TEACHERS' KNOWLEDGE AND IMPLEMENTATION OF RESPONSE TO

INTERVENTION PRACTICES: GRAPH LITERACY AND DATA-BASED

DECISION MAKING

by

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This work is dedicated to my daughter, Audrey. Never give up on your dreams.

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ABSTRACT

Response to Intervention (RTI) is a general education initiative intended to identify struggling readers and provide them with early, targeted intervention. The RTI model—which emphasized research-based instruction presented with fidelity along with the use of informed student data—was adopted by many school districts not only to provide intervention for struggling students but also as a proactive method for identifying students for special education services.

The model held great promise, but RTI in practice has not necessarily been as successful at remediating struggling readers as was anticipated. While quality instruction is important for the success of RTI, some researchers contend the use of student data to make informed intervention decisions is *the* most important element in the model's (and students') success.

Teachers and instructional coaches are often tasked with reading, interpreting, and making educational decisions based on student data, which are typically presented in the form of graphs. However, many educators indicate they do not have sufficient training in interpreting student data nor do they know how to use such data to inform instruction.

This study surveyed 451 elementary teachers regarding their perceptions of the quality and availability of professional development opportunities related to RTI Tier 2 and Tier 3 reading intervention instruction and measured their ability to interpret student data presented graphically. Findings indicate the more teachers agreed with the statements they have high quality and available PD the poorer they were at reading student graphs and interpreting educational placement. Results suggest more intensive

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and sustained methods of interpreting and using graphical data to make data-based decisions might be incorporated in professional development (e.g., a task to measure knowledge). Such methods may help to ensure those who are responsible for making educational placement and/or reading intervention decisions have the skills to correctly interpret student data so that students receive the instruction needed to improve their reading proficiency.

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LIST OF ABBREVIATIONS

CBM: Curriculum-based Measure

DBDM: Data-based Decision Making

IDEA: Individuals with Disabilities Education Act (2004)

MTSS: Multi-tier System of Supports

NAEP: National Assessment of Educational Progress

NCES: National Center for Education Statistics

NCLB: No Child Left Behind Act (2004)

OECD: Organisation for Economic Co-operation and Development

PD: Professional Development

PM: Progress Monitoring

PISA: Programme for International Student Assessment

RTI: Response to Intervention

CHAPTER I

INTRODUCTION

Background of Reading Proficiency

The ability to read and comprehend proficiently has ramifications that reach far beyond the classroom. Students who are not proficient readers by the end of third grade are more likely to exhibit emotional and social problems in later grades, drop out of high school, and earn less over the course of their lifetimes (Annie E. Casey Foundation, 2013). While many school and national programs exist to encourage children to read (e.g., Read to Succeed, Read Across America), on international measures of reading proficiency, students in the United States continue to perform in the low to average range (OECD, 2015). The Programme for International Student Assessment (PISA) test, for instance, administers tests of reading, math, and science proficiency of 15-year-old students around the world; U.S. adolescents' scores in reading have remained within the same average range for the past 17 years (OECD, 2015).

Similarly, tests of reading progress within the U.S. also indicate students' reading scores have remained stagnant for nearly 40 years. The National Assessment of Educational Progress (NAEP), also known as the Nation's Report Card, indicated that from 1992-2015, 4th- and 8th-grade students' average reading scores have remained below proficient (National Center for Education Statistics [NCES], 2018).

One of the criteria for reading proficiency on the NAEP is that students are able to determine relevant information in a passage and be able to adequately summarize main ideas. However, results from the 2015 assessment indicate that only 36% of 4th-grade students were at or above proficient. This means that a majority, 64%, of these students

was not proficient in this foundational comprehension skill. Similarly, 2015 results indicated that only 34% of 8th-grade students were at or above proficient in reading. Results from the 2017 assessment indicate scores for 4th-grade students remained the same while scores for 8th-grade students improved by a single point (NCES, 2016; 2018).

While students' scores overall continue to remain fairly unchanged over the recent years, lower-achieving students are actually performing more poorly over the same time period. Specifically, 4th-grade students scoring in the 10th and/or 25th percentiles in reading had statistically significantly lower scores ($p < .05$) in 2017 than in 2015 (NCES, 2018). The gap between struggling readers and typical readers appears to be widening.

Such lackluster reading scores are not only disheartening, but they also have an impact on the overall impression on public education. According to a 2017 Gallup survey, confidence in public schools hovered around 36%. While this was an improvement over the dismal 26% confidence rating in 2014, it was still apparent that 64% of respondents were not confident in the existing education system (Calderon, Newport, & Dvorak, 2017). Similarly, satisfaction with the quality of public education was at 47% in 2017; although this was an increase over the previous year, it still indicated a majority of respondents were not satisfied with the quality of public education.

Lack of reading proficiency is not limited to U.S. schools of course. For example, lower than expected reading scores on international tests such as PISA resulted in the Dutch government implementing a data-based policy such that teachers would use data to inform instruction in an effort to improve reading scores (Staman, Timmermans, & Visscher, 2017); similarly, education guidelines in many parts of Western Europe have

been updated to emphasize the use of student data to inform instruction in order to improve reading outcomes (MacLellan, 2004).

Response to Intervention (RTI)

Improving reading outcomes has been a national concern for decades. To address struggling readers' progress, the reauthorization of the Individuals with Disabilities Education Act (IDEA) in 2004 allowed RTI as an alternative to the discrepancy model (sometimes referred to as the "wait to fail" model) for identifying students with learning disabilities with the stipulation that information be based on documented student data (Balu et al., 2015; Stecker et al., 2008). RTI, with its emphasis on test-teach-test, ensures that student progress within an intervention is quantitatively measured and documented (Fuchs & Fuchs, 2017).

Although there is not a singular prescribed format for implementing RTI, there is a general structure that is considered best practices (Harvey, Yssel, & Jones, 2015). The multi-tiered system that defines RTI begins with all students taking a universal screener. With universal screening and proactive instructional interventions, the RTI model emphasized early identification of students who evidenced academic difficulties. These students were to be provided with targeted, evidence-based interventions; likewise, interventionists were to document students' receptiveness to the interventions through frequent progress monitoring (PM) and data collection (Stecker et al., 2008; Vujnovic, Fabiano, Morris, Norman, Hallmark, & Hartley, 2014). If students failed to respond to the first tier of instruction, they were to be moved to a more intensive tier to improve educational outcomes.

Once students are placed in a more intensive tier, they continue to take progress monitoring assessments to determine their responsiveness to the more specific instruction. Should the data indicate the student is not benefitting from Tier 2 and needs more intensive instruction (generally three to six data points), the student is then moved to Tier 3. This tier typically represents individualized, intensive instruction in order to best address the student's specific academic needs (Fuchs & Fuchs, 2017). Throughout this process, it is the progress-monitoring data that determine a student's responsiveness and subsequent academic placement. The emphasis on student data to inform instruction and guide placement remains at the heart of the RTI process and is a major component of its success.

Appropriately implemented RTI, with its emphasis on screening, PM, and research-based instruction, provides an effective method for identifying struggling learners by applying early, appropriate, and targeted interventions (Beach & O'Connor, 2015; Bradley, Daley, Levin, O'Reilly, Parsad, Robertson, & Werner, 2011; Regan, Berkeley, Hughes, & Brady, 2015). However, a study by the Institute of Educational Sciences (IES) did not bode well for the efficacy of RTI practices. The researchers determined that first-grade students in need of interventions actually performed more poorly than their peers (Balu et al., 2015). A critique of the IES study argued that the successful application of RTI—early, appropriate intervention—and its intended outcomes is only as effective as the quality and accuracy with which it is implemented (Fuchs & Fuchs, 2017).

Progress Monitoring and Curriculum-based Measures

The introduction of RTI as a general education initiative—with its emphasis on using student PM data to determine intervention effectiveness—required that educators alter the focus of how they gathered student information. Rather than relying on their observations and other subjective data to make decisions about a student's performance, teachers were encouraged to include objective student data to make educational decisions. In fact, the passage of No Child Left Behind (NCLB) in 2001 indicated schools would be held accountable for students' academic proficiency based on such data (U.S. Department of Education, 2010). With the culture of accountability at the forefront in education, effective use of student data in order to make informed educational decisions is of greater importance in American schools than ever before (Deno, 2003; Gotch & French, 2013; Mandinach, 2012; Mandinach & Gummer, 2016; U.S. Department of Education, 2011; Wayman & Jimerson, 2014).

Prior to the introduction of curriculum-based measures (CBMs), typically the only student achievement data available for teachers were annual assessments (Deno, 1985). The very nature of the infrequency of these annual assessments meant they were not useful for making timely educational decisions (Gibbons & Casey, 2012). Although initially designed to ensure special education teachers had frequent data from which to make instructional decisions, CBMs grew in popularity as a method used to monitor students in general education (Jenkins & Fuchs, 2016). In addition, as software became more readily available to schools, CBM results were available in graph formats and presented a simple and clear visual of student performance (Deno, 1985). At a time when

many teachers preferred to rely on observation as data, CBMs were intended to provide frequent reliable and valid data designed to be sensitive to student improvement.

The purpose of CBMs, of course, was not simply to collect student data. The explicit goal of such measures was to allow teachers to determine the effectiveness of their instruction and to change methodology if students were not showing improvement (Jenkins & Fuchs, 2016). Thus, those reading the data were responsible for making critical educational decisions (Deno, 2016). As implementation of RTI practices increased nationally, along with the emphasis on early academic intervention, general education teachers became increasingly responsible for reading and interpreting student data (Mandinach, 2012). In a recent study, however, some teachers indicated they generally consult data only one to two times per year (Schildkamp, Poortman, Luyten, & Ebbeler, 2017). Such infrequent use of student data speaks to the climate of accountability rather than the use of student information for instructional purposes. In order for student data to meaningfully impact instruction, especially for struggling students, data should be gathered and consulted on a regular—i.e., at least monthly— basis in order to target a student's academic needs (Gibbons & Casey, 2012). Consulting student data one to two times per year does not allow for iterative changes in instruction.

Despite the emphasis on data collection and analysis in RTI (and for special education referral), research is sparse concerning U.S. teachers' ability to accurately interpret student data, determine student placement, and decide if interventions are effective, particularly for students with potential learning difficulties (Espin et al., 2017; Gelderblom et al., 2016; Preston et al., 2016; Schifter, Natarajan, Ketelhut, &

Kirchgessner, 2014; Staman et al., 2017; Vujnovic et al., 2014; Wixson & Valencia,

2011).

Barriers to Data Use

While some fields such as medicine, engineering, and business have relied on data

to inform their practices, education has been much more reluctant to embrace a

quantitative approach (Bineham, Shelby, Pazey, & Yates, 2014; Mandinach & Gummer,

2013). Although the use of data for instructional purposes has historically been a part of

the education process, the primary source of such information has typically been

qualitative in the form of teacher observations of student performance (Deno, 1985).

Although student observation can be an important factor in the overall collection of

student data, observations regarding students' academic performances are often

inaccurate.

For instance, an early survey by Fuchs, Fuchs, and Warren (1982) found teachers

preferred observation as their primary source of student data and 93% of teacher

respondents indicated they were "sure" or "very sure" they could rely on observation

alone to determine student proficiency. However, results indicated the teachers judged

their students as higher achieving and more proficient than the students actually

evidenced. Conversely, a meta-analysis by Südkamp, Kaiser, and Möller (2012) found an

average correlation of .53 between teachers' judgments of students' ability with students'

actual testing performance. Nevertheless, Südkamp et al. (2012) determined that, while

teacher observation is a necessary component in making educational decisions,

observation as a method of determining student achievement was often inaccurate and

unreliable. The researchers found teachers' judgments were more accurate when they were informed by student data rather than observation alone.

Educators may also be hesitant to use student data to inform instruction because they may find it difficult to be critical reviewers of their own teaching practices (van den Bosch, Espin, Chung, & Saab, 2017). Research indicates some teachers have a negative outlook towards data use; they do not believe data present an accurate picture of a student's ability and, therefore, do not wish to believe the data (Espin et al., 2017; Poortman & Schildkamp, 2016; Prenger & Schildkamp, 2018).

Another and more troublesome factor regarding some educators' reluctance to use data is that teachers often do not believe in the value of quantitative information (Espin et al., 2017). Part of that reluctance to use data may stem from lack of emphasis in pre-service teacher programs, an over reliance on observation, or lack of understanding and knowledge regarding how to use data to make academic decisions. However, research indicates that when teachers receive instruction on how to analyze and interpret student data, accept the significance of their role in the process, and have a clear purpose for using data, they are more likely to have a positive outlook towards data use (Castillo et al., 2016a; Wagner, Hammerschmidt-Snidarich, Espin, Seifert, & McMaster, 2017).

Yet another barrier to data collection and use is the view that progress monitoring is too time consuming, particularly given the numerous other requirements that teachers must meet (e.g., set minutes per week of content instruction, state standardized testing, classroom assessments) (Hoogland, Schildkamp, van der Kleij, Heitink, Kippers, Veldkamp, & Dijkstra, 2016; Schildkamp et al., 2017; Stecker, Fuchs, & Fuchs, 2005). However, survey data from one study found that progress monitoring took an estimated

10% of teachers' time per week (Deno, 2003). If data are used with purpose, and teachers have the training to use the data effectively, it need not be a hindrance (Gelderblom et al., 2016).

Although research has demonstrated the link between purposeful data use and student improvement, some educators remain reluctant or unsure of their abilities to use PM data as a method to guide instruction (Dunn, Airola, Lo, & Garrison, 2013; Hall, 2013; Jimerson & Wayman, 2015; Schwartz et al., 2009). Studies of teachers' ability to analyze student data and make educational decisions from that data found that, despite the availability of an abundance of progress-monitoring information, educators often did not know *what* to change about their instruction in order to improve students' learning (Espin et al., 2017; Stecker et al., 2005). In one study by Gelderblom et al. (2016), teachers claimed to use data for instructional purposes; however, the researchers found little discernable differences in the teachers' instructional methods used before and after assessment data were gathered.

Despite the hesitancy of some to incorporate data into instructional practices, there is ample evidence that the proper use of data to inform instruction has a direct benefit on student improvement (Dunn et al., 2013; Gelderblom et al., 2016; Schildkamp et al., 2017; Staman et al., 2017; Stecker et al., 2005; van den Bosch et al., 2017). For example, Stecker et al. (2005) reported a difference in student outcomes when teachers were explicitly trained in data use practices (such as frequent PM, interpreting trend lines, and making adjustments to their instruction) as compared to students' outcomes when teachers were not directly trained in data use. Students in the trained teachers' group evidenced an average of 13 more correct words read per minute versus the untrained

teachers' group who evidenced only three more correct words read per minute following a weekly assessment on oral reading fluency. While not all data-based training will yield such results, the use of data to make informed educational decisions may be beneficial for struggling readers.

Not only is data use considered best practices, it is ubiquitous in education reform. Mandates including No Child Left Behind (NCLB) in 2001, the reauthorization of IDEA (2004), the American Recovery and Reinvestment Act (2009), and the Race to the Top initiative (2009) specifically indicate the purposeful use and analysis of student data to make informed educational decisions (Mandinach, 2012; Mandinach & Gummer, 2016; Schifter et al., 2014). Educators who are knowledgeable at analyzing student data can help ensure students receive the appropriate interventions as well as determine the efficacy of overall classroom instruction.

Teachers' Accuracy in Data Use

Many teachers understand the importance of correctly interpreting student data and want to do what is best for each student. Often, however, a lack of adequate training, along with the pressure surrounding high-stakes decision making, can result in misunderstanding of student data or misinterpretation regarding student placement. For instance, in Vujnovic et al.'s (2014) study that examined the levels of RTI knowledge among school psychologists, special education teachers, and general education teachers, school psychologists reported having the greatest knowledge of RTI practices and appropriate data-based decision making skills followed by the special education and general education teachers. For example, when asked what percentage of students should be provided Tier 1 instruction, school psychologists answered with 100% accuracy that

Tier 1 is intended for nearly all students. However, only 78.7% of general education teachers answered that question correctly. Providing effective Tier 1 instruction in the general education classroom is the first line of prevention in the RTI model; the fact that nearly a quarter of general educator respondents did not correctly answer this question is rather troubling.

When asked to interpret samples of student data and make decisions on academic placement (e.g., effectiveness of an intervention or placement within an RTI tier), less than half of all respondents in all categories accurately placed students in the appropriate level of intervention support based on student data (Vujnovic et al., 2014). Only 19.8% of general education teachers were able to accurately determine that a student was adequately responding to a Tier 2 intervention while 43% were able to determine a student was not responding to a Tier 2 intervention (Vujnovic et al., 2014). All respondents—school psychologists, general education teachers, and special education teachers—were the most successful at determining student placement for those who scored either very well (i.e., met or exceeded the benchmark cutpoint) or very poorly. It was much more difficult for them to determine the efficacy of Tier 2 interventions and the resulting placements (e.g., back to Tier 1 or move to Tier 3).

Both Vujnovic et al. (2014) and Espin et al. (2017) noted respondents in their surveys were more successful at identifying either the high-achieving or very-low achieving students; respondents were less successful at determining students' responsiveness in Tier 2 interventions, often indicated by slope of progression. However, these students who do not show substantial improvement and whose data may evidence considerable fluctuation are the very students who require accuracy and precision in RTI

placement (Newell & Christ, 2017). RTI is not simply providing interventions; it is an iterative process that involves testing, teaching, and testing to determine a student's responsiveness to that instruction (Fuchs & Fuchs, 2017). As previously noted, interpreting assessment results and making informed decisions is a fundamental component necessary for RTI's success.

The accurate use of student data to inform instruction and gauge receptivity to intervention can have life-long educational consequences for students (Gotch & French, 2013; Paleczek, Seifert, & Gasteiger-Klicpera, 2017; U.S. Department of Education, 2011; Wayman & Jimerson, 2014). Students who do not receive the intervention they need as a result of misinterpreted data may needlessly continue to struggle academically and miss out on the help necessary to succeed (Albritton & Truscott, 2014). Similarly, students may continue in an intervention that does not meet their academic needs, setting them on a course for unnecessary special education services.

Teachers' Training in Data Use

Possibly the greatest barrier to teachers' use of data stems from a lack of adequate training. Professional development focused on RTI practices not only has the potential to assuage teachers' concerns over data interpretation and buoy attitudes towards data in general, but targeted professional development can also potentially improve student outcomes (Castillo, March, Tan, Stockslager, & Brundage, 2016; LearningForward, 2017). Some in-service teachers indicate a reluctance to use data precisely because they understand its importance and are fearful of making incorrect educational decisions by misinterpreting the data (Jimerson & Wayman, 2015). Teachers continually indicate a

desire for effective professional development, yet high quality professional learning is often lacking (LearningForward, 2017).

Likewise, in-service teachers report a lack of targeted professional development (PD) in general data literacy can impact how—or if—they use data in the classroom. A report on teachers' use of student data, conducted by the U.S. Department of Education in 2011, found that teachers' lack of training in effective data use often leads to a lack of confidence in their ability to use data; this often results in a reluctance to use data in general (Means, Padilla, & Gallagher, 2010). Some of the teachers in this nationwide study indicated their pre-service education programs did not address this topic sufficiently, if at all, and that targeted PD was needed to help them understand how to use data to make instructional changes.

In their study of professional learning opportunities focused on student data, Jimerson and Wayman (2015) found that one of the six main areas teachers indicated as needing more attention included data literacy and interpretation of student data. In addition, these teachers also noted they needed more specific professional training in using student data to inform daily instruction. This echoes findings by Stecker et al. (2005) who determined that teachers were often open to the idea of using data to change their instruction, but they often did not know exactly *how* or *what* to change.

Additionally, many pre-service education programs do not include or emphasize the use of data-based decision making in their curriculum (Bineham et al., 2014; Mandinach, Friedman, & Gummer, 2015; Reeves, 2017a; Wagner et al., 2017**)**. One study found that 82% of responding pre-service teachers indicated they had neither a course in RTI/data literacy in their education program nor did they have access to such

information through professional development (Reeves, 2017a). Thus, new general

education teachers are simply not trained to adequately decipher and make educational

decisions based on PM data (Espin et al., 2017; MacLellan, 2004). Although the Council

for the Accreditation of Educator Preparation (formerly the National Council for

Accreditation of Teacher Education) includes proficiency at using student data to make

informed instructional decisions as one of its standards, to date there is no evaluative

criteria to ensure educators possess adequate graph literacy (Wagner et al., 2017). It

appears that many new teachers are entering their classrooms underprepared. If

educational programs are not adequately teaching pre-service educators how to use data

and its importance in guiding instruction, there is little wonder many educators question

their ability to correctly interpret data.

      Similarly, a national survey of teachers found that two-thirds of the more than 600

respondents indicated they had not received PD in RTI practices (Bineham et al., 2014).

As a result of a lack of targeted instruction, many pre-service and in-service teachers

indicated they have had inadequate instruction and are unprepared to decipher student

data (Barrio & Combes, 2015; Dunn et al., 2013; Mertler, 2009; van Geel, Keuning,

Visscher, & Fox, 2017).

      A lack of appropriate training in analyzing and interpreting student data may

result in educators not using this source of information to its fullest extent or,

unfortunately, using it primarily for accountability purposes (Chick & Pierce, 2012;

Gotch & French, 2013; Schildkamp et al., 2017; Zeuch et al., 2017). Inexperience with

data and the resulting high stakes decisions may prohibit some teachers from using data

at all while others do not feel confident in their ability to use data to inform instruction

(Dunn et al., 2013; Hall, 2013; Mertler, 2009). The consequences of such inaction can result in students languishing in unhelpful interventions and not getting the specific help they need (Fuchs & Fuchs, 2017).

Survey Rationale

Teachers' knowledge of educational practices is often measured through self reports (e.g., surveys and questionnaires). Such measures allow for large numbers of respondents to provide an overview of their perceptions, knowledge, and implementation of RTI practices (Castillo, March, Stockslager, & Hines, 2016). Because RTI is implemented in a majority of states and school districts, the purpose of this study is to survey a nationwide sample of 451 teachers and query them on their perception of professional development in regards to the availability and quality of PD in intervention instruction. In addition, respondents were asked to read, interpret, and make educational decisions from student data in order to quantify their graph literacy skills.

Level of intervention training was examined as well. Response to Intervention is a tiered system that relies on student data to determine responsiveness to instruction and movement among tiers. Tier 2 intervention is often more closely aligned with Tier 1 in that it is focused on ensuring students are competent at grade-level core instruction (Vaughn, Wanzek, Woodruff, & Linan-Thompson, 2007). Tier 3 interventions, however, are intended to provide more intensive instruction than Tier 2 (Mellard, McKnight, & Jordan, 2010). Because instructional intensity varies between Tier 2 and Tier 3, teachers' perceptions of the availability and quality of both are examined in relation to their graph literacy skills.

The purpose of this study is to examine elementary teachers' level of graph literacy and their ability to make appropriate educational placement decisions from that data, especially when considering self reports of the amounts and quality of PD they receive. While data used to inform instruction can be based on both qualitative and quantitative practices (e.g., observations, attendance, language background), this study aims to examine educators' intervention placement decisions for students based on quantitative graph tasks (Bernhardt, 2003; Mandinach & Gummer, 2016). The data in each graph represent students' PM results in intervention classes. If teachers' perceived and practical knowledge do not align, it may be necessary for districts to become more strategic in their PD options and provide teachers with the targeted, systematic instruction they need to confidently and successfully use student data.

Graph literacy is an emerging area of research intended to determine teachers' ability to make informed educational decisions from student data. Schildkamp et al. (2017), van den Bosch et al. (2017), and Vujnovic et al. (2014) used surveys or questionnaires to gather teachers' perception of their abilities to read data; Espin et al. (2017) and van den Bosch et al. (2017) also conducted think-alouds and asked respondents to interpret student graphs and explain subsequent decisions they would make based on that data. The results of these studies found that, in general, educators could benefit from targeted instruction related to data interpretation, both for competency and confidence (Dunn et al., 2013; MacLellan, 2004; van den Bosch et al., 2017; Zeuch et al., 2017).

Statement of Problem and Purpose of Study

Response to Intervention (RTI)—also known as Response to Intervention and Instruction (RTI[2]) or Multi-tier System of Supports (MTSS)—began as a general education initiative implemented to support students who struggle academically and/or behaviorally; additionally, RTI evolved to serve as a way of identifying students for special education services (Fuchs & Fuchs, 2006; Preston, Wood, & Stecker, 2016). The emphasis on early intervention was meant to provide students who evidenced below grade-level reading and/or math skills with early, research-based interventions to keep these students from falling further behind academically (Balu, Zhu, Doolittle, Schiller, Jenkins, & Gersten, 2015; Hudson & McKenzie, 2015; Wixson & Valencia, 2011). However, debate continues as to the effectiveness of RTI as currently practiced (Balu et al., 2015; Fuchs & Deshler, 2010). It has been noted that, while many school districts have adopted RTI, reading scores for struggling students continue to remain lackluster.

Students who struggle with reading may continue to fail to make or maintain adequate gains even with added academic supports (Fuchs & Fuchs, 2017). Research has indicated it may not be the RTI process, per se, that is ineffective; instead, it appears a lack of fidelity to RTI procedures and insufficient understanding and use of student data may explain why RTI is not always as successful as it was anticipated to be (Benner, Nelson, Stage, & Ralston, 2011; Castillo, March, Tan, Stockslager, & Brundage, 2016; Schwartz, Blue, McDonald, & Pace, 2009; U.S. Department of Education, 2011).

A key component of the RTI model includes the purposeful use of data to determine intervention placement and student responsiveness to intervention. RTI encompasses a variety of models and iterations of those models. Unfortunately, this can

lead to confusion or lack of consistency among practitioners, which ultimately may impact students' reading success. As Tilly (2003) has pointed out, universal components of any problem-solving model should include a definition of the problem, a plan to solve the problem, implementation of the plan, and evaluation of the plan's effectiveness. In order to define the problem (e.g., reading below grade level), student assessments and data collection are the initial steps. Implementing the plan (i.e., interventions) and evaluating the plan (i.e., progress monitoring) are key to determining a student's responsiveness to an intervention and making adjustments as necessary. Thus, teacher knowledge of data is critical to adapting instruction to best meet students' academic needs in a timely manner.

While quality instruction is essential for the model to be effective, some experts contend students' data should be the primary factor that determines instruction (Stecker, Fuchs, & Fuchs, 2008). In fact, several argue that progress monitoring (PM) and data analysis are *the* most important components in order for RTI to be successful (Ball & Christ, 2012; Stecker et al., 2008; Wixson & Valencia, 2011). Although studies have emphasized the necessity of using research-based intervention programs as well as fidelity of implementation (e.g., Benner et al., 2011; Sharp, Sanders, Noltemeyer, Hoffman, & Boone, 2016), less is known about educators' ability to interpret and make appropriate educational decisions based on student's PM data (Espin, Wayman, Deno, McMaster, & de Rooij 2017; Gelderblom, Schildkamp, Pieters, & Ehren, 2016; Zeuch, Förster, & Souvignier, 2017).

The purpose of this study is to examine teachers' ability to accurately interpret student PM data in graph form in order to make appropriate educational placement

decisions from that data. A second purpose is to examine the relationship between professional development experience and teachers' graph literacy skills. Proper use of data and teachers' graph literacy may be influenced by the amount and quality of targeted professional development opportunities teachers have. Indeed, if a teacher is not trained in how to use data (usually provided in the forms of graphed student progress), it is unreasonable to expect them to be highly proficient or accurate in their decisions.

This study will add to this emerging area of research by gathering information from U.S. elementary teachers regarding their perceptions of PD opportunities along with their graph literacy proficiency. To the best of our knowledge, this is the first survey developed that asks respondents to quantify their purported knowledge of graph literacy by asking them to read graphs and make decisions from the student's data. We will also examine the psychometric properties of the graph questions in order to determine construct validity and reliability. Prior studies incorporated surveys concerning teachers' perceptions of their graph literacy abilities, and a few with small sample sizes were able to conduct think-alouds. However, this project is unique in that a large number of participants were not only asked to indicate their perceptions of the availability and quality of professional development as it relates to using student data, but they were also asked to perform graph tasks by reading and drawing conclusions about the data presented.

Despite the ubiquity of PM data, and the extreme importance it has in educational decision making, little is known about teachers' graph literacy and even less is known about the link between PD and graph literacy. To further explore these issues, the following research questions will be addressed

Research questions:

1. What are the psychometric properties (e.g., construct validity, reliability) of the survey?

2. What are teachers' perceptions regarding the amounts and quality of training in Tier 2 and Tier 3 interventions?

3. How does the perception of the amounts of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?

4. How does the perception of the quality of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?

CHAPTER II

LITERATURE REVIEW

Introduction

RTI is a pro-active, multi-tiered system that relies on evidence-based

interventions presented with fidelity to improve academic performance (Fuchs, Mock,

Morgan, & Young, 2003; Stecker et al., 2008). However, RTI also entails the use of data

collection and analysis to make informed decisions regarding a student's response to an

intervention. The area of data analysis and graph literacy and its role in the RTI process

has only recently gained attention, with particular attention to teachers' role in reading

and interpreting data.

An emphasis on student data also gained prominence in the U.S., when, in 2001,

the NCLB act was passed and included strict accountability measures for low-performing

schools. With the reauthorization of IDEA in 2004 and its allowance of documented

response to intervention as evidence of a student's learning disability, data-based

decision-making was at the forefront of educational policy. However, simply mandating

a policy without providing sufficient training is not likely to result in student

improvement (Mandinach & Gummer, 2016).

While research has indicated that constructive use of data can facilitate a student's

academic improvement, data without interpretive knowledge do not serve their intended

purpose (Deno, 2016; Gelderblom et al., 2016; Mandinach, 2012). Several studies have

indicated that lack of adequate data is not an issue; rather, the inability to construct

information and guide instruction from that data is the problem faced by many educators

(McCombes-Tolis & Spear-Swerling, 2011; U.S. Department of Education, 2010;

Vujnovic et al., 2014).

Data-based Decision Making in an RTI Framework

The significance of accurately interpreting data regarding students' education is

underscored by the necessity of early intervention to treat or assuage reading problems

(Balu et al., 2015). Research has indicated that early, targeted intervention can help to

mitigate potential reading problems (Spear-Swerling & Cheesman, 2001; Stecker et al.,

2008). RTI emerged as a strategy for early identification and intervention for struggling

learners (Preston et al., 2016) and as an alternative to the discrepancy model for special

education placement, which required that students have a sizable discrepancy between

their academic achievement and their aptitude. Because of its emphasis on the use of

research-based interventions, fidelity of implementation, and use of student data, RTI was

intended to ensure that students would no longer have to "wait to fail" before receiving

timely reading interventions (IDEA, 2004), which was one of the problems with the

discrepancy model.

Data collection and data analysis have long been staples in special education

(Deno, 2003; Espin et al., 2017; Preston et al., 2016). However, since the passage of

NCLB (2001) and the reauthorization of IDEA in 2004 along with both mandates'

emphasis on the importance of student data, general educators have become increasingly

responsible for data collection and interpretation (Mandinach et al., 2015). Teachers are

expected to be knowledgeable at turning data points and trend lines into pertinent

information that drives instruction (Schifter et al., 2014; Schwartz et al., 2009). As such,

it is necessary to understand whether classroom teachers—those who are tasked with

making daily educational decisions based on student data—are adequately prepared to read, interpret, and apply such information (Mandinach, 2012; Reeves, 2017a). Currently, research is sparse regarding the training teachers receive and their ability to analyze and interpret progress-monitoring data in ways that inform instruction (Fuchs & Deshler, 2010; Vujnovic et al., 2014; Zeuch et al., 2017).

Teachers are tasked with an ever-growing list of responsibilities, which now includes the ability to read, interpret, analyze, and make decisions from student data for instructional purposes; however, many educators lack appropriate training and/or confidence concerning how best to use student data to inform or change classroom instruction (Mertler, 2009; Prasse, Breunlin, Giroux, Hunt, Morrison, & Thier, 2012; Schifter et al., 2014; van Geel et al., 2017). Whether it is pre-service programs that inadequately address the issue of data analysis or school districts that do not provide ongoing, targeted PD opportunities, when teachers do not have the training needed to use data to its fullest extent, student achievement may suffer (Bineham et al., 2014).

Despite more than a decade of research and implementation, debate continues as to the effectiveness of RTI as currently practiced (Balu et al., 2015; Fuchs & Deshler, 2010). It appears that many school districts essentially dove head first into RTI implementation before adequate research could speak to its effectiveness (Hudson & McKenzie, 2015), likely because of the legal obligation to do so. In addition, millions of dollars in resources have been invested into RTI alone; technological implementation adds billions more to that cost (Mandinach & Gummer, 2013). Nevertheless, students who struggle academically continue to fail to make or sustain adequate gains even with added academic supports (Fuchs & Fuchs, 2017).

Research indicates that the RTI process may not be flawed but the fidelity or integrity of implementation may be lacking (Castillo, March, Tan, Stockslager, Brundage, McCullough, & Sabnis, 2016; Fuchs & Fuchs, 2017; Keller-Margulis, 2012; Vujnovic et al., 2014). For instance, recent studies have found that teacher education programs often do not adequately address RTI practices. In their survey of education faculty, Schwartz et al. (2009) found that, five years after the passage of IDEA and its inclusion of RTI practices, nearly 30% of faculty members indicated they were "somewhat familiar" or "not familiar at all" with RTI. A 2011 review of 29 education course syllabi revealed that only one referenced the term "progress monitoring," while none of the syllabi mentioned RTI or any type of tiered intervention practice (McCombes-Tolis & Spear-Swerling, 2011). Others have noted courses that claim to include instruction in graph literacy but are, in fact, referring to assessment literacy (Mandinach et al., 2015).

In a more recent survey of teacher education programs in institutions of higher learning in the Midwest United States, faculty were asked about perceptions of their own and other faculty members' knowledge of RTI practices. On a 5-point Likert scale, faculty in elementary education departments averaged 3.25 in their self report of RTI knowledge; faculty in secondary education departments did not fair as well, averaging 2.75 in their self report of RTI knowledge (Harvey et al., 2015). More than 10 years after the passage of IDEA and its emphasis on RTI, many pre-service teachers may still not be receiving the training needed to appropriately implement RTI, which includes progress monitoring and data interpretation.

Classroom teachers indicate they want to utilize data to inform instruction but are often unsure how to do so (Stecker et al., 2005; Zeuch et al., 2017**).** Many have access to data and can decipher basic indicators in student data (e.g., data points above or below a targeted percentile), but making informed decisions based on that data (e.g., using trend lines to determine efficacy of particular interventions) have proven to be more challenging (Reeves 2017a; Schifter et al., 2014).

Graph Literacy

The use of data in schools is not a new issue; however, the types of data teachers are expected to reference have changed (Jimerson & Wayman, 2015; Mandinach, 2012; Mertler, 2014). The definition of the term *data literacy* itself is still evolving (Mandinach & Gummer, 2013). For instance, *data literacy* and *assessment literacy* are often used interchangeably; however, these represent two distinct practices. Data literacy can include a variety of tools to evaluate student performance, such as attendance and/or behavior, while assessment data are singularly focused on test outcomes. Mandinach (2012) refers to the collection and use of a multitude of sources to inform instruction as *pedagogical data literacy*. Even schools of education conflate assessment literacy to mean data literacy (Mandinach et al., 2015). For the purposes of this project, *graph literacy* refers to the specific ability to read, interpret, and make informed decisions based on graphical representations of students' frequent PM data within RTI interventions.

The practice of accurately reading, interpreting, and making educational decisions based on student data is one of increasing importance (Mandinach, 2012; Mandinach & Jimerson, 2016; Schifter et al., 2014). The federal government uses student data to determine general education trends as well as how U.S. students compare with other

nations (NCES, 2017). School districts use student data to gauge student and teacher improvements, and individual schools use student data for monitoring progress in their building (Gelderblom et al., 2016). In addition, IDEA (2004) and many school districts mandate that educational decisions that drive instruction should be based on student data, which are typically presented as graphs and/or tables (Friel, Curcio, & Bright, 2001; IDEA, 2004). With the abundance of online assessments that generate graphs based on student performance, there are no shortages of methodologies to collect student data (U.S. Department of Education, 2010; Wayman & Jimerson, 2014). While data presented graphically may be ubiquitous in many schools, graph literacy can prove to be challenging for many, including educators (Carpenter & Shah, 1998; Chick & Pierce, 2012; Friel et al., 2001).

Reading a graph appears simple enough; indeed, the definition of graph comprehension is the "readers' abilities to derive meaning from graphs created by others or by themselves" (Friel et al., 2001, p. 132). Reading the data—considered the most basic component of graph interpretation—entails locating the x- and y-axes, determining the construct being graphed, and locating data points (Friel et al., 2001). However, in order to make informed decisions from the data, graph literacy entails more than a superficial reliance on graphics (Chick & Pierce, 2012; Friel et al., 2001; van den Bosch et al., 2017). Although some studies have found teachers were generally proficient at reading data related to goal attainment, they struggled to consolidate all the pertinent information necessary to inform instruction or intervention placement in a timely manner (Zeuch et al., 2017). As Espin et al. (2017) point out, determining goal attainment is not the primary goal of data-based decision making.

While student data are often readily available to teachers (e.g., CBMs) and schools and policy makers expect educators to make data-based decisions on this data, few studies have examined whether teachers have the required training and requisite skills to determine the necessary information from graphs (Chick & Pierce, 2012; Newell & Christ, 2017). Student data presented visually as graphs have become ubiquitous in many schools (Friel et al., 2001). However, there often appears to be an implicit assumption that teachers should be able to read and interpret the data as well as make educational placement decisions with little or no explicit training (Mandinach & Gummer, 2013; Schifter et al., 2014).

Research into the area of graph literacy indicates the processes required to generate information from graphs and make informed decisions are quite complex and require some degree of graph literacy or training (Carpenter & Shah, 1998; Garcia-Retamero, Cokely, Ghazal, & Joeris, 2016; van den Bosch et al., 2017). Few teacher education programs require courses that might address data-based decision making and graph interpretation; for example, statistics, measurement, or assessment courses that might directly address graph literacy are largely left out of undergraduate education programs (Galesic & Garcia-Retamero, 2011; Mandinach & Gummer, 2013).

Errors in interpretation can be attributed to the myriad factors involved in making sense of graphically presented data. Eye-tracking studies indicate many readers' eyes track repeatedly from the labels (e.g., axis titles) to the patterns in the graph (Carpenter & Shah, 1998; Peebles & Cheng, 2003). The more complex the graph (e.g., trend lines, goal lines, variable or extreme data points), the more chances there are for mistakes to be

made in synthesizing information (Garcia-Retamero et al., 2016; Ratwani, Trafton, & Boehm-Davis, 2008).

Graph comprehension can be inherently complex, particularly for those without appropriate training. Beyond simple reading the surface data (e.g., data points), graph analysis involves identifying the essential information, making inferences about that information, and integrating knowledge gained from the graph with content knowledge to produce an accurate interpretation (Ratwani et al., 2008). It is not surprising, then, that the task of analyzing data to inform instruction as well as to determine students' rate of improvement tends to be a more challenging task than simple pattern recognition (Friel et al., 2001; van den Bosch et al., 2017; Zeuch et al., 2017).

The following graph highlights the variety of tasks necessary to comprehend and make decisions from student data. Using Figure 1 as an example, the first data point for Amy indicated she read 40 words correct per minute (WCPM) on the oral reading fluency (ORF) screener. In this case, 4th-grade norms indicate Amy is performing well below the 25th percentile (i.e., 68 WCPM) and just below the 10th percentile (i.e., 45 WCPM) for her grade level.

Amy is reading considerably fewer words per minute than is expected at her grade level. As the data show, however, she does not respond adequately to Tier 1 classroom instruction: after each weekly PM assessment, she is not averaging the expected improvement of .9 words per week (Hasbrouck & Tindal, 2006) and, in fact, her total WCPM drops from 40 to approximately 38 by the fourth week of school. With this information, it is necessary to move Amy to Tier 2 in order to receive more intensive intervention.
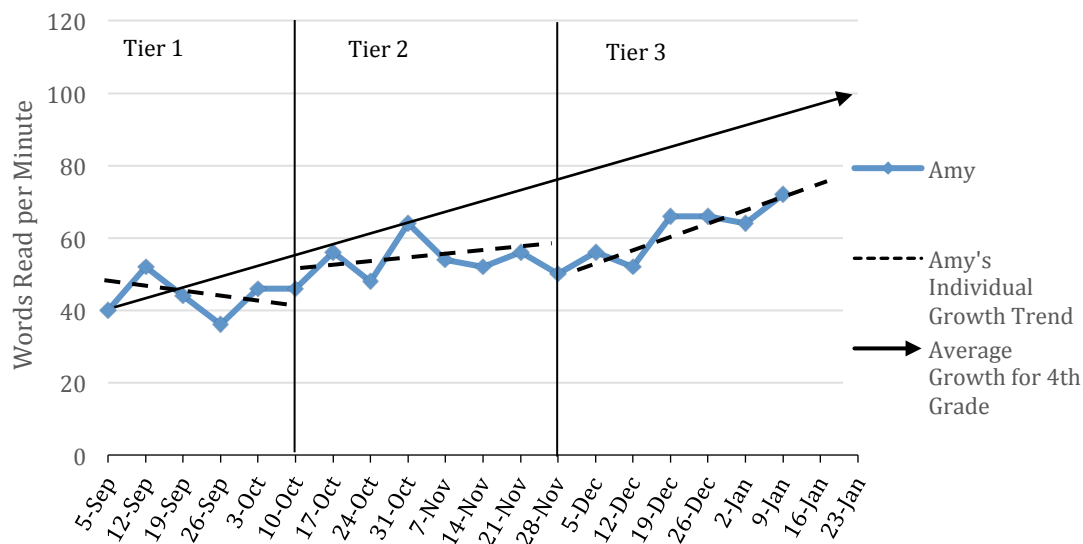
Figure 1

Sample Student Graph

Initially, it appears Amy responded well to the Tier 2 intervention because each week her PM data show her WCPM increased. Effective graph literacy, however, requires more than reliance on data points. Specifically, Amy's data indicate her growth trend line (dotted line), while positively sloped and indicating growth, is below the average rate of growth for 4th-grade students (solid line). The discrepancy between expected growth and Amy's trend line indicate she is not on track to meet her 4th-grade reading goals (i.e., 98 WCPM by Spring). Amy is making progress in her Tier 2 intervention but not at the expected rate. Additionally, because she evidenced more than three instances of falling below her goal line (e.g., 10/24, 11/7, and 11/14), a change to Amy's instruction and/or intervention is warranted (Hasbrouck & Tindal, 2006).

The next decision based on this data involves making a change to the existing intervention and/or instruction. Since the trend line indicates less than expected growth, it is necessary to move Amy to a Tier 3 intervention—the most intensive intervention before Special Education. According to the data, Amy started Tier 3 below her Tier 2 WCPM but responded well to the individualized, intensive instruction of Tier 3. Her growth trend line in this intensive intervention indicated she made progress but may fail to reach the 25th percentile of 4th-grade reading norms by the end of the school year (i.e., ORF norms of 98 WCPM).

Reading fluency is but one measure of reading competence. However, this foundational reading skill can impact comprehension in later grades (Kent, Wanzek, & Al Otaiba, 2017). If a student struggles with reading and spends time trying to decode words, less attention can be given to understanding the text in general. This can be especially problematic for older elementary students when instruction tends to focus on content rather than reading skills. Despite her apparent improvement in WCPM in Tier 2, Amy would likely not meet her end-of-year 4th-grade goals. Had she not been moved to the more productive Tier 3 intervention, Amy could have languished in an ineffective intervention in which her fluency would continue to indicate below grade level reading skills.

Teachers' Training in Data-based Decision Making

The latest iteration of teaching standards, as set forth by the National Board for Professional Teaching Standards (NBPTS, 2016), recommends that teachers be adept at using and interpreting student data in order to make informed instructional decisions. Likewise, the Interstate Teacher Assessment and Support Consortium (InTASC)

standards include a strand focused on the growing importance of assessment, progress

monitoring, and data-based decision making (Council of Chief State School Officers,

2013). Despite this growing emphasis on the importance of student data, educators

continue to report professional trainings, if they exist at all, do not present effective

training in data or graph literacy. Others report the professional training opportunities

present information that is not relevant or helpful for data-based decision making

(Albritton & Truscott, 2014; Reeves, 2017a; Wayman & Jimerson, 2014).

