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Elementary Pre-Service Teacher Knowledge and Transfer of Mathematics Intervention Practices

Amanda R. Hurlbut
Texas Woman's University

Jeanne Tunks
University of North Texas

Abstract

The purpose of this study was to examine how elementary pre-service teachers' transferred mathematics instructional practices learned in a methods course at the university to a field-based classroom setting using response to intervention (RTI) methodology. Pre-service teachers (PSTs) implemented a required Mathematics Interaction Project with small groups of elementary students in the field. The project consisted of initiating a screening instrument on a targeted math skill, providing four to six intervention lessons, and then tracking student progress using formative and summative assessment measures. Data were generated through document analysis of the MIP reflection submissions and focus group interviews with 22 participants. Findings indicate that most PSTs' transferred mathematics instructional practices such as manipulative use, lesson planning, and assessment to the field-based setting. However, only candidates with a background in special education saw the process specifically tied to response to intervention.

Introduction

Response to Intervention (RTI) is a general education intervention system used by classroom teachers to assist at-risk learners and provide individualized academic support to help all students succeed (Fuchs & Fuchs, 2006). It has been widely studied as an evidence-based intervention process to assist struggling learners or to identify a student with a learning disability in either reading or math (Fuchs, Compton, Fuchs, Paulsen, Bryant & Hamlet, 2005; Gersten, Chard, Jayanthi, Baker, Morphy & Flojo, 2009; Scammacca, Roberts, Vaughn, Edmonds, Wexler, & Reutebuch, 2007; Wanzek & Vaughn, 2007), especially in a post-No Child Left Behind 2001 legislation era.

Research has indicated that general education pre-service elementary teachers experience greater anxiety and lower levels of self-efficacy toward teaching mathematics in future settings than in reading, although participation in mathematics methods courses has shown to increase self-efficacy and lower anxiety toward teaching math (Philippou & Christou, 1998; Rule & Harrell, 2006; Sloan, 2010; Swars, 2005; Vinson, 2001). The National Mathematics Advisory Panel (2008) reported an overwhelming need for more research in teacher preparation and professional development, stating a lack of strong evidence for the impact of teacher education on teachers' knowledge or on their students' learning related to the teaching of mathematics. These factors, coupled with a general trend that favors reading-based intervention research over mathematics research in a classroom environment (Crawford & Ketterlin-Geller, 2008; Fