Exploring Middle School Mathematics Teachers' Approaches to Instruction and Assessment

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Abstract

U.S. middle school teachers have struggled to meet the instructional needs of students in the area of mathematics. Teachers' approaches to assessment and instructional strategies remain understudied; such knowledge could help educational leaders to devise strategies to boost student achievement. The purpose of this qualitative study was to examine teachers' perceptions of assessment data usage and instructional strategies used in middle school mathematics. The conceptual framework was based on Fullan et al.'s three Ps (precision, personalization, and professional learning) framework. The guiding research questions for this study concerned teachers' perceptions of assessment usage and instructional strategies and their considerations prior to assessment and strategy implementation. This study was conducted in the basic qualitative tradition. Eight middle school mathematics teachers were recruited using criterion sampling. Individual interviews were conducted to gain insight regarding participants' perceptions of assessment usage and instructional strategies. Thematic analysis yielded six themes regarding the adequacy of time for analyzing data results, the realization that stakeholder input enhances classroom success, the use of varied instructional strategies, the use of data to support personalized instruction and to better understand students, and the implementation of instructional duties with fidelity. This study contributes knowledge regarding mathematics teachers' use of assessment data to improve instructional delivery and assessment. Study findings may inform classroom teachers' professional development in assessment data usage and instructional strategies. With such knowledge, teachers may have greater agency and be better able to increase student achievement.

Keywords: Assessment Usage; Use of Assessment; Instructional Strategies; Teacher Perception; Formative Assessment; Classroom Strategies; And Differentiated Instruction

Introduction

Assessment of student learning is a hallmark of contemporary U.S. education. The Every Student Succeeds Act (ESSA) of 2015 emphasizes the alignment of assessment and instruction (U.S. Department

of Education, 2019). However, recent literature suggests that teachers' varied perceptions of instructional strategies and assessment usage poses an obstacle to implementing consistent, tailored instruction (Guay et al., 2017). Fullan et al. (2006) reasoned that precision, personalization, and professional learning (the three Ps), when fully developed, may lead to changes in teachers' beliefs, perceptions, and understanding of data usage to drive continuous improvement in student achievement. This study has the potential to advance positive social change by providing insight into assessment usage to inform instructional strategies; as Pinger et al. (2018) noted, the use of data-informed instructional strategies may boost student achievement.

Assessment data have the potential to inform how teachers plan and differentiate instruction. However, some teachers struggle to use assessment data (Datnow et al., 2021). Moreover, how teachers leverage assessment data to inform instructional decisions is relatively unknown (Datnow & Hubbard, 2015). This lack of knowledge represents a gap in practice. Some U.S. classroom teachers are struggling to interpret lapses in understanding shown in student performance levels (McGlynn & Kelly, 2017), specifically in mathematics. A teacher's ability to accurately diagnose and prescribe remediation for students positively affects student achievement in mathematics (Deunk et al., 2018). Teachers who are less skilled in interpreting lapses in student performance often have trouble implementing appropriate and consistent interventions (Prast et al., 2018).

In conducting this study, I sought to contribute to a growing body of knowledge concerning how teachers use assessment data to inform instruction. This study may be of use to the educational field because it provides insight into teachers' assessment data use. Specifically, I examined teachers' perceptions of assessment data usage and instructional strategies. The targeted content area was middle grades mathematics.

Research Problem

The problem that prompted this dissertation is that some U.S. middle school teachers struggle to implement effective instructional strategies based on students' assessment data in mathematics. I sought to address this gap in professional practice by contributing to a growing body of knowledge about how teachers use assessment data to inform instructional strategies. In comparison to 2009, national average scores in eighth grade mathematics continue to lag for lower and middle performing students based on the 2019 National Assessment of Educational Progress mathematics assessment report (The Nation's Report Card, 2021). These lagging deficits may be due to teachers' inability to diagnose and prescribe remediation for students accurately. Similarly, Raffe and Loughland (2021) gathered data on teachers' perspectives to examine the factors affecting teachers' use of assessment data. Lack of confidence and skill level required to collect and analyze assessment data properly were among the 16 factors identified.

Furthermore, teachers lack the skills to interpret lapses in student performance data, contributing to difficulties in implementing appropriate and consistent interventions (Prast et al., 2018). To emphasize, only 25-50% of U.S. teachers use student assessment data to inform instruction (Kippers et al., 2018). Schildkamp (2019) noted that more information about how teachers use assessment is needed. More recently, Datnow et al. (2021) reported that teachers struggle to use data to inform daily instruction. This continued interest in teachers' assessment data usage to inform instruction demonstrates a gap in professional practice.

Purpose Statement

The purpose of this qualitative study was to investigate middle school teachers' perceptions of assessment data usage and instructional strategies in mathematics. The following research questions for this study were as follows:

- Research Question 1: What are middle school mathematics teachers' perceptions of assessment data usage?
- Research Question 2: How do middle school mathematics teachers choose personalized instructional strategies based on students' assessment data?

Literature Review

Since the late 1960's, assessment has played a pivotal role in how students learn and their motivation to learn. Equally important, assessment has been shown to be essential to how teachers teach. Scriven (1967) first coined the term *formative evaluation* as a continual means of influencing student achievement. Bloom (1968) elaborated on the term formative evaluation and its inherent link to summative evaluation. At the end of the century, it was the seminal work of Wiliam and Black (1996) that catapulted the role of assessment to include students as an integral part of the assessment feedback loop. The authors presented formative assessment as a graphic and multi-interpretive means for teachers and students to navigate the process of teaching and learning. Assessment feedback was employed to elicit the evidence needed to inform and adjust instruction (Black & Wiliam, 1998). Moreover, the teacher reconstructs assessments according to their classroom environment. Comprehension evolves continuously in a classroom environment. A teachers' use of assessment and reflexive, timely feedback to students helps to identify and address learning gaps (Black & Wiliam, 2004). Improvement occurs when teachers gain new meaning by using a reflective analysis of instructional innovations (Fullan, 2007). Assessment should benefit students during the learning process by allowing teachers to recognize and respond to learning and deficit cues (Schildkamp, 2019). In essence, the assessment-feedback loop activates student learning by allowing them to apply the data generated in a meaningful way (McMillan, 2018).

The No Child Left Behind Act of 2001 brought assessment practices under the scope across the country (Popham, 2013). The No Child Left Behind era ushered in yearly standardized testing that was designed to determine academic progress. These assessments were performed summatively; however, there were growing concerns regarding the need for frequent progress monitoring (Popham, 2013). Using formative assessments allowed teachers to better track their students' instructional deficits (Connors, 2021). Black and Wiliam (1998) suggested that teachers will require pedagogical upgrades to ensure proper implementation for formative assessments to be effective. Moreover, assessment practices are enhanced when teachers participate in learning communities with a focus on improving teaching and learning (Fullan, 2011).

Accountability became the focus of measure with the Every Student Succeeds Act (ESSA) of 2015. The ESSA requires schools to adhere to rigorous accountability measures while preparing students for postsecondary education and careers (U.S. Department of Education, 2019). The ESSA also scores schools based on graduation rates, retention rates, and the implementation of college and career readiness standards in addition to the Common Core standards (Urick et al., 2018). ESSA placed tremendous stress on teachers and principals due to the multiple federally mandated accountability measures (Reed & Rose, 2018). According to Davis et al., (2018), teachers were not prepared to properly implement the Common Core standards. Moreover, 33% of middle school mathematics teachers struggle to name the standards for mathematical practice and often misinterpret the standards (Davis et al., 2018).

Teachers are expected to gather and generate student data for instructional purposes. This practice of data-driven decision making (DDDM) involves monitoring student progress through assessment and making informed instructional decisions (Schildkamp & Datnow, 2020). Additionally, analyzing student data using DDDM skills helps teachers to identify instructional gaps (Mandinach & Schildkamp, 2020). DDDM is most effective when teachers can translate students' assessment data into meaningful practice. Moreover, teachers can include students when establishing and implementing instructional goals, which allows the student to play an active role in the DDDM monitoring process (Mandinach & Schildkamp, 2020).

A. Assessment Usage as a Strategy

Assessment is embedded in the process of learning. Students who take practice tests perform better than those students who only review course content (Adesope et al., 2017). According to Adesope et al., students who took practice tests outperformed those students in non-testing learning environments. Still, there was limited information regarding whether such tests enhance or reduce student learning. The most crucial component of assessment is the interpretation and use of the information garnered for its intended purpose. Teachers' use of informal formative assessments affects student learning and teachers' recognition of learning gaps (Lekwa et al., 2020). For example, reflection, analysis, and real-time interaction are effective tools that can be used to guide informal formative assessments (Lekwa et al., 2020). Pre and post-testing are useful means of benchmarking student growth. Moreover, pre-testing promotes significant content retention, while post-testing provides an effective bridge towards related untested content (Latimier et al., 2019). Both teachers and students benefit from apt assessment usage. Therefore, understanding assessment usage as a strategy to inform students and teachers in practice is essential to sustainable growth in student and teacher performance (Adesope et al., 2017). When teachers assess students' understanding and adjust their instruction to rectify misconceptions, it helps students to realize their academic goals. This apt usage of assessment increases student achievement (Andersson & Palm, 2017). Assessments of and for learning allow teachers to assist students' learning endeavors structurally. Furthermore, a teacher's capacity to aptly use assessment data is directly proportional to student achievement (Toropova et al., 2019). Therefore, higher levels of teacher capacity yield higher levels of student achievement.

B. Teachers' Perceptions of Assessment

Teachers' perceptions, beliefs, and understandings about assessment impact assessment practices and implementation (Cotton, 2017). A teacher's personal perceptions regarding the efficacy and use of assessment will influence her assessment practices (Tomlinson, 2017). While teachers may understand assessment practices, some still opt not to employ certain formative assessment measures despite receiving training (Cotton, 2017). Opting not to employ a variety of assessments could be due to how teachers perceive their own abilities as assessors (Cotton, 2017). By the same token, Van Gasse et al. (2020) reported that teacher attitude and perceived self-efficacy affects how teachers use data. Classroom observations revealed that teachers generally used the same classroom strategies, but master teachers implemented assessment strategies more effectively (Johnson et al., 2019). With adequate support, teachers can adjust instruction, implement effective assessments, and modify summative assessments (Yin & Buck, 2019). Moreover, reducing the number of classroom activities while implementing diverging and converging assessments helps students build ideas over time (Yin & Buck, 2019).

On the other hand, teachers may be experiencing a diminishing agency to assess student needs due to using mandated assessments, as opposed to teacher authored assessments (Golden, 2018). Perhaps, teachers feel pressured or threatened to assess their students in a particular way, thereby reducing teacher agency concerning compliance (Golden, 2018). Some teachers may struggle to create meaningful assessments because of the use of mandated assessments that fail to provide a detailed profile of student

growth (Golden, 2018). Reduced autonomy in curricular decisions about assessment contributes to a diminishing agency to assess student needs (Golden, 2018). Furthermore, agency in mathematics teaching practices often lag teacher mindset and ability to aptly explicate students' needs (Bobis et al., 2019).

C. Frequency and Agency of Assessment

Analyzing students' achievement provides insight into formative assessment intervention efficacy (Pinger et al., 2018). As students' complete assessments, teachers should provide frequent, specific, and personalized feedback (Pinger et al., 2018). Non-specific and infrequent feedback has a negative effect on students' mathematic achievement (Pinger et al., 2018). However, when teachers provide frequent feedback that is embedded within instruction, with an emphasis on feedback utilization, mathematics achievement is positively affected (Pinger et al., 2018). Gaps in teacher understanding may contribute to the low-frequency usage of certain assessments (Johnson et al., 2019). It has been reported that limited data literacy reduces teacher agency (Jimerson et al., 2021).

Additionally, assessments that occur within and between lessons, referred to as medium-cycle assessments, are valid observation tools for mathematics and literacy teachers (Lee et al., 2020). Assessments during medium cycle grading periods are beneficial for students by detecting gaps in knowledge, which provide teachers the feedback needed for adjusting instructional strategies (Lee et al., 2020). This method is a valid and reliable metric for implementing formative assessments in the classroom (Lee et al., 2020).

D. Personalized Learning and Assessment

Increasing classroom diversity has caused teachers to shift their instructional practices towards more differentiation (Darling-Hammond, 2006; Santangelo & Tomlinson, 2009). Over the years, personalizing instructional strategies and assessments as a form of differentiated instruction has expanded as a globally recognized instructional practice (see Chamberlin & Powers, 2010; Lawrence-Brown, 2004; Tomlinson et al., 2003). There are numerous proposed structures and components of differentiation. However, the works of Tomlinson (2017), Hall (2002), and Lawrence-Brown (2004) are the most well-known (see Pozas & Schneider, 2019). Differentiation through personalization is highly influenced by the classroom teacher's understandings and beliefs (Tomlinson, 2005, 2014, 2017). Teachers' beliefs, attitudes, and understandings refer to the intrinsic mindsets possessed by those facilitating the learning process (Seo & Lee, 2020). Ultimately, these beliefs may pose barriers to the level of strategy implementation efficacy, and student success (Paek & Sumners, 2019). Flexible learning environments where teachers are responsive to student needs enable students to sharpen their existing skills towards competency (Sousa & Tomlinson, 2011). Tomlinson (2017) proposed that teachers could raise student achievement by differentiating concerning process, content, and product. Differentiating the process pertains to personalizing learning activities that are tailored to the needs of the student. Content may be differentiated according to the content that is introduced to the student. Likewise, student readiness levels can inform teacher choice of assessment products. The goal is to maintain rigor while providing personalized, tailored instruction for each student. To achieve this, teachers should maintain detailed profiles of each student to facilitate differentiation through personalization (Tomlinson, 2017).

Assessment and personalized learning go hand-in-hand. Hall (2002) suggested using pre-assessments as the strategic fulcrum for differentiation and personalization. This method allows teachers to collect insight regarding student interests, understandings, and current skill levels before beginning a new unit (Coubergs et al., 2017). These pre-assessments can be conducted formally or as an impromptu survey of student readiness. In this manner, assessments are used as a diagnostic tool rather than a mere measure of outcomes (Puzio et al., 2020). Moreover, learning targets and objectives should be clearly communicated to students. Once learning objectives are delineated to students, teachers may customize

lessons for students according to their learning profiles (Hall, 2002; Tomlinson, 2014). Lawrence-Brown's (2004) model uniquely established a set of criteria defining minimum proficiency for struggling learners, while emphasizing the importance of personalizing instruction for the enrichment of high achievers. This model relied upon curricular adaptations to meet standards per category of learner. In contrast, Hall (2002) and Tomlinson (2017) proposed modifications to the process, content, and product based on each learner's assessed needs.