Although including instruction in RTI practices and data literacy in pre-service

education programs has been shown to positively influence new teachers' view of data

use, pre-service teachers continue to express concerns over their ability to understand and

implement RTI practices in the classroom (Barrio & Combes, 2015; Barrio, Lindo,

Combes, & Hovey, 2015). In a survey of novice teachers' self-reported ability to use

data to inform classroom instruction, 76% of participants admitted they were unsure of

their ability and needed additional support; similarly, two-thirds noted they were not

confident in their ability to use PM data to make educational decisions (Prasse et al.,

2012). Such information does not bode well for novice teachers, who are often expected

to enter the classroom with knowledge of RTI practices and effective decision-making

skills in order to successfully implement RTI in their classrooms (Mandinach &

Gummer, 2013; McCombes-Tolis & Spear-Swerling, 2011; Monetti, Breneiser, &

McAuley, 2013).

Teachers' Accuracy in Data-based Decision Making

Citing lack of training concerning the use of student data to accurately inform

reading instruction, teachers may find it difficult to interpret all of the information

presented to them. For example, Espin et al.'s (2017) graph analysis task illustrated the apparent discrepancy between graph literacy and making informed placement decisions. As in Vujnovic et al.'s (2014) study, all of the respondents (N=14) in Espin et al.'s (2017) study correctly identified when a student had met her goal; however, none adequately answered the question on using slope to determine intervention placement or efficacy. The inability to adequately address slope as a function of graph interpretation led to several incorrect responses concerning students' responsiveness to an intervention. However, it is the ability to determine responsiveness to intervention that influences instruction; without correctly using slope to determine progress, students may linger in ineffective interventions or be moved to another intervention that is unnecessary.

Likewise, it appears that experience with CBM data does not necessarily indicate expertise. Espin et al. (2017) reported that three of the five teachers in their survey who indicated the most experience in using CBM data actually performed the lowest in reading and interpreting student data. The respondents were the most successful at determining goal attainment; however, determining goal attainment is not only an easier skill, it is also one of the least useful in regards to instructional planning as well as to an iterative process such as RTI (Espin et al., 2017).

The apparent variability in teachers' graph literacy also poses another problem for data-based decision making. Van den Bosch et al. (2017) found that teachers' scores in their ability to accurately read and explain data from graphs ranged from 0% to 100%. Likewise, Espin et al. (2017) found significant variability in respondents' ability to accurately interpret and describe student data. In addition, several of the teachers who scored the lowest in accuracy also indicated they had the most experience with creating

graphs (Espin et al., 2017). Clearly there is a large variability in how accurate teachers are at reading graphs and making subsequent decisions based on their graph literacy.

While some teachers doubt their abilities and others are overly confident in their perceived ability to read and interpret student graphs, others have indicated they simply do not know how to interpret student data. A number of participants in the study by Schildkamp et al. (2017) revealed they did not know how to answer the questions related to the use of student data. If teachers are expected to effectively use student data to inform their instructional practices and determine a student's responsiveness to an intervention, it is imperative they are provided with the training and tools necessary to be successful.

Graph interpretation can be a challenging task, even for experts (Zeuch et al., 2017). Compound that difficulty with the high stakes of data-based decision making and many teachers' lack of experience with graph analysis and it is easy to understand their lagging confidence. This is problematic, however, because research indicates teachers who lack confidence in their ability to use and interpret data are indeed less likely to make instructional decisions based on student data (Dunn et al., 2013; Means, Chen, DeBarger, & Padilla, 2011). Fortunately, research also suggests when teachers are trained to use data with the intention of informing instruction, students' achievement increases (Hoogland et al., 2016; Santi & Vaughn, 2007; Stecker et al., 2005). Studies have indicated that students from a variety of socio-economic backgrounds and from all grade levels improved when their teachers purposefully used data to determine students' academic strengths and weaknesses (Bernhardt, 2009; Carlson, Borman, & Robinson, 2011; van Geel et al., 2017). Unfortunately, a reluctance to use data—whether from lack

of confidence or inadequate training—to inform instruction appears commonplace in the majority of U.S. schools (Dunn et al., 2013; U.S. Department of Education, 2011).

If teachers are not receiving adequate instruction prior to entering the classroom or have been in the classroom prior to the introduction of RTI, professional learning opportunities can help to improve teachers' knowledge and confidence regarding data practices. In a national survey by the Department of Education, a majority of responding teachers indicated a preference for targeted PD to help them both interpret a variety of student data (e.g., state tests, school-wide assessments, PM data) and use such data to inform instruction (Means et al., 2011). Unfortunately, these types of trainings—targeting graph literacy and data analysis—are often not provided to teachers (Means et al., 2010). In fact, a recent report from IES found that neither RTI training nor graph literacy were included in the top 5 most prevalent areas of PD (Rotermund, DeRoche, & Ottem, 2017).

Research on effective PD indicates the trainings should, ideally, be ongoing and specific to teachers' needs in the classroom (LearningForward, 2017). However, teachers indicate a majority of their PD experiences take place outside of school, are presented in workshop formats, and are often ill-timed or irrelevant to classroom needs (Jimerson & Wayman, 2015). Research is clear that teachers' confidence in their ability to use student data is often determined by the level of knowledge and training they have received on the topic (Means et al., 2011). Nevertheless, teachers continue to indicate PD often fails to adequately address data literacy skills (Jimerson & Wayman, 2015; Means et al., 2010).

For instance, although 90% of school districts responding to a study by the U.S. Department of Education indicated they provide school staff with some training designed

to enhance their data interpretation skills, teachers report they do not receive the training and practice they need to become proficient with data use and struggle to use the information to inform instruction (Means et al., 2010; Newell & Christ, 2017; Wagner et al., 2017). If teachers are expected to effectively use student data to inform their instructional practices and determine a student's responsiveness to an intervention, it is crucial they are provided with the training and tools they need to be successful. Without effective training or professional learning opportunities in data literacy, teachers continue to feel unprepared when it comes to making appropriate decisions based on student data.

Education is a dynamic field; much like science and medicine, practices are iterative and informed by research. However, it often appears that teacher education programs and professional development opportunities do not meet the needs of a changing profession (Mandinach, 2012; Schwartz et al., 2009). With the emphasis on data analysis and student progress, teachers are expected to be knowledgeable at interpreting student data and implementing individualized student instruction based on that data. Without proper training, teachers may be ill-equipped to go beyond the data and make informed educational decisions.

The Present Study

RTI has the potential to provide early intervention for struggling readers; however, as researchers have explained, RTI is only as effective as those making the educational decisions (Fuchs & Fuchs, 2017). While using research-based materials presented with fidelity is foundational to the RTI process, some researchers contend the use of data to make informed educational decisions is the most important factor in the model's success.

Prior research has indicated teachers—those tasked with making daily educational decisions from student data—feel unprepared and uncertain of their ability to accurately read student data to inform their instruction.   Likewise, many indicated a lack of professional development opportunities or professional development that is not targeted to their classroom needs. In addition, teacher preparation programs often fail to provide new teachers with the knowledge necessary to make data-based decisions. Student data, presented in graph form, has become ubiquitous in many schools and teachers are expected to make decisions from such data. Without the proper training and informed practice surrounding student data use, teachers may be inadvertently impeding students' progress by placing them in inappropriate interventions or not recognizing when students need a different level of intervention.

The survey questions and graphs in this study were informed by a review of the literature in the area of RTI knowledge, implementation, and use as well as student data interpretation (Espin et al., 2017; Schildkamp et al., 2017; van den Bosch et al., 2017; Vujnovic et al., 2014; Zeuch et al., 2017). Several of the above mentioned authors, along with Mellard, McKnight, and Woods (2009), shared their survey questions and graphs in order to inform this study.

The graph tasks were also informed by the limitations and recommendations noted in recent research.   For instance, studies by Espin et al. (2017) and van den Bosch et al. (2017) noted their small sample sizes (N=14; N=30, respectively) and suggested that future research attempt to obtain data from larger samples. In addition, because these studies were mostly conducted in the Netherlands, some researchers also recommended future studies include a more diverse sample of participants (Schildkamp et al., 2017).

Prior studies investigating teachers' graph literacy often relied on surveys or questionnaires. Carlson et al. (2011) argued that self-reports alone do not provide objective data regarding teachers' graph literacy. Similarly, Schildkamp et al. (2017) and Espin et al. (2017) noted a limitation of their studies was a lack of an actual task to measure graph competency. They suggested the use of more quantitative measures in order to gauge participants' actual knowledge compared to their reported knowledge. Taking these suggestions into account, this project obtained a larger, more diverse sample of teachers across the U.S. and was unique in that it provided tasks from which teachers were to interpret sample student graphs.

CHAPTER III

METHODOLOGY

Participants and Survey Distribution

Previous studies, including the survey by Zeuch et al. (2017), noted their

limitations included small sample sizes; the researchers suggested future studies could

benefit from larger sample sizes as well as including participants from a variety of states

to better gauge teachers' data interpretation. In order to address these recommendations,

the researchers obtained 451 responses from U.S. elementary teachers and administrators.

The proportion of teachers in this national survey roughly matched the proportion of

teachers in each state (as determined by the National Center for Educational Statistics for

teachers by state), ensuring the dataset more closely resembled the national demographics

(see Appendix B). Tennessee was overrepresented in the sample.

In order to participate in the survey, respondents provided their consent, indicated

they were familiar with RTI, and were a current elementary school teacher/administrator.

If any of these questions was answered "no," respondents were thanked for their

participation and the survey was ended. In an effort to ensure that responses were of high

quality, Qualtrics, an online survey distribution company, rejected any surveys completed

too quickly or those that were "straight-line answered" (i.e., the participant chose the

same response over and over). Incomplete submissions were not included in the final

sample, which ensured there was no missing data. In total, roughly 1,500 surveys were

initially sent out to arrive at the final sample of 451. A vast majority of these were

rejected because they did not meet the qualifying criteria. Roughly 12% were eliminated

due to either straight-line responding or completing it too quickly. In addition, Qualtrics

maintains a database of teachers (for the purposes of this survey) nationwide.
Participants have opted in to receiving survey request and are verified by Qualtrics to the
maximum extent possible. Participants were contacted by Qualtrics and had the option to
take the survey or not. Following the agreement to take the survey, the qualifying criteria
described above were implemented.

Survey Instrument

Several studies have incorporated surveys in order to ascertain educators'
perceptions of RTI (Bineham et al., 2014; Castro-Villarreal, Rodriguez, & Moore, 2014;
Donnell & Gettinger, 2015; Regan et al., 2015; Rinaldi, Averill, & Stuart, 2011;
Swanson, Solis, Ciullo, & McKenna, 2012; Werts, Carpenter, & Fewell, 2014).
However, many of these relied on qualitative data, such as interviews and open-ended
written responses to surveys. While these studies provided valuable information
regarding teachers' views, few contained quantitative questions related to the practice of
graph literacy and placement decisions. The graphs included in this survey allow
respondents to indicate decision-making skills based on student data, explain their
rationale for such choices, and indicate their level of confidence in each answer choice.

This study was part of a larger study examining RTI and graph literacy. The
following survey construction description applies to the survey development completed
in the larger study. Because a subset of those items were included in this study, we felt a
full description of the creation process adds to the understanding of the survey.

Prior to conducting the pilot survey, a Subject Matter Expert (SME) group was
held. This group consisted of six doctoral students (four of whom were currently
teaching in K-12 settings) and two PhD faculty members. Several graphs were updated

to include information relevant to the group's input (e.g., clarifying trend lines), as well as the wording of answer choices. Further revisions to questions and graphs were made as needed. For example, school districts may have different criteria for determining whether a student is or is not responding to an intervention (e.g., some will move a student after collecting three data points while another may require more); thus, wording of the questions and answer choices were edited for clarity. To the extent possible, graphs were constructed to avoid such ambiguity.

After making the changes based on suggestions raised by the SME group, the survey was administered to a larger group of current teachers. This version contained questions relevant to RTI knowledge and use—such as whether all students take a universal screener, how often students in different tiers are progress monitored, and how often PM data are used to inform instruction—and student graphs. Based on additional feedback, the wording in some answer choices was changed for consistency and the placement of questions was changed so that questions were grouped by domain (whenever possible). The pilot version also revealed some respondents did not answer several of the graph questions; as a result, the survey was updated to ensure every question required a response. Additionally, the survey and graphs were sent to leaders in the field for review and feedback.

Although the overall survey consisted of 92 questions regarding teachers' self-reported knowledge of RTI practices, its implementation, and their PD experiences, this project focused on the four questions related to teachers' perceptions of the amount and quality of available professional development opportunities in order to strengthen Tier 2 and Tier 3 instructions along with their responses to the 14 graph questions.

The graph tasks included sample student graphs, modeled after those generated using commonly available PM assessments (e.g., AIMSweb, DIBELS, etc.), with data points plotted regarding a student's responsiveness to an intervention. Graphs included intercepts and slopes or trend lines along with comparisons to students who were expected to meet their annual reading goals. Respondents were asked to answer, according to the student data, whether the current intervention was effective or if the student should be moved to a more or less intensive intervention or no intervention at all (i.e., returned to Tier 1). Each graph was followed by multiple choice questions; some questions contained as few as three options while others contained as many as nine options. Three graphs had nine answer choice options, asking participants to decide intervention placement (e.g., be placed in Tier 2, remain in Tier 2 intervention, move to Tier 3) and only one answer choice for each graph was allowed.

The third and final phase of the survey asked for demographic information. Questions included the state in which the respondent currently teaches, number of years teaching, and school demographics. The questions related to perception of professional development opportunity and quality, demographics, and graph literacy can be found in the Appendix A.

Procedures

The International Review Board at Middle Tennessee State University approved the study procedures. A focus group and pilot study of the survey and graphs were conducted, which addressed issues concerning clarity of questions, response options, and organization of topics. After changes were made, the survey link was then sent to Qualtrics, a survey distribution platform that maintains a database of current teachers'

emails who have agreed to contribute to online survey research. Participants were required to be a current teacher or administrator in an elementary school and familiar with RTI practices. Before beginning the survey, participants were presented with a consent form that detailed the purposes of the survey and were reminded of the voluntary nature of their participation. Participants then had the option to continue the survey or decline to participate. Each question in the survey required a response before the participant was allowed to move forward. The survey consisted of a total of 92 response items; however, this study focused on the 14 items specific to graph literacy and the four questions related to teachers' perceptions of the availability and quality of professional development opportunities.

