies between MAP data and their existing understandings of students based on perceptions of the accuracy and reliability of MAP data as well as perceptions of student effort. Finally, teachers reframed existing understandings by revising or developing concurrent understandings based on their interpretation of MAP data. For example, one teacher explained how she develops two understandings of her students at the beginning of the year based on MAP and their in-class performance, respectively.

Taken together, my dissertation addresses critical nuances of data use in education that confound the relationship between variation in teachers’ practice of data use and student outcomes. Specifically, my first and second studies characterize and explore the significance of how teachers choose between and combine data sources for instructional purposes. Based on an innovative application of network analysis, I measured the degree to which teachers synthesize MAP data with other data sources and found this to be a conditionally independent dimension of their practice of interim assessment data use. Combined with a second dimension – perceived informative value – I identified evidence of meaningful differences in the authenticity of teachers’ data use.

Through my second and third studies, I advanced our theoretical and empirical understanding of how teachers make sense of interim assessment data. Based on an innovative application of eye tracking analysis, I transcended abstract conceptualizations of how teachers notice raw data to objectively measure teachers’ cognitive focus on personally significant types and features of interim assessment
data. Additionally, I developed a unique theoretical model of teachers’ interpretive process to not only explore how teachers make sense of the data they notice, but also how teachers use the new information they gather to elaborate, preserve, and reframe their understandings of students.

My dissertation represents a necessary first step toward understanding the systematic variation in how teachers choose between, combine, and make sense of assessment data that confounds the relationship between teachers’ data use and their students’ learning outcomes. In so doing, my dissertation advances the field of research on data use in education and informs both education practice and policy.

5.2 Implications

My dissertation suggests important implications for instructional support coaches, administrators, interim assessment developers, and researchers. From the perspective of instructional support coaches and administrators, my dissertation provides insight into two key markers of comprehensive data use: synthesis and informative value. Instructional support coaches and administrators should consider these two dimensions of data use when working with prospective and in-service teachers, seeking authentic evidence of how teachers use and combine data sources to develop nuanced understandings of students and instructional responses. Relatedly, instructional support coaches and administrators should be aware of teachers’ repetition of data-specific terminology and use of hypothetical examples as potential indicators of the need for data literacy supports and professional development. Furthermore, my dissertation provides a framework to support school stakeholders’ understanding of how teachers individually enact, reinforce, and challenge shared understandings of students when making sense of assessment data.
From the perspective of interim assessment developers, my dissertation provides insight into how teachers notice and make sense of interim assessment data. Interim assessment developers may use this information to inform the development of systems to support teachers’ capacity to interpret and meaningfully synthesize interim assessment data with other data sources to inform their instructional decision making. Interim assessment developers should also be aware of teachers’ propensity to preserve existing understandings when confronted with otherwise disconfirming evidence of student achievement and learning. Toward this end, interim assessment developers may create systems to support teachers’ engagement with instructional support coaches and administrators in collaborative, critical thinking about how disconfirming evidence provides opportunities to question and reframe existing understandings.

Finally, from a research perspective, my dissertation affirms the need to understand individual data sources as indelibly interwoven within teachers’ broader practice of data use. Researchers should continue to explore the unique and collective contribution of data sources to teachers’ practice of data use as well as the multidimensionality of comprehensive data use. Toward this end, researchers could support teacher preparation, professional development, and evaluation by identifying key markers in pre- and in-service teachers’ ability to meaningfully collect, analyze, and use assessment data. Furthermore, my dissertation provides a model for exploring not only how frames shape teachers’ interpretative process, but also how teachers’ interpretation of assessment data in turn shapes their understanding of students. Toward this end, future research should further explore how teachers’ interpretation of data affects the stories, maps, or scripts they evoke about student achievement and
learning in addition to informing observable instructional practices. Such research will contribute to a more nuanced understanding of teachers’ practice of data use and the development of systems to meaningfully support teachers’ collection, analysis, and use of student achievement data.

5.3 Significance to Research, Practice, and Policy

Data use in education is often depicted as a panacea for substandard and inequitable student achievement. To support teachers’ collection, analysis, and use of student achievement data to inform their decision making, states and districts have designed and implemented comprehensive assessment systems comprised of an array of assessment tools and processes. However, the relationship between teachers’ use of student achievement data for instructional purposes and student learning outcomes is confounded by systematic variation in teachers’ practice of data use. Taken together, the three studies that comprise my dissertation represent a necessary first step toward understanding and supporting teachers’ use of assessment data to positively affect student learning and achievement. As a next step, we must connect differences in teachers’ stated practice of data use – data synthesis, perceived informative value, enactment of data use frames, processes of frame alignment – with observable differences in teachers’ instructional practice. Then, we can further link these observable differences in teachers’ instructional practice with differences in student learning outcomes to identify best practices. Through such work, future research on data use in education can support practitioners’ collection, analysis, and use of data to address the substandard and inequitable student achievement underlying prominent education policy.
REFERENCES


Appendix A

IRB/HUMAN SUBJECTS APPROVAL

DATE: April 27, 2018

TO: Austin Jennings
FROM: University of Delaware IRB

STUDY TITLE: [1057376-5] Teachers' Use of MAP Data

SUBMISSION TYPE: Continuing Review/Progress Report

ACTION: APPROVED
APPROVAL DATE: April 27, 2018
EXPIRATION DATE: April 30, 2019
REVIEW TYPE: Expedited Review
REVIEW CATEGORY: Expedited review category # (7)

Thank you for your submission of Continuing Review/Progress Report materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All serious and unexpected adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all non-compliance issues or complaints regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.