Assessment feedback helps teachers to make informed instructional decisions. Ideally, teachers can address learning deficits by implementing instructional strategies specific to the learner's needs (McGlynn & Kelly, 2017). Moreover, diversification of instructional strategies is directly correlated to higher achievement (Clements et al., 2020). However, teachers use a greater variety of assessments in a student's early learning phases instead of later learning phases (Clements et al., 2020). Moreover, student learning experiences, particularly in mathematics, become increasingly homogenous during later learning phases (Clements et al., 2020). Likewise, struggles persist for science teachers to raise students to mastery level in learning and applying new scientific words for newly introduced concepts; vocabulary instructional strategies enhance content-area teacher effectiveness (Rasinski et al., 2017). Furthermore, a constructivist approach to curricular strategies may better promote literacy (Nguyen et al., 2018). When coupled with targeted, content-specific instruction, this approach is most effective for the whole learner (Nguyen et al., 2018).

Adapting and modifying assessments and instructional strategies towards better meeting the students' needs is a form of differentiating instruction (Letwinsky, 2017). Differentiated instruction necessitates teachers to allot students to access, develop, and demonstrate skills through thoughtful planning (Goddard et al., 2019). Instructional strategies and assessments can be modified according to student readiness and interests (Dennis & Gratton-Fisher, 2020). Differentiating instruction through personalization helps cultivate authentic and engaging learning experiences for students while adhering to a rigorous curriculum. However, for a teacher to personalize content without changing the rigor level, the teacher must have sufficient content knowledge and the flexibility to work with a ride range of learners (Neuman & Danielson, 2020). If teachers are to provide higher efficacy of instructional strategy implementation, more emphasis should be placed on teacher content knowledge. Also, appropriately timed assessments can help teachers make informed decisions towards the preparation of personalized instructional strategies (Dennis & Gratton-Fisher, 2020).

In recognition of student diversity, personalizing instruction as a process affects teacher choice of instructional strategies, accommodating student learning (Smith & Williams, 2020). Often, subtle differences in instructional practices and strategies yield substantially different learning outcomes for students (Donaldson et al., 2017). Personalization honors student individuality, which may positively affect student motivation (Haymon & Wilson, 2020). Moreover, a lack of individualized instructional strategies, assessments, and learning activities may be the culprit for underachieving students (Siegle & McCoach, 2018). Classroom environments that offer choice of assessment allot student autonomy, which inspires student interest (Haymon & Wilson, 2020). Therefore, it is incumbent upon the teacher to help students identify their unique abilities by cultivating an environment that celebrates choice.

Ultimately, a teacher's overall aim when administering any assessment or instructional strategy is to analyze and interpret student performance to determine areas for improvement. Based on student performance, teachers can determine the necessary instructional adjustments to develop a precise plan of action. However, Trumbull and Nelson-Barber (2019) suggested that using assessment data to make instructional adjustments continues to be a struggle for teachers, especially considering the full learner profile per student. The hardest task for teachers remains to target student deficits and close instructional gaps once it is diagnosed (Trumbull & Nelson-Barber, 2019). Moreover, Kruse et al. (2017) reported that math teachers have acknowledged the need for support concerning differentiated practices.

Methodology

This study followed the basic qualitative tradition. In a basic qualitative study, researchers interpret personal experiences within social constructs (Merriam & Tisdell, 2016). Participants were eight U.S. middle school mathematics teachers who were selected using criterion sampling from a population of middle school teachers who responded to social media announcements and a university participant pool. Each research participant gave voluntary informed consent to participate in the study. As an additional incentive, gift cards in the amount of $15 were issued to each participant upon completion of data collection.

Data collection consisted of semistructured interviews consisting of 14 questions, conducted remotely via the Microsoft Teams video conferencing app. The interview protocol is shown in Table 1.

Table 1. Alignment of Interview Questions to Research Questions

Research question	Corresponding interview question
Research Question 1: What are middle school mathematics teachers' perceptions of assessment data usage?	How does your planning differ when preparing to administer formative assessments when compared to summative assessments? What kinds of assessments tell you the most about what students are learning? When might you differentiate assessments for your students? How do you use assessment data in your classroom?
Research Question 2: How do middle school mathematics teachers choose personalized instructional strategies based on students' assessment data?	What motivates you to employ innovative instructional strategies in your teaching? What instructional strategies do teachers in your department use for improving assessment? Do you believe that these strategies are effective? Why or why not?
	Specifically, what instructional strategies and assessments have you used in your classroom? Describe the instructional and assessment practices at your school. What instructional strategies do you use between assessments? How do you decide which instructional strategies to employ? Which instructional strategies do you use when checking for student comprehension of a concept? What involvement do you have in the evaluation of instructional and assessment practices at the school?

The interviews ranged from 57 minutes to 75 minutes in length, and the mean interview length was 60 minutes. Each interview was recorded and later transcribed verbatim. Data analysis followed the procedures of Braun and Clarke (2006). As a first step in data analysis, we organized the interview data to identify commonalities among participants' responses. This process involved manual transcript coding using the simple markup feature in Microsoft Word to add comments within the transcript to highlight initial a priori and open codes throughout each documented transcript. This method helped us to generate a useful typology of initial codes. Next, we used a process of axial coding to develop broader categories pertaining to how, when, and why teachers collected student data. We made stringent comparisons of

codes into cohesive groups. This axial coding process led to the identification of overarching themes based on repeating patterns.