Research Design

In order to address the research questions in this study, quantitative data measuring teachers' graph literacy as well as their perceptions of the amount and quality of RTI-focused PD opportunities were gathered using a survey conducted through Qualtrics. Participants' responses from the survey were analyzed using descriptives, exploratory factor analysis, Cronbach's alpha, and regression. The survey was sent to elementary school teachers and administrators across the U.S. in order to gather a large national sample of educators to determine their level of RTI knowledge and graph literacy. These procedures were used to address the following research questions:

1. What are the psychometric properties (e.g., construct validity, reliability) of the survey?

2. What are teachers' perceptions regarding the amounts and quality of training in Tier 2 and Tier 3 interventions?

3. How does the perception of the amounts of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?

4. How does the perception of the quality of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?

Analysis Plan

To address the first research question, "What are the psychometric properties (e.g., construct validity, reliability) of the survey?" an exploratory factor analysis was conducted to check for unidimensionality and obtain factor scores, which helped establish validity of the survey. Cronbach's alpha was used to determine scale reliability.

Addressing research question two, "What are teachers' perceptions regarding the amounts and quality of training in Tier 2 and Tier 3 interventions?" simple descriptives were run on the amount of professional development teachers have received and their perceived quality of such instruction. This information was analyzed in order to gauge teachers' training via PD, as well as their perception of the quality of the professional development they received.

Research questions three and four, "How does the perception of the amounts of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?" and "How does the perception of the quality of professional development opportunities in Tier 2 and Tier 3 instruction predict graph literacy?" were answered using a regression analysis to examine 1) whether graph literacy could be predicted by the perceived amounts of professional development opportunities and 2) whether graph literacy could be predicted by the perceived quality of professional development opportunities.

Survey Validity

Validity represents whether the survey measures what it aims to measure. For this study, which examines teachers' graph literacy, it was important to determine the survey instrument's content, ecological, and face validity. Validity was addressed primarily through focus group input along with input from industry experts.

Content Validity

Content validity examines whether the instrument contains information and material pertinent to the study questions. For example, to address the first question in examining the psychometric properties of the survey graphs?" sample student graphs were included along with real-world decision-making options (e.g., "keep student in Tier 2" or "move student to Tier 3"). These graphs and answer choices were informed by prior surveys and questionnaires; in addition, input from teachers and industry experts also helped to ensure the graphs and answer choices addressed the issue of graph literacy.

Ecological Validity

Ecological validity examines the likelihood of applying study results to real-world situations. The graphs included in the survey were modeled after programs teachers often use (e.g., AimsWeb, EasyCBM, DIBELS) and the questions following each graph were representative of decisions teachers make regarding student placement. In addition, reading and interpreting graphs reflect common classroom practices for many teachers.

Face Validity

Although face validity can be considered subjective, it is important to examine the instrument for its accuracy and content relevancy. In order to address face validity, several groups reviewed the graphs and answer options, including graduate students,

teachers, university faculty, and industry leaders. These reviewers have extensive experience with graph literacy, and their informed recommendations were made in the final iteration of the survey. Because the purpose of the study was to ascertain teachers' graph literacy the survey, instrument included graphs similar to what teachers may see in their daily practice.

CHAPTER IV

RESULTS

This study investigated teachers' graph literacy as well as their perceptions of the amount and quality of professional development opportunities related to Tier 2 and Tier 3 RTI intervention. The descriptive data are examined first, followed by an examination of the psychometric properties of the survey (e.g., reliability). Then participants' responses to survey questions were analyzed to address three primary questions: 1) What are teachers' perceptions regarding the amounts and quality of training in Tier 2 and Tier 3 interventions; 2) How does the perception of the amounts of PD opportunities in Tier 2 and Tier 3 instruction predict graph literacy; and 3) How does the perception of the quality of PD in Tier 2 and Tier 3 predict graph literacy.

Demographics

Demographic and descriptive data for teachers and students are presented in Tables 1 and 2, respectively. Where applicable, data of survey responses are compared to 2015-2016 data from the National Center for Educational Statistics (NCES). Demographics between survey participants and NCES data are generally comparable. However, the state of Tennessee was overrepresented. These discrepancies were due to a soft launch of the survey that was sent primarily to Tennessee teachers.

A soft launch, in which the survey was sent locally to approximately 10% of the potential sample, was conducted in order to estimate response rate, check for survey errors (e.g., ensuring every question required a response), and length of time to complete the survey. Once preliminary data was received, any formatting issues were addressed and the survey was then sent out to all participants.

Table 1

Teacher Demographics

Characteristic		N	%	NCES%[1]
Gender				
	Female	414	91.8%	89.3%
	Male	34	7.5%	10.7%
	Declined to state	3	0.7%	NA
Race/ethnicity				
	White	321	71.2%	80.2%
	African American	48	10.6%	6.4%
	Hispanic	45	10.0%	8.8%
	Asian/Pacific Islander	22	4.9%	2.5%
	Multi-racial	7	1.6%	1.5%
	Native American or			
	Alaskan Native	2	0.4%	0.4%
	Declined to answer	6	1.3%	NA
Level of education				
	Bachelor's degree	177	39.2%	43.3%
	Master's degree	236	52.3%	45.7%
	Educational Specialist	21	4.7%	8.5%
	Doctorate	11	2.4%	0.8%
	Other	6	1.3%	1.7%
Years teaching				
	Less than 3	32	7.1%	10.1%
	3-9	170	37.7%	28.3%
	10-20	179	39.7%	39.3%
	Over 20	70	15.5%	22.3%
Subject(s) currently teaching				
	General education	300	66.5%	70%[2]
	Special education	100	22.2%	13.9%[2]
	Special area (e.g., music)	35	7.8%	6.2%
	Administrator	9	2.0%	NA
	Other	40	8.9%	NA

[1] NCES 2015-2016 percentages specific to elementary teachers

[2] NCES 2011-2012 percentages specific to elementary teachers
NA: Not available from NCES or not applicable to elementary teachers

Table 2

School Demographics

Characteristic	N	%	NCES%[1]
Number of students enrolled			
Up to 450 students	187	41.50%	
451-700 students	168	37.30%	
701 or more students	96	21.30%	
Percentage of students who receive free/reduced lunch			
25.0% or less	57	12.60%	21.40%
25.1% - 50.0%	71	15.70%	20.90%
50.1% - 75.0%	104	23.10%	22.10%
75.1% or more	205	45.50%	33.30%
Not sure	14	3.10%	2.3%[2]
Reported school SES[3]			
Low	242	53.70%	
Average	168	37.30%	
High	41	9.10%	
School location			
Rural	112	24.80%	18.50%
Urban	140	31.00%	31.20%
Suburban	199	44.10%	40.0 %

[1] 2015-2016 percentages specific to elementary teachers

[2] Do not participate in free or reduced lunch program

[3] SES = Socio-economic status

Factor Analysis

To address the first research question, an exploratory factor analysis was conducted to check for unidimensionality, which helped establish validity of the survey and obtain factor scores, which were used for subsequent regression analysis. It was observed that of the 14 items, 10 items had factor loading greater than .4. The four items with loadings less than .4 were deemed not to fit the model. The four items that did not fit were questions that potentially required more inferencing skills on the part of the respondents, which may explain the low loadings. Specifically, these four questions asked participants to go beyond reading the data and determine plausible explanations *why* the students were or were not responding to the intervention. All 14 graph items only explained 16.2% of variance, indicating the items did not load well on a single factor.

Next, those four items were removed and a second factor analysis was run. A dominant factor emerged with an Eigenvalue of 2.165, indicating that a single factor explained 21.65% of variance. The scree plot likewise showed a distinct change in slope after the first factor. Results from the Eigenvalues and scree plot indicated a single dominant factor, which supported the assumption of unidimensionality (Slocum-Gori & Zumbo, 2011).

Survey Reliability

Cronbach's alpha was used to measure internal consistency of the survey in order to gauge survey reliability. Internal consistency is an indicator of how well the items in the survey measures the same construct (i.e., graph literacy). In this analysis, Cronbach's

alpha indicated the final questions included after the EFA reached a reliability of $\alpha = .71$, which is acceptable reliability, especially for developmental measures with relatively few questions and a large sample size, both of which negatively bias reliability (Cortina, 1993).

Table 3

Participants' Perceptions of Professional Development Opportunities and Quality

	N	M	SD	No training[1]	Strongly Agree[2] N (%)	Agree[2] N (%)	Disagree[2] N (%)	Strongly Disagree[2] N (%)	Total N (%)
There are adequate PD opportunities to strengthen Tier 2 intervention instruction.	451	1.98	1.059	52	73 (16.2%)	189 (41.9%)	108 (23.9%)	29 (6.4%)	399 (88.4%)
The PD opportunities in Tier 2 instruction are high quality.	399	2.02	0.895	26	62 (13.7%)	203 (45.0%)	93 (20.6%)	15 (3.3%)	373 (82.6%)*
There are adequate PD opportunities to strengthen Tier 3 intervention instruction.	451	1.82	1.156	82	76 (16.9%)	162 (35.9%)	104 (23.1%)	27 (6.0%)	369 (81.9%)*
The PD opportunities in Tier 3 instruction are high quality.	369	1.95	0.953	32	65 (14.4%)	178 (39.5%)	78 (17.3%)	16 (3.5%)	337 (74.7%)*

[1] Those who indicated no training were not included in the analysis
[2] Strongly Agree was coded as 4; Agree was coded as 3; Disagree was coded as 2; Strongly Disagree was coded as 1

Descriptives

      To address research question 2, regarding teachers' perceptions of the amounts and quality of training in Tier 2 and Tier 3 interventions, descriptives were run on the amount of professional development teachers received and their perceived quality of such training. Results are shown in Table 3. Correct and incorrect responses to graph literacy questions, along with descriptives, are found in Table 4.

Table 4

Means, Standard Deviations, and Responses to Graph Literacy Questions

Question	*M* (SD)	Incorrect (%)	Correct (%)
Tom is or is not adequately responding	.747 (.435)	114 (25.3%)	337 (74.7%)
Tom intercept and slope	.393 (.489)	274 (60.8%)	177 (39.2%)
Tom's words read per minute by end of year	.182 (.386)	369 (81.8%)	82 (18.2%)
Susan's reading comprehension progress	.479 (.500)	235 (52.1%)	216 (47.9%)
Susan's fluency progress	.709 (.454)	131 (29.0%)	320 (71.0%)
Recommendation for Raul	.441 (.497)	252 (55.9%)	199 (44.1%)
Recommendation for Sam	.667 (.472)	150 (33.3%)	301 (66.7%)
Recommendation for Tina	.495 (.501)	228 (50.6%)	223 (49.4%)
Amy's response to intervention	.517 (.500)	218 (48.3%)	233 (51.7%)
Amy's end of year growth	.419 (.494)	262 (58.1%)	189 (41.9%)
Recommendation for Amy	.271 (.445)	329 (72.9%)	122 (27.1%)

Lisa's predicted growth	.645 (.479)	160 (35.5%)	291 (64.5%)
Least likely cause of Lisa's fluctuation of scores	.228 (.421)	348 (77.2%)	103 (22.8%)
Best way to minimize Lisa's fluctuation of scores	.282 (.450)	324 (71.8%)	127 (28.2%)

The frequency of answer choice responses was also examined and can be found in Tables 5 and 6. The incorrect response frequencies may provide insight into the reasoning behind responses. For instance, the second question regarding the intercept and slope on Tom's graph had a single word difference in answer options (i.e., "slower" and "faster"). This difference may have been overlooked. Additionally, it may be that the majority was incorrect because they did not accurately use slope to answer the questions.

Table 5

Frequency of Responses for Graph Tasks with Three to Six Answer Options

Question	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Tom is or is not adequately responding	52 (11.5%)	51 (11.3%)	**337 (74.7%)**	11 (2.4%)		
Tom intercept and slope	214 (47.5%)	32 (7.1%)	**177 (39.2%)**	6 (1.3%)	12 (2.7%)	10 (2.2%)

Tom's words read per minute by end of year	116 (25.7%)	**82 (18.2%)**	253 (56.1%)		
Susan's reading comprehension progress	39 (8.6%)	146 (32.4%)	**216 (47.9%)**	17 (3.8%)	33 (7.3%)
Susan's fluency progress	**320 (71.0%)**	58 (12.9%)	29 (6.4%)	44 (9.8%)	
Amy's response to intervention	38 (8.4%)	132 (29.3%)	**233 (51.7%)**	48 (10.6%)	
Amy's end of year growth	139 (30.8%)	123 (27.3%)	**189 (41.9%)**		

Correct responses are in bold

Table 6

Frequency of Responses to Graph Tasks with Nine Answer Options

	Recommended for Raul	Recommended for Sam	Recommended for Tina
Option 1	55 (12.2%)	19 (4.2%)	**223 (49.4%)**
Option 2	92 (20.4%)	10 (2.2%)	74 (16.4%)
Option 3	30 (6.7%)	45 (10.0%)	12 (2.7%)
Option 4	**199 (44.1%)**	17 (3.8%)	76 (16.9%)
Option 5	60 (13.3%)	17 (3.8%)	14 (3.1%)
Option 6	9 (2.0%)	42 (9.3%)	28 (6.2%)

Option 7	2 (.4%)	96 (21.3%)	12 (2.7%)
Option 8	1 (.2%)	73 (16.2%)	4 (.9%)
Option 9	3 (.7%)	**132 (29.3%)**	8 (1.8%)

Correct responses are in bold

Regression Results

As can be seen in Table 7 below, those who strongly agreed with the statements they received both adequate and high quality Tier 2 professional development performed the most poorly on the graph tasks. In contrast, those who disagreed with those statements performed better overall, followed by those who strongly disagreed. In general, those who either strongly agreed or agreed did worse than those who disagreed or strongly disagreed.

Table 7

Graph Literacy Means and Perception of Amount and Quality of Tier 2 Training

	Strongly Agree (*M*)	Agree (*M*)	Disagree (*M*)	Strongly Disagree (*M*)
Graph literacy (PD Opportunities)	5.38	6.33	7.38	6.38
Graph literacy (PD Quality)	5.34	6.34	7.14	6.53

Similarly, those who strongly agreed with the statements they received both adequate and high quality Tier 3 PD performed lowest on the graph literacy. Those who strongly disagreed regarding the adequacy of Tier 3 training did the best. Regarding the perceived quality, those who disagreed that they had high quality PD performed best. The pattern is the same as the perception of Tier 2 training; that is, those who either disagree or strongly disagree do better than those who felt they had adequate and high quality Tier 3 training (see Table 8).

Table 8

Graph Literacy Means and Perception of Amount and Quality of Tier 3 Training

	Strongly Agree (*M*)	Agree (*M*)	Disagree (*M*)	Strongly Disagree (*M*)
Graph literacy (PD Opportunities)	5.24	6.36	6.67	7.78
Graph literacy (PD Quality)	5.45	6.25	7.01	6.88

Prior to running the regression analysis to determine if perception of the amount and quality of training could predict graph literacy, responses of "no training" were

removed. We were interested in how those with stated PD experience perceived the availability and quality of their experiences; thus, those who had no training (and could therefore not judge the quality or availability of their PD experiences) were not included in this analysis. Those who indicated they received training were coded according to whether they strongly agreed, agreed, disagreed, or strongly disagreed with the questions concerning amounts and quality of PD. Strongly disagree was coded as 1, disagree as 2, agree as 3, and strongly agree as 4.