Data Analysis and Results

Before the coding process started, we developed seven a priori codes. From these codes emerged 31 broader, axial codes. Using inductive reasoning, we carefully revisited each interview transcript document to develop a consensus of participants' perceptions, and we were able to group the data into 16 categories. After assigning codes per category, we identified a total of six more dominant emergent themes. Table 2 displays the relationship of codes to the six emergent themes.

Table 2. Alignment of Codes to Themes

Code	Theme
Using assessment results, time constraints (affecting data analysis), frequency of assessment, continuous diagnostic assessment, feelings towards using and analyzing data, low growth attributed to attendance issues or apathy	Theme 1: Teachers perceive that they do not have enough time to analyze data results due to repetitious testing schedules.
Instructional support, involving parents as partners, collaboration	Theme 2: Teachers realize that stakeholder input enhances classroom success.
Awareness of assessment data, reflection, kinesthetic learning, self-paced learning, project-based, vocabulary emphasis/writing prompts, instructional strategies, backwards planning, real-world application, evidence-based, interactive, technological application, providing feedback to the student	Theme 3: Teachers use varied instructional strategies.
Measuring effectiveness, using data to measure teacher efficacy, effectiveness measured by student enjoyment, effectiveness measured by student engagement, understanding data, remediation, personalization, precision	Theme 4: Teachers use data as a metric for improvement, but teachers' determinant percentage for remediation appears to vary.
Fidelity, autonomy, personal learning, establishing an environment conducive to learning	Theme 5: Teachers implement their instructional duties with fidelity, but some describe a diminishing sense of autonomy related to instructional and assessment decisions at the school level.
Surveying student opinion, student/peer evaluations, using data to understand student, motivated by student engagement, low growth attributed to attendance issues or apathy	Theme 6: Teachers use data to understand their students better; however, some teachers are concerned with whether students can translate data into meaningful practice.

Themes 1 and 2 apply to the first research question, and Themes 4 through 6 apply to the second research question. Theme 1 encompasses teachers' perception that they do not have enough time to analyze data results due to repetitious testing schedules. Theme 2 shows teachers' realization that stakeholder input enhances classroom success. Theme 3 reveals that teachers use varied instructional strategies. Theme 4 pertains to the realization that teachers use data as a metric for improvement, but teachers' determinant percentage for remediation appears to vary. Theme 5 reveals that teachers implement their instructional duties with fidelity, though some described a diminishing sense of autonomy related to instructional and assessment decisions at the school level. Theme 6 suggests that teachers are concerned with whether students can translate assessment data into meaningful practice. Table 3 displays the alignment between emergent data themes and the RQs for this study.

Table 3.Alignment of Themes to Research Questions

Theme	Research question
Theme 1: Not enough time to analyze data results due to repetitious testing schedules.	RQ1: What are middle school mathematics teachers' perceptions of assessment data usage?
Theme 2: Realization that stakeholder input enhances classroom success	
Theme 3: Use of varied instructional strategies	
Theme 4: Use of data as a metric for improvement, but determinant percentage for remediation appears to vary	RQ2: How do middle school mathematics teachers choose personalized instructional strategies based on students' assessment data?
Theme 5: Implementation of instructional duties with fidelity	
Theme 6: Use of data to better understand students	

A. Research Question 1

The first RQ addressed the participating mathematics teachers' perceptions of assessment data usage. There were two themes associated with the first RQ. Theme 1 was there was not enough time to analyze data results due to the repetitious testing schedules. Having available time was a critical factor for teachers when collaboratively planning and analyzing assessment results. Although all teachers reported that they gathered assessment data for instructional purposes, multiple teachers reported that periods between assessments were not lengthy enough to allocate time toward analysis of the data from the assessments. Participant 2 explained, "We don't discuss common assessments results because of the frequency of them." Moreover, a related pattern emerged as the teachers' responses revealed a preference towards shorter, informal assessment practices that better fit their content pacing schedules. For example, Participant 3 stated, "I believe the daily, quick, formative assessments…do not have to take a long time to be written and…[are] efficient in determining understanding." Participant 3 further emphasized, "Formative assessments can be given whenever a teacher needs to determine comprehension before moving onto another topic…but [with] summative assessments…students do not have a chance to redo." On another note, a different pattern emerged as one of the teachers discussed how time restraints may contribute to lagging student performance when trying to remediate instruction for absentee and ELL students. Specifically, Participant 8 explained, "[The] students may be two to three grade levels behind…continuously digging a hole as the year progresses and never fully mastering the previous standard… Students move on to the next grade with teachers trying to differentiate."

Overall, the participants all reported their usage of assessment to inform instruction. Teachers provided insight pertaining to how they use technology to facilitate the assessment process. However, some teachers reported that frequent testing cycles posed time restraints on assessment data analysis. Responses indicated that these time restraints contribute to gaps of knowledge among some students.

Theme 2 was the realization that stakeholder input enhances classroom success.

Teachers shared that the leaders in their schools supported them through the facilitation of professional development and content collaboration meetings. This support enabled teachers to obtain valuable input from their peers and other stakeholders. For instance, Participant 2 stated, "We like to…compare results, discuss common misconceptions, and share resources for remediation." Furthermore, the data revealed that teachers regularly met with other teachers to develop, plan, and evaluate the effectiveness of common assessments. Participant 2 further elaborated, "Well, we meet with the team weekly. Wednesdays are designated days for professional development and content planning." Likewise, Participant 5 explained, "Planning [assessments] is done in collaboration with the mathematics department and county, as well." A pattern involving collaborative stakeholder efforts was also demonstrated when Participant 7 remarked, "Well, my grade level meets every Wednesday to discuss sixth grade content." In like manner, Participant 3 spoke about the school improvement meetings, stating:

> These meetings are comprised of administration, other school leaders, and department chairs. Additionally, once a month, all content teachers meet for their department meetings where vertical planning and data analysis takes place. Department chairs lead those meetings and bring thoughts, questions, [and] ideas from those meetings to the School Improvement Team meetings on the last Wednesday of each month.

Furthermore, when we questioned Participant 3 regarding forms of student data used to inform instruction, the response was, "data…information from my team teachers, student portfolios and reflections, student surveys, et cetera." Additionally, one of the teachers shared their successes with communicating data results to parents and students as stakeholders in the education process. Specifically, Participant 5 explained assessment data usage in the classroom stating, "I use data to create a plan for personalized progress for each of my students…I share the data with my peers, parents, and the students to communicate their progress." In fact, many teachers reported that assistive technology helps them be more intentional when planning instruction. For example, Participant 5 said, "In my classroom, I love using assistive technology and programs that assist me in quickly monitoring the progress of my students…It also provides my students with a continuous diagnostic…and areas in need of support."

Moreover, a variant pattern emerged as another teacher mentioned a varied approach that involved students as active members in the evaluation process. According to Participant 4, incorporating student input in assessing and evaluating a learned skill enhances learning outcomes. Participant 4 added, "My students love test analysis days. I think they'd rather find their own errors and work at their own pace rather than me standing in front and telling them what to write." By the same token, it was further revealed that some teachers used student survey input to guide instructional decisions. Participant 3 offered, "I also conduct student surveys to gauge how my students felt about a particular assignment or project." Overall, the participants shared information about how they are making efforts to collaborate with stakeholders at the school level. Reports indicate that teachers are using technology to communicate assessment data to student and parent stakeholders. However, only some teachers reported actively involving their students in the evaluation and instructional planning processes.

B. Research Question 2

The second research question addressed how mathematics teachers choose personalized instructional strategies based on students' assessment data. Four themes addressed this research question.

Theme 3 was the use of varied instructional strategies. All teachers reported using formal and informal instructional and assessment practices to develop student profiles. For instance, Participant 6 explained, "Because all students do not learn or master content in the same manner, so it is important that I utilize various strategies to reach all of my students." The same pattern was demonstrated in the remarks of Participant 5: "Students are moving away from long lectures and note taking and instead are participating in more engaging learning activities, performance tasks, [and] projects... They also take county benchmarks, short quizzes, participate in discussions, writing prompts, and compete in educational gaming." When asked whether these varied strategies have proven to be effective, Participant 3 asserted:

> Yes, I do. When you use best practices in your classroom combined with analyzing data and a caring attitude towards your students, great things happen in the classroom. Not all students learn the same way, so it is important to offer students many ways to learn and show what they know.

Some of the most-mentioned instructional strategies were backwards planning, project-based learning, student reflection via peer review, incorporating writing prompts with an emphasis on content-based vocabulary, and creating assignments that include technological and real-world applications. Furthermore, both Participant 3 and Participant 5 shared similar opinions on the topics of emphasizing content-based vocabulary and writing prompts in mathematics. Specifically, Participant 3 found, "When checking for comprehension of a concept, I find that requiring students to explain their learning, usually through constructed response questions or some type of writing within a real-world situation, determines whether they [students] truly understand the concept." Similarly, Participant 5 emphasized that, "teachers should follow a Common Core-based, student-focused...classroom where students are exposed to differentiated instructions along with incorporating writing across the curriculum."

A new pattern was revealed as a portion of teachers also shared that they are differentiating instruction based on student interest, while most reported that they differentiate instruction according to student ability or current research trends. For example, Participant 8 explained, "It depends on my audience. I have to decide what works or does not work because all classes and students are different. You just have to feel out how your classes respond on your delivery of instructional material." Likewise, Participant 3 stated the following:

> Many factors determine which instructional strategies to employ. Such as, the capabilities of the students within a class, the learning styles of the students, how much time we have, student surveys, what has worked well with a particular group of students...student needs, et cetera.