A linear regression was conducted to predict graph literacy based on participants' perceptions of the amounts of professional development opportunities for Tier 2. The model indicated statistical significance regarding graph literacy prediction and the perceived amounts of PD opportunities for Tier 2 intervention training, $F (1, 397) =$ 10.406, $p < .001$, $R^2 = .026$. The standardized coefficient of -.160 ($p < .001$) indicated that as the level of agreement increased, the performance on graph literacy decreased   A linear regression was conducted to predict graph literacy based on participants' perceptions of the quality of PD for Tier 2 and indicated a significant relationship $F (1, 371) = 11.992$, $p < .001$, $R^2 = .031$.   Similar to the findings for perceived amounts of PD, the relationship was negative ($\beta = -.177$, $p < .001$), which indicated that the higher the level of agreement of perceived quality of PD, the worse teachers performed on graph literacy.

A linear regression was conducted to predict graph literacy based on participants' perceptions of the amounts of professional development opportunities for Tier 3 intervention instruction. The model indicated significance regarding graph literacy prediction and the perceived amounts of PD opportunities for Tier 3 intervention

instruction, $F(1, 367) = 20.408$, $p < .001$, $R^2 = .053$ with $\beta = -.230$, $p < .000$. Finally, a linear regression was conducted to predict graph literacy based on participants' perceptions of the quality of professional development for Tier 3 and found a statistically significant relationship, $F(1, 335) = 11.927$, $p < .001$, $R^2 = .034$. Additionally, the relationship between level of agreement and graph literacy was negative with $\beta = -.185$, $p < .001$. For both perceived amount and quality of Tier 3 training, similar to Tier 2 training, the coefficients were negative, indicating that as agreement went up, teachers performed worse on graph literacy tasks.

CHAPTER V

DISCUSSION

Lack of reading proficiency can have life-long repercussions, from impacting one's school career to earning abilities as an adult. The urgency to ensure that students are proficient readers has continually been at the forefront of education. Early, targeted interventions for struggling students have the potential to assuage, or even ameliorate, reading difficulties. RTI was proposed as a systematic, tiered approach that was intended to provide quality, research-based instruction with fidelity. The iterative nature of RTI depends on the use of student data to measure students' responsiveness to a given intervention, determine its effectiveness, and change instruction accordingly. However, struggling readers often have not evidenced or maintained adequate gains despite receiving academic interventions (Fuchs & Fuchs, 2017). While much research has been conducted in the areas of research-based interventions and the need for fidelity of implementation, less is known about teachers' use of data to make informed educational decisions.

This study investigated teachers' perceptions of the amount and quality of professional development opportunities related to Tier 2 and Tier 3 RTI intervention. These responses were then compared to teachers' responses on graph literacy tasks in order to address whether PD opportunities and quality could predict graph literacy. The results of this study aim to contribute in several ways to the small but growing number of studies in the area of teachers' graph literacy and its influence on reading outcomes.

Previous research that has examined teachers' ability to read and interpret student data has largely relied on surveys alone (Schildkamp et al., 2017; van den Bosch et al.,

2017; Vujnovic et al., 2014) or surveys along with interviews (Espin et al., 2017; van den Bosch et al., 2017). These researchers noted that limitations to their studies included small sample sizes from limited areas or regions. Zeuch et al. suggested future research with larger sample sizes and participants from a variety of states may help to better gauge teachers' data interpretation. While many prior studies featured surveys in their studies, few featured tasks intended to quantitatively measure participants' graph literacy. Our national survey addressed these limitations by obtaining a fairly large sample (N = 451), which closely matched national teacher demographics in the U.S.; our study also included specific graph tasks to quantify teachers' perceptions of the availability and quality of their PD training as they relate to RTI intervention instruction.

Research consistently demonstrates the link between purposeful use of student data and student improvement; some RTI experts contend that use of students' data is *the* most important factor for successful implementation (Stecker et al., 2008; Wixson & Valencia, 2011). Unfortunately, various studies have indicated such data are not being used effectively or even accurately (Dunn et al., 2013; Jimerson & Wayman, 2015; Schwartz et al., 2009). Although many acknowledge the use of student data to be a critical component for determining instruction and responsiveness to intervention (and is foundational for the iterative nature of the RTI process), teachers have indicated they do not feel prepared to use student data accurately or in a timely manner (Bineham et al., 2014; Stecker et al., 2005).

Professional Development Perceptions and Graph Literacy

The results of our graph literacy tasks seem to support prior research findings in which teachers struggled to correctly interpret and use student data. Overall, participants

were generally unable to correctly interpret student data and determine what intervention would be most appropriate for each struggling reader. For example, in the first graph, participants were asked to determine number of words read over the course of the year compared to peers and whether the student would meet yearly goals. Although such information represents basic reading fluency information for many students, participant responses were largely incorrect. Almost 61% did not read the trend lines correctly, which was necessary in order to gauge number of words read per minute and determine anticipated rate of growth. Such results are comparable to findings by Espin et al. (2017) in which a majority of participants were unable to use slope in order to correctly determine student achievement. Perhaps more alarming, nearly 82% could not extrapolate information from the data to determine the student's reading progress in relation to peers (see Graph 1 in Appendix).

Similar to the findings by Espin et al. (2017) and Vujnovic et al. (2014), participants in our study were somewhat more successful at answering questions in which the student data were noticeably higher or lower than the trend line. For instance, a majority, 71%, correctly determined a student's fluency progress that consistently matched that of her peers. However, fewer than half (47.9%) was able to determine a student's reading comprehension progress even though the student was considerably and consistently below that of her peers (see Graph 2 in Appendix A). In their responses to a student graph that indicated data consistently below the expected trend line for a Tier 3 intervention, participants were correct only 67% of the time; this means that more than a third were unable to accurately determine whether the student was responding to a Tier 3 intervention (see graph 4 in Appendix A).

In instances where student data were noticeably above or below the expended trend line, nearly half of respondents were incorrect. In graph 5 (see Appendix A), the student appeared to not only exceed the expected growth for her grade level but also surpassed her own predicted growth. Despite this progress, only 49.4% of respondents were correct in determining the appropriate placement for this student. A majority, 50.6%, was unable to correctly use slope to determine the appropriate level of intervention for this student. Although the student made gains and even surpassed expected growth, half of the respondents would place the student in an intervention that was potentially ineffective. These findings are comparable to the findings by Vujnovic et al. (2014), in which only half of the respondents were able to accurately determine whether a student was adequately responding to an intervention.

Although teachers have often expressed a need for more specific PD related to data-based decision making (cf. Bineham et al., 2014; Jimerson & Wayman, 2015), the majority of respondents in our national survey indicated they agreed with the statements they received both adequate and high-quality PD opportunities in Tier 2 and Tier 3 intervention instruction. While on the surface that seemed encouraging and perhaps school districts were providing targeted, graph-specific professional development, respondents' answers on the graph analysis tasks were less correct than those who disagreed with the statements that they received adequate and high-quality Tier 2 and Tier 3 intervention instruction.

In contrast, those who disagreed with the statements they had both adequate opportunities and high quality PD consistently scored (relatively) higher on the graph tasks. Such variability in teachers' data-based decision making skills has been noted in prior research as well. For instance, van den Bosch et al. (2017) found that participants'

ability to interpret and explain student data ranged from 0% to 100%; similarly, Espin et al. (2017) found significant variability in their participants' description and interpretation of student data. Such inconsistencies and variability can result in students not receiving the appropriate intervention and thus not making gains in their reading skills.

The findings regarding the adequacy and high quality training for both Tier 2 and Tier 3 training were very consistent. As teachers' agreement with the adequacy and quality statements agreed, they performed worse. One thing to note is that the effect sizes were fairly small with all standardized coefficients being less than .20. However, perhaps more important than the size of the effects was the direction of the relation and the consistency. That teachers who felt they had better access and quality of Tier 2 and Tier 3 training performed worse is concerning. One possible explanation is related to the Dunning Kruger (1999) effect, which postulates that people are unaware of their inability to perform a task and falsely overestimate their ability to do so. The findings certainly suggest this may be a plausible explanation in that teachers who perceived they had adequate and high quality PD performed worse, which could indicate they fail to see their own inadequacy and need for further training.

Such dichotomous results are concerning. Not only were the teachers incorrect in their interpretation of student data and the implications that imparts for struggling readers and their intervention needs, but these teachers also were unaware of their lack of knowledge. Again, this speaks to an assumption of knowledge of graph literacy and the absence of purposeful, systematic training in graph literacy. Additionally, teachers may conflate classroom experience with ability. For example, Espin et al. (2017) noted that

many of the teachers in their survey with the most experience scored the lowest in accuracy on graph-related tasks. Thus, experience may not necessarily equal expertise.

Despite some teachers' indication they are adequately trained to interpret student data, many teachers continue to indicate a lack of appropriate training in reading, interpreting, and making educational decisions from student data. A study in 2017 (LearningForward) found that teachers noted a dearth of professional development in the area of graph literacy. Similarly, a national survey of teachers in 2014 found that two-thirds of the 600-plus respondents noted no PD training in RTI intervention practices (Bineham et al., 2014). Jimerson and Wayman (2015) found that one of the main areas teachers indicated as needing more targeted PD included data literacy and interpretation of student data.

Perhaps training that is available is confusing or does not provide practical applications of data literacy. Research in RTI has traditionally focused on the need for research-based interventions; research on the importance of data literacy has only recently emerged. It is possible that teachers have received the same PD over the same topics year after year with little relevancy to their classroom needs (Jimerson & Wayman, 2015).

Limitations

The study had several limitations. First, only current elementary school teachers were included as respondents. Because RTI emphasizes early intervention, it was often implemented in elementary schools years before middle and high schools began incorporating these systems of support. Omitting teachers at the middle and/or high school levels who have potentially less experience in RTI practices could impact (i.e.,

inflate) overall survey results (Reeves, 2017b). Another limitation concerns the nature of the survey respondents. People who self-select to be part of survey research may not be representative of the population at large.

In addition, state-by-state guidelines vary regarding when students can be moved from one tier to another. While every effort was made to ensure graphs were clear and concise, they might have differed from graphs teachers are accustomed to reading. Although it was explicitly stated to only rely on the data in the graph, it is possible that teachers' choices were influenced by their state guidelines. For example, in some states, students can be moved after four data points while others require seven or more data points before a student can be moved among tiers. Further analyses that compare teachers with similar state guidelines may help shed light on whether they were influenced by state guidelines and rules versus overall graph literacy.

Finally, while there were statistically significant differences among the various responses to the amount and quality of PD, the practical significance was small.   The largest R^2 value only explained 5.3% of variance for graph literacy and the perceived amounts of PD opportunities for Tier 3 intervention instruction. Clearly, there are other factors that inhibit teachers from accurately making educational placement decisions from student data.

Future Studies

Teachers' graph literacy and its effects on reading outcomes in an RTI framework remain an emerging area of research around the globe. One of the goals of this study is to contribute to that body of research by examining teachers' perceived and practical knowledge related to graph literacy and its potential impact on students' intervention

placement. Results indicate discordance between perception of opportunities and quality of PD and the ability to accurately read student data. Research notes teachers struggle to use data effectively. Future studies may want to investigate the quality of existing professional development and, if necessary, introduce PD that provides systematic instruction in graph literacy. The inclusion of a quantitative measure following PD instruction to ascertain mastery may indicate the efficacy of the PD as well as participants' ability to utilize that knowledge with their own students' data. It may not be sufficient to provide educators with the information without also providing guidance on practical applications of that information.

Additionally, further research is needed to investigate other factors that might explain teachers' graph literacy skills, since results noted small effect sizes. Confounding influencers such as school climate, resources, and leadership may hinder teachers' view of data use along with lack of training.

Another area of potential inquiry is "why" teachers make the decisions they do, not just "what" decisions they make. Understanding the reasons teachers make the decisions they do, especially when they are incorrect, can help researchers identify common mistakes and thus revise PD accordingly. More research is needed to determine the thoughts and reasoning that influence their decision making.

Conclusion

The main questions addressed in this study concern teachers' perceptions of the availability and quality of professional development for Tier 2 and Tier 3 interventions and whether availability and quality could predict graph literacy. Graph literacy, in the context of RTI, is a means to determine a student's response to instruction and make

appropriate academic decisions based on that responsiveness. The end goal is to ensure students are receiving the intervention they need in order to become more proficient readers.

Although schools are often required to rely on data to make informed educational decisions, the results of this study indicate teachers still need explicit training and understanding of how and why to use student data. Graph literacy encompasses more than simply the ability to read a graph. Each data point represents a student's progress and indicates general responsiveness to an intervention. Failure to interpret student data correctly can potentially hinder a student's access to appropriate reading instruction.

Graph literacy is a complex skill that requires the discernment of a variety of information presented graphically. The reader must determine what information is important, how that information relates to reading (e.g., fluency or comprehension, grade-level norms), amount of data gathered, and significance of slope. If teachers have not received this instruction in their education programs, they can potentially gain this knowledge through professional development. However, as noted earlier, graph literacy was not included in the top 5 most prevalent areas of PD offered to teachers (Rotermund et al., 2017). Professional development that provides focused training on the complexities involved in graph literacy and how to make informed educational decisions—and the importance of doing so—is needed to bridge the gap between determining appropriate reading interventions and teachers' abilities to make those decisions.

The emphasis on data-based decision making in schools has become ubiquitous and is a skill that teachers are expected to know. As prior research has indicated, many

teachers do not have the training needed to accurately read student data; results of the graph literacy tasks in our research seem to support this conclusion. Instead, there appears to be an implicit assumption that teachers should have the knowledge necessary to use student data to determine responsiveness to intervention in order to address reading difficulties. The unfortunate result of not accurately reading student data, thus placing students in ineffective or ill-fitted interventions, may be that students fail to receive the specific instruction necessary to improve their reading proficiency.

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APPENDIX A: Graph Tasks and Survey Demographics

Principal Investigator: Eric L. Oslund

Study Title: Teachers' Knowledge and Implementation of Response to Intervention

Practices: Graph Literacy and Data-based Decision Making

Institution: Middle Tennessee State University

The following information is provided to inform you about the research project and your participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and the information given below. You will be given an opportunity to ask questions, and your questions will be answered. Also, at your request you will be given a copy of this consent form.

Your participation in this research study is voluntary. You are also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

For additional information about giving consent or your rights as a participant in this study, please feel free to contact the MTSU Office of Compliance at (615) 494-8918.

Purpose of the study:

You are being asked to participate in a research study because Response-to-Intervention (RTI) is increasingly being used in American school systems. The purpose of this survey is to gather teachers' perceptions and knowledge about RTI in order to

better understand how RTI is being implemented, how teachers perceive RTI, and their knowledge of data use to inform instructional decisions.

Description of procedures to be followed and approximate duration of the study:

Participants will complete an approximately 20 minute online survey. There is no additional work or participation required beyond completing the survey.

Expected costs:

No cost to participants.

Description of the discomforts, inconveniences, and/or risks that can be reasonably expected as a result of participation in this study:

No discomforts or inconveniences are expected.

Compensation in case of study-related injury:

MTSU will not compensate study-related injuries.

Anticipated benefits from this study:

The potential benefits to science and humankind that may result from this study are: this study will contribute to the body of knowledge regarding teacher perception, use, and understanding of RTI. Because of its pervasive use, yet little understanding of how well teachers are trained and their perception of RTI, this survey can inform the field at large with essential information.

Alternative treatments available:

None

Compensation for participation:

Participants will be given points that can be redeemed in various ways.

Circumstances under which the Principal Investigator may withdraw you from study participation:

Participant indicates they no longer want to participate.

What happens if you choose to withdraw from study participation:

No negative consequences to participants.

Contact Information.

If you should have any questions about this research study or possible injury, please feel to contact **Dr. Eric Oslund** at **(615) 904-8006.**

Confidentiality.

All efforts, within reason, will be made to keep the personal information in your research record private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, or Federal Government Office for Human Research Protections, if you or someone else is in danger or if we are required to do so by law.

STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS STUDY

I have read this informed consent document and the material contained in it has been explained to me. I understand each part of the document, all my questions have been answered, and I freely and voluntarily choose to participate in this study.

I agree to participate (1)

I do not wish to participate (2)

For the purpose of this survey, RTI includes Multi-tiered System of Supports (MTSS). We recognize some programs have more than 3 Tiers, so for the purpose of this survey, we define Tiers in the following way: Tier 1 = general education; Tier 2 = interventions that can include small group instruction, alternative, and/or additional interventions and; Tier 3 = intensive individual instruction and/or Special Education placement.

Also, you can save your responses at any time and return to finish the survey at a later time as long as it is within 6 days.

Q1 Grade level you currently teach (select all that apply)
    Elementary school (K-5)
    Middle school (6-8)
    High school (9-12)
    Other (please specify)

Q2 Are you currently a teacher or administrator in a K-12 school setting?
    Yes
    No

Q3 Are you familiar with Response to Intervention (RTI) [also known as Multi-tiered System of Supports (MTSS)]?
    Yes
    No

Q11 There are adequate professional development opportunities to strengthen Tier 2 intervention instruction.

Strongly Agree

Agree

Disagree

Strongly Disagree

I do not receive any training in Tier 2 instruction

Q12 The professional development opportunities in Tier 2 instruction are high quality.

Strongly Agree

Agree

Disagree

Strongly Disagree

I do not receive any training in Tier 2 instruction

Q14 There are adequate professional development opportunities to strengthen Tier 3 intervention instruction.

Strongly Agree

Agree

Disagree

Strongly Disagree

I do not receive any training in Tier 3 instruction

Q15 The professional development opportunities in Tier 3 instruction are high quality.
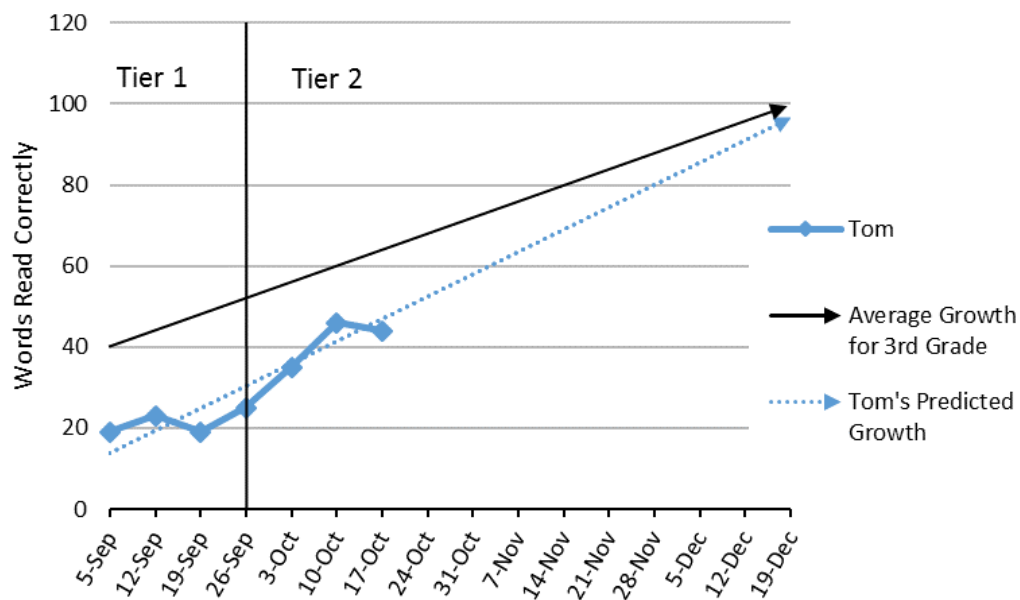
Strongly Agree

Agree

Disagree

Strongly Disagree

I do not receive any training in Tier 3 instruction

Graph 1

Q46 Tom was placed in Tier 2 intervention (as shown by the vertical line) on September 26th. This graph represents the data collected September 5th through October 17th. According to the graph, Tom is:

Not adequately responding to Tier 2 instruction and should be placed in Tier 3

Not adequately responding to Tier 2 instruction and should be left there

Adequately responding to Tier 2 instruction and should be left there

Tom should be moved back to Tier 1

Q47 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Q48 Tom:

Read roughly half as many words as the average student at the start of the year and grew slower than average

Read roughly half as many words as the average student at the start of the year and grew faster than average

Read roughly the same number of words as the average student at the start of the year and grew slower than average

Read roughly the same number of words as the average student at the start of the year and grew faster than average

Read roughly twice as many words as the average student at the start of the year and grew slower than average

Read roughly twice as many words as the average student at the start of the year and grew faster than average

Q49 Please briefly explain the reason for your answer choice.

_____

Q50 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Q51 Based on the current data, by May or June; Tom will likely be _____ on Words Read per Minute.

Below average
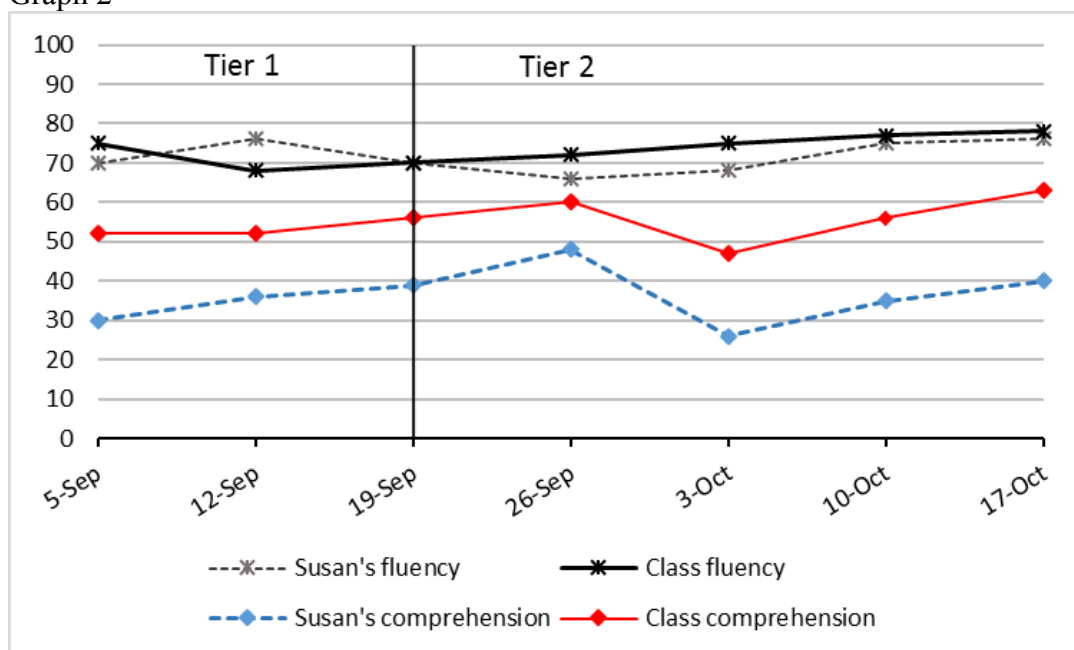
Average

Above average

Q52 Please briefly explain the reason for your answer choice. _____

Q53 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Graph 2

Q54 Susan was placed in a Tier 2 intervention (as shown by the vertical line) on September 19th for Reading Comprehension. According to her Comprehension scores:

Susan was making adequate progress in Tier 1 and should be moved back to Tier 1 only

Susan is making adequate progress in Tier 2 and should remain there

Susan is not making adequate progress in Tier 2 and should be placed in a Tier 3 intervention

Susan should be placed in an intervention for fluency only instead of comprehension

Susan should be placed in an intervention for fluency in addition to comprehension

Q55 Please briefly explain the reason for your answer choice.

_____

Q56 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer ()

Q57 According to her Fluency scores:

Susan is making adequate progress in Tier 1 and should remain there

Susan is not making adequate progress and should be moved to a Tier 2 fluency intervention

Susan is not making adequate progress and should be moved to a Tier 3 fluency intervention

Susan should be placed in an intervention for fluency in addition to reading comprehension

Q58 Please briefly explain the reason for your answer choice.
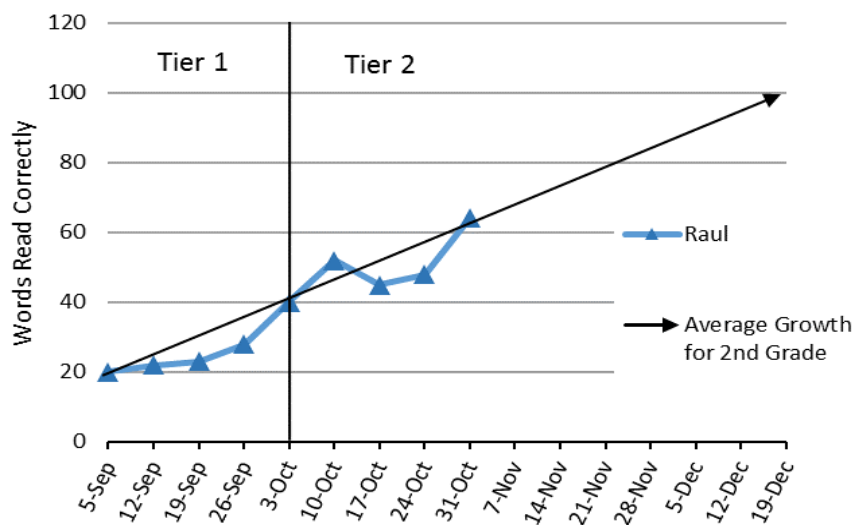
_____

Q59 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Please select the best answer from the 9 available options.

Graph 3

Q60 Based on this graph, please indicate what you would recommend for Raul:

Place in Tier 1 only

Continue in Tier 1 only

Place in Tier 2

Continue in Tier 2

Modify Tier 2

Place in Tier 3

Continue in Tier 3

Modify Tier 3

Refer for Special Education

Q61 Please briefly explain the reason for your answer choice.

_____

Q62 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Graph 4

Q63 Based on the graph, please indicate what you recommend for Sam:

Place in Tier 1 only

Continue in Tier 1 only

Place in Tier 2

Continue in Tier 2

Modify Tier 2

Place in Tier 3

Continue in Tier 3

Modify Tier 3

Refer for Special Education

Q64 Please briefly explain the reason for your answer choice.
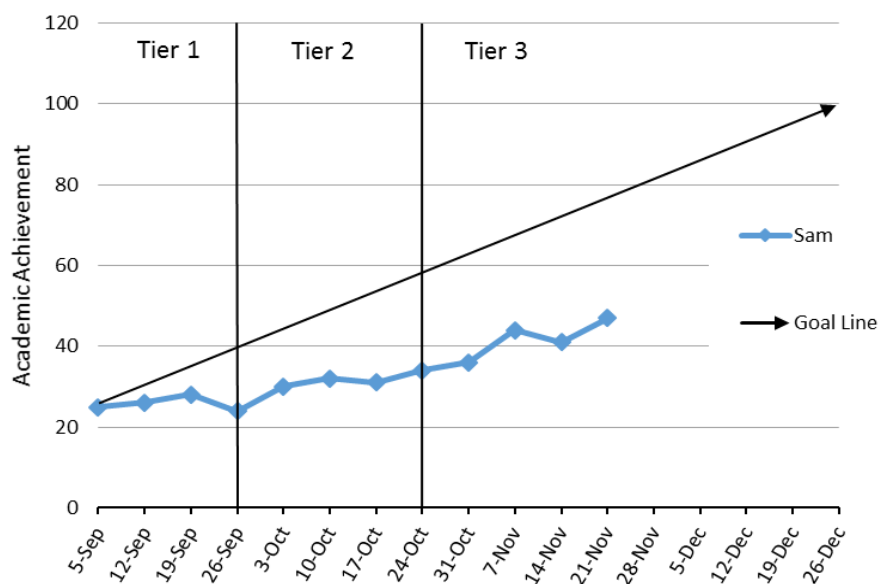
_____

Q65 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Graph 5

Q66 Based on this graph, please indicate what you recommend for Tina:

Place in Tier 1 only

Continue in Tier 1 only

Place in Tier 2

Continue in Tier 2

Modify Tier 2

Place in Tier 3

Continue in Tier 3

Modify Tier 3

Refer for Special Education

Q67 Please briefly explain the reason for your answer choice.
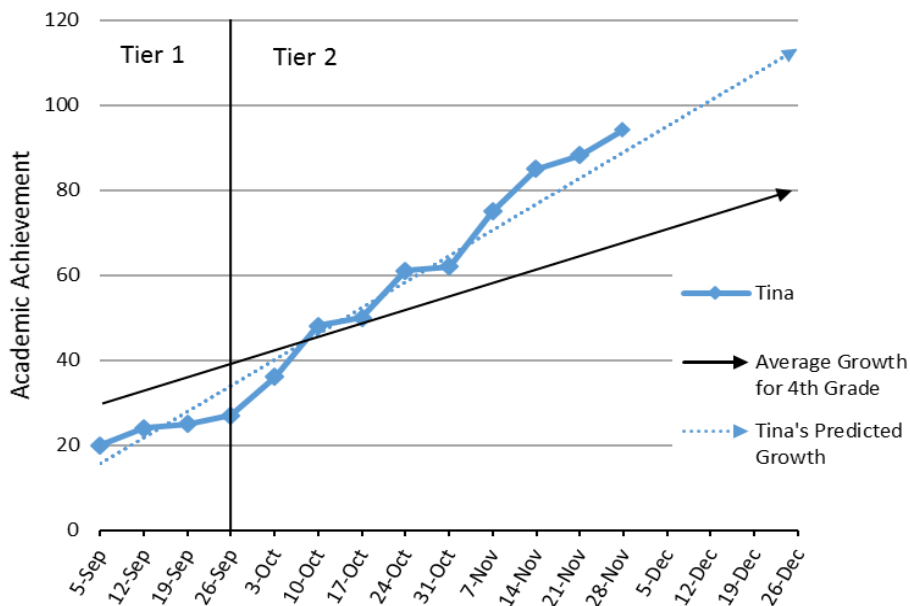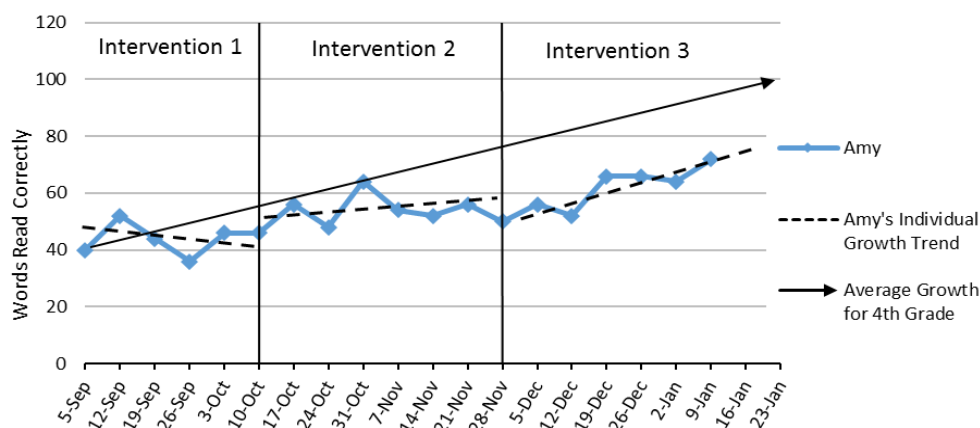
_____

Q68 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Graph 6

Q69 Based on the graph, which intervention did Amy respond to the best?

Intervention 1

Intervention 2

Intervention 3

Cannot be determined from the graph

Q70 Please briefly explain the reason for your answer choice.

_____

Q71 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Q72 Amy is now in intervention 3. Based on her response, she will likely:

Grow at a faster rate than her peers and catch them by the end of the year

Grow at a slower rate than her peers and fall further behind by the end of the year

Grow at the same rate as her peers and stay equally behind for the rest of the year

Q73 Please briefly explain the reason for your answer choice.

_____

Q74 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer
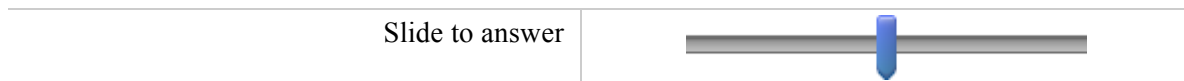
Q75 Based on the graph, please indicate what you recommend for Amy:

Intervention 1

Intervention 2

Intervention 3

Place her in new, more intensive intervention

Q76 Please briefly explain the reason for your answer choice.

_____

Q77 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Graph 7

Q78 What is Lisa's predicted growth score for December 12th?

43

62

50

55

40

Q79 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer

Q80 Lisa has a lot of bounce (i.e., fluctuation) in her data. Which of the following is the *least likely* contributing factor?

The fidelity of assessment administration and scoring

Lisa's motivation

Variability in the difficulty level of the progress monitoring probes

Too many progress monitoring probes being administered

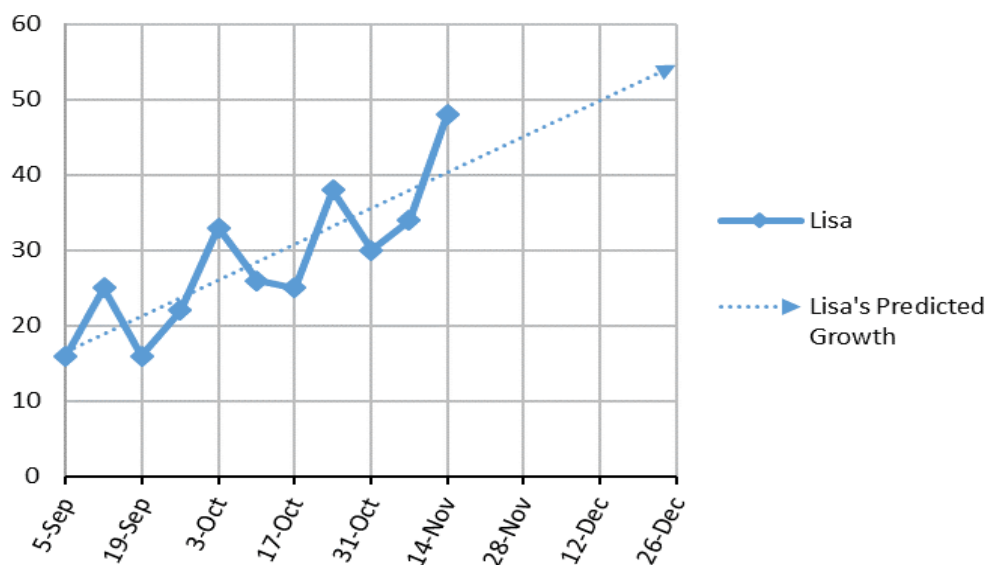Lisa's mastery level of the skill being measured

Q81 Please briefly explain the reason for your answer choice.

_____

Q82 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer	

Q83 Ideally, what would be the ***best*** way to minimize the bounce/fluctuation in Lisa's data in order to get the most accurate estimate of her growth?

Administer fewer probes overall

Administer more probes at each measurement occasion and take the average score

Change the setting, time, and person administering the measure

There is no way to help reduce bounce/fluctuation

Q84 Please briefly explain the reason for your answer choice.

_____

Q85 How confident are you of your answer (0 being not at all confident and 100 being completely confident)?

0   10   20   30   40   50   60   70   80   90   100

Slide to answer	

Q86 Number of years teaching

▼ 1 (1) ... 21 or more (21)

Q87 My school is considered

Rural

Urban

Suburban

Q88 To the best of your knowledge, what percentage of students at your school receive free or reduced-priced lunches?

75.1% or more

50.1-75.0%

25.1-50.0%

25.0% or less

I don't know

Q89 Would you consider your school:

Low socio-economic status (SES)

Average SES

High SES

Q90 Please select the number of students enrolled at your school:

Up to 450 students

Between 451 and 700 students

More than 701 students

Q91 I am currently teaching (select all that apply)

General core-content education (e.g., reading, math, science)

Special Education

Special area (e.g., music, physical education, art, etc.)

I am an administrator

Other (please specify) _____

Q89 Please indicate your gender

    Male

    Female

    Decline to state

Q90 In which state do you currently reside?

▼ Alabama (1) ... Wyoming (52)

Q91 Please indicate your race/ethnicity

    African American

    Asian/Pacific Islander

    Hispanic

    Native American or Alaskan Native

    White

    Multi-racial

    Decline to answer

Q92 What is the highest level of formal education you have attained?

    Bachelor's degree

    Master's degree

    Educational Specialist (Ed.S.)

    Doctorate or other terminal degree

    Other (please specify) _____

APPENDIX B

Table B1: Percentage of Teacher Respondents from Each State

50 States, D.C. and Puerto Rico

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Alabama	7	1.6	1.6	1.6
	3 Arizona	11	2.4	2.4	4.0
	4 Arkansas	3	.7	.7	4.7
	5 California	36	8.0	8.0	12.6
	6 Colorado	8	1.8	1.8	14.4
	7 Connecticut	6	1.3	1.3	15.7
	8 Delaware	1	.2	.2	16.0
	10 Florida	31	6.9	6.9	22.8
	11 Georgia	29	6.4	6.4	29.3
	12 Hawaii	8	1.8	1.8	31.0
	13 Idaho	2	.4	.4	31.5
	14 Illinois	20	4.4	4.4	35.9
	15 Indiana	9	2.0	2.0	37.9
	16 Iowa	3	.7	.7	38.6
	17 Kansas	5	1.1	1.1	39.7
	18 Kentucky	6	1.3	1.3	41.0
	19 Louisiana	7	1.6	1.6	42.6
	20 Maine	3	.7	.7	43.2
	21 Maryland	2	.4	.4	43.7
	22 Massachusetts	9	2.0	2.0	45.7
	23 Michigan	10	2.2	2.2	47.9
	24 Minnesota	8	1.8	1.8	49.7
	25 Mississippi	5	1.1	1.1	50.8
	26 Missouri	12	2.7	2.7	53.4
	28 Nebraska	2	.4	.4	53.9
	29 Nevada	5	1.1	1.1	55.0
	31 New Jersey	14	3.1	3.1	58.1
	32 New Mexico	3	.7	.7	58.8

33 New York	16	3.5	3.5	62.3
34 North Carolina	16	3.5	3.5	65.9
36 Ohio	17	3.8	3.8	69.6
37 Oklahoma	5	1.1	1.1	70.7
38 Oregon	4	.9	.9	71.6
39 Pennsylvania	9	2.0	2.0	73.6
42 South Carolina	6	1.3	1.3	74.9
44 Tennessee	32	7.1	7.1	82.0
45 Texas	52	11.5	11.5	93.6
46 Utah	1	.2	.2	93.8
47 Vermont	1	.2	.2	94.0
48 Virginia	12	2.7	2.7	96.7
49 Washington	6	1.3	1.3	98.0
50 West Virginia	2	.4	.4	98.4
51 Wisconsin	5	1.1	1.1	99.6
53 Washington D.C.	2	.4	.4	100.0
Total	451	100.0	100.0	

APPENDIX C: IRB Exemption Form

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN007 – EXEMPTION DETERMINATION NOTICE

Monday, July 30, 2018

Investigator(s):   Eric Oslund
Investigator(s') Email(s): eric.oslund@mtsu.edu
Department: Education

Study Title: Teachers' Knowledge and Implementation of Response to Intervention
                        Practices: Graph Literacy and Data-based Decision Making
Protocol ID: **18-1153**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category *(2) Educational Tests* A summary of the IRB action and other particulars in regard to this protocol application is tabulated as shown below:

IRB Action	EXEMPT from furhter IRB review***	
Date of expiration	**NOT APPLICABLE**	
Participant Size	450 [Four Hundred Fiftey]	
Participant Pool	**Adults 18+**	
Mandatory Restrictions	1. Participants must be age 18+	
	2. Informed consent must be obtained	
	3. Indentifiable information may not be collected	
Additional Restrictions	**None at this time**	
Comments	None at this time	
Amendments	**Date**	**Post-Approval Amendments**
	2.14.18	Survey revisions submitted 2.13.18 approved.
	4.9.18	Survey revisions submitted 4.5.18 approved.
	07.30.2018	Adam Rollins, Collin Olson, Nicole Couch and Masoud Mahmoodi-Shahrebabaki have been added to the protocol as co-investigators

***This exemption determination only allows above defined protocol from further IRB review such as continuing review. However, the following post-approval requirements still apply:
- Addition/removal of subject population should not be implemented without IRB approval
- Change in investigators must be notified and approved

Institutional Review Board   Office of Compliance   Middle Tennessee State University

- Modifications to procedures must be clearly articulated in an addendum request and the proposed changes must not be incorporated without an approval
- Be advised that the proposed change must comply within the requirements for exemption
- Changes to the research location must be approved – appropriate permission letter(s) from external institutions must accompany the addendum request form
- Changes to funding source must be notified via email (irb_submissions@mtsu.edu)
- The exemption does not expire as long as the protocol is in good standing
- Project completion must be reported via email (irb_submissions@mtsu.edu)
- Research-related injuries to the participants and other events must be reported within 48 hours of such events to compliance@mtsu.edu

The current MTSU IRB policies allow the investigators to make the following types of changes to this protocol without the need to report to the Office of Compliance, as long as the proposed changes do not result in the cancellation of the protocols eligibility for exemption:

- Editorial and minor administrative revisions to the consent form or other study documents
- Increasing/decreasing the participant size

The investigator(s) indicated in this notification should read and abide by all applicable post-approval conditions imposed with this approval. Refer to the post-approval guidelines posted in the MTSU IRB's website. Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 within 48 hours of the incident.

All of the research-related records, which include signed consent forms, current & past investigator information, training certificates, survey instruments and other documents related to the study, must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data storage must be maintained for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:
  Click here for a detailed list of the post-approval responsibilities.
  More information on exmpt procedures can be found here.

APPENDIX D: FCRAC Grant

Office of Research Services
Sam H. Ingram Building, Garden Level
MTSU Box 124
Murfreesboro, TN 37132
o: (615) 898-5005 • f: (615) 898-5028

MIDDLE
TENNESSEE
STATE UNIVERSITY.

November 16, 2017

Dr. Eric Oslund
Department of Elementary & Special Education
College of Education
MTSU Box 69

Proposal Title: Teachers' Knowledge, Training, and Use of Response to Intervention

Dr. Oslund:

Thank you for your application to the Faculty Research and Creative Activity Awards Committee (FRCAC). Excitedly, your application was awarded. The committee reviewed all applications and has provided peer-review feedback for you on this application. It is my hope that you are able to use this feedback on future submissions for funding support for your scholarship. The Office of Research (ORS) is here to assist you moving forward until you are successful on all funding applications. I pledged to all Middle Tennessee State University faculty that if they are interested in obtaining external funds to support their scholarly activities, I will use all the resources at my disposal to ensure that they are guided effectively over time until successful. Please use this pledge, and your FRCAC award, to help jumpstart a larger scholarly project.

If you have any questions about the FRCAC, please do not hesitate to contact the chair of the committee, Dr. Deborah Wagnon, at FRCAC@mtsu.edu. If you have any other questions regarding external funding to support your scholarship, do not hesitate to contact me. I wish you great success moving forward in your scholarship. And again, congratulations on your award.

Sincerely,

David L. Butler, Ph.D.
Vice Provost for Research and
Dean of the College of Graduate Studies
615.898.2182
David.Butler@mtsu.edu

cc: Dr. Robyn Ridgley, Chair, Department of Elementary & Special Education
      Dr. Lana Seivers, Dean, College of Education

<div align="center">Committee's Recommendation</div>

Total AY Awarded Amount: $9,550.00

Committee's Decision: Awarded as Requested

Comments
Reviewer 1
The findings of this proposal will help educators understand RTI better and will contribute to the RTI research from the teachers' perspective. The only question I have is the author has proposed several statistical models to analyze the data, the author can give a solid example on how the data will be analyzed and what are the variables are of interest.

Reviewer 2
The bulk of the requested funds would go to purchasing expensive software that will benefit the college long-term. He addresses a gap in the existing literature.

Committee Comments
- This proposal has the most potential of all the proposals for having a real impact. I feel this is a very valuable study.

- Please note that the applicant may not be able to appeal the committee's decision if the requested amount of funds were not granted.
- The awardee has to accept the committee's recommendation if a different amount has been granted – instructions for submitting an acceptance letter are enclosed.