Along the lines of the same pattern, Participant 4 discussed, "I base it [differentiation] off the class, their learning levels, and types. I also consider the time that we have in class and the end goal that I'm trying to accomplish." In contrast, Participant 2 differentiated mostly based on current research trends. The respondent noted, "I like to use instructional strategies that research has shown to be highly effective...for students." Participant 2 further elaborated on instructional and assessment practices, "I research...to assist with instructional and assessment practices at the school. As for myself, I am a data fanatic."

Ultimately, the teachers provided insight into how they vary instructional strategies and provided justification based on varied perspectives. Reports revealed that teachers are differentiating instruction. Some teachers differentiate solely according to test results and research trends, and others reported using student interest level in an activity to guide their instructional decisions.

Theme 4 was the use of data to support personalized instruction. The results indicated that teachers are efficacious in collecting data as a determining factor for remediation. Participant 1 commented, "The program we use...provides easy to understand data records for teachers to support students in struggling content areas." Similarly, Participant 3 shared:

Assessment data was a very important part of my teaching. After every assessment, I would look for the questions that the majority of my students answered incorrectly…For those answered incorrectly by the majority, I would use those same questions in opening starters for the day. I would also make notes in my unit plans…for new ways to teach the topic and new strategies.

In fact, many teachers reported using student performance data to measure their effectiveness of instructional delivery. For instance, when asked about assessment data usage in the classroom, Participant 1 stated:

Well, A: Check for understandings. For example, during class lessons to see if I need to review material or change the way I am teaching it. B: Exit tickets, like, done daily to determine if students understood the lesson objective. This will also inform me of who I need to group together for small group instruction…D: Summative assessments, which typically are done like small group instruction, are for review or spiraling throughout future lesson.

Likewise, Participant 5 said, "I use data to create a plan for personalized progress for each of my students. I also use the data to plan for future lessons and tutorials…I also use the data to evaluate my effectiveness as an educator." Furthermore, a few teachers shared that they measure their effectiveness based on student engagement and the extent to which students enjoyed the lesson. For instance, Participant 5 elaborated on the employment of instructional strategies, "I decide which strategies to use based on the level of student engagement and pre assessment results." Likewise, Participant 7 in a similar pattern commented, "I consider the lesson to be effective if majority of the class is answering the questions accurately and each student is involved."

However, each teacher's response varied when asked to provide a scale for determining what percentage of students would need to fail a task before implementing remediation. These are the responses per participant. Participant 1 reported, "At my school, we use the 70% as a cut off as it aligns to standard based grading. So, any students who falls below that 70% would be a candidate for an intervention for that skill." Participant 2 reasoned:

I would say, if about 50% or more aren't getting it, then it would require reteaching or a different strategy. Anything less than that, it could be just a common misconception that's easier to clear up with reviewing a problem or two as a class for an opening.

Likewise, Participant 8 also found, "If I get more than, say, 50% not doing well, that is when I still reteach the whole class." Moreover, a different pattern emerged as other teachers proposed lower determinant percentages for remediation, as illustrated in the responses from Participant 3, Participant 5, and Participant 6. Specifically, Participant 3 considered, "I figure if about 40% or more of the students miss a question—definitely time to regroup." Along the same lines, Participant 5 asserted, "If more than 30% fail, we do a quick review, and I invite students to tutorial. If under 30%, I reveal solutions and invite students to tutorials." The narrowest of determinant percentages for remediation was observed in the comments of Participant 6, who shared, "After testing, I will remediate students individually if less than 90% have mastered the concepts."

Thus, all teachers reported using student assessment data to assist with the provision of personalized instruction. Moreover, all teachers are remediating instruction for struggling students. Equally important, all teachers use a district-approved grading scale. There was not a consistent determinant percentage for implementing remediation.

Theme 5 was implementation of instructional duties with fidelity. When we asked teachers about their level of involvement in evaluating instructional and assessment practices at their schools, their responses varied. For example, Participant 7 commented, "I have little involvement." Similarly,

Participant 2 answered, "I have some involvement…but not at the school level. At the school level, we rarely evaluate instructional and assessment practices." Teachers serving as department chairs or school improvement committee members reported higher levels of involvement related to instructional and assessment decisions. For instance, Participant 3 explained, "I have quite a bit of involvement in the evaluation of instructional and assessment practices at our school. I am writer of the CSIP [continuous school improvement plan] …We discuss assessment data…implementation of strategies, et cetera." Most teachers shared that they follow a rigorous assessment schedule that includes both state-mandated assessments and daily teacher-authored assessments.

We also inquired into the frequency of assessments so as to confirm the extent of rigor posed by the assessment schedules and fidelity of implementation. For example, Participant 2 shared, "Students complete individual assessments, like the Quizizz [assessment platform], every other week…They have a quiz maybe one to two times per unit, and a summative test one per unit—which is, like, every 4 to 6 weeks." Participant 2 further elaborated on how the use of daily learning targets helped to determine instructional activity effectiveness leading up to the summative assessments. Specifically, the respondent added, "I do not think students have to meet the learning target within 1 day, but they know they have met a learning target based upon their scores for the assessment—formative or summative." Likewise, Participant 4 pointed out, "The learning target and success criteria helps both students and I stay on track with what they should be mastering…The success criteria [data] will oftentimes lead me to the formative assessments for that day." The remarks of Participant 1 also followed the same pattern pertaining to assessing students daily. The respondent explained, "Well…exit tickets, like, done daily to determine if students understood the learning objectives. This will also inform me of who I need to group together for small group instruction."

Although teachers reported what could be perceived as a rigorous testing schedule, teachers also recognized that consistent assessment data collection and data analysis facilitated the precision of their instruction. Specifically, Participant 6 mentioned, "I think that data is an essential part of teaching and learning so collecting and analyzing is essential reteaching, enrichment, and differentiation of content and delivery." Similarly, Participant 3 pointed out, "When you use best practices in your classroom combined with analyzing [assessment] data and a caring attitude towards your students, great things happen in the classroom."

A discrepant case was established when a teacher asserted that mandated standardized test content and testing schedule contributed to the disenfranchisement of English language learners. This teacher also shared that more could be gauged from students when they engage in shorter, teacher-authored assessments. More specifically, Participant 8 commented, "In all honesty, my daily informal observations and daily assignments give me a better idea if they are learning the material." Furthermore, the respondent expressed that mandated assessments do not culturally align with the student body compared to teacher-authored assessments. Participant 8 further explained, "I think the leveling of how the assessments are created do affect mastery from my [English language learner] students…So, basically the student is continuously digging a bigger hole…and never fully mastering the previous standards."

Ultimately, teachers reported varying opinions regarding their level of input and autonomy regarding assessment practices. Some teachers shared that they could better serve their students if they had more control over assessment practices. Only those teachers in leadership positions shared that they have a role in the decision-making process for assessment practices at the school level.

Theme 6 was the use of data to better understand students. Many teachers revealed that they involve their students in the assessment process by allowing students to evaluate their peers. For instance, Participant 3 said, "[I] analyze data to see strengths and weaknesses to drive instruction…and we also use

peer sharing, peer evaluation…for diagnostics and practice." Along the same lines, Participant 7 explained how assessment data are assistive when grouping students. The respondent elaborated:

> I know some students need extra help, so I place them with a student who would be able and willing to assist them in the activity…One student should be slightly higher, but not too much. I also place students together as partners if they might need language assistance, and they speak the same home language.

Furthermore, a few teachers reported that they conducted surveys of their students' opinions regarding classroom instructional and assessment practices yielding positive results. Particularly, when asked about using forms of data to develop student profiles, Participant 5 pointed out, "I also use…results from their [students'] continuous diagnostic, learning style surveys, student surveys…et cetera." The respondent further explained:

> Yes, customizing, individualizing instruction to fit the needs of the students has proven to be effective. I can say this based on the evidence of student growth…I have my students work on their customized learning plans at least twice weekly.

A different category emerged when some teachers shared that their students were indifferent to knowing their assessment results. Participant 5 stated, "For example, while I teach many low performing students…of the low growth population, many [were] students with attendance issues or who refuse to participate." Similarly, Participant 2 discussed making students members of the evaluative process. The respondent explained, "I also use assessment data as talking points with students for them to see their individual growth and their growth as a class." However, when I asked the respondent to discuss how students responded to being a part of their own performance evaluation process, the respondent laughed and remarked, "Well, the responses vary because some students enjoy knowing their data and seeing what they need to work on—I can tell by their follow-up questions. Other students act like they don't care and just take in the information." In efforts to combat student apathy towards assessment data, one teacher shared a success story involving merging students into the evaluative process by providing them with point-based incentives for participation. Specifically, Participant 4 stated, "After classroom assessments, my students complete a test analysis…I give them half credit back for each question that they correct." The respondent further explained:

> I do believe that they [strategies] are effective because I believe in students learning not only from their mistakes but also from independently correcting them. I believe that it has a positive impact on their learning and gives them more motivation to find their errors.

Overall, some teachers had success with students translating assessment data into meaningful practice. It was reported that incentives, such as extra course credits, boost student participation in evaluating assessment data. Some teachers in the study noticed apathy among students pertaining to evaluating assessment data for growth purposes.

Conclusions

This qualitative study focused on middle school mathematics teachers' perceptions of assessment data usage. The study aimed to explore how teachers use assessment data to inform instruction and improve student learning. The results showed that teachers perceive a lack of time to analyze assessment data due to repetitious testing schedules, which can lead to gaps in knowledge among some students. However, teachers realize that stakeholder input enhances classroom success, and they use varied instructional strategies to engage students. Teachers use data as a metric for improvement, but their determinant percentage for remediation appears to vary. Additionally, teachers implement their

instructional duties with fidelity, but some describe a diminishing sense of autonomy related to instructional and assessment decisions at the school level. Finally, teachers are using data to better understand their students; however, some teachers are concerned with whether students can translate data into meaningful practice. The study provides insights into how assessment data is used in middle school mathematics classrooms and highlights the challenges teachers face in interpreting and using the data.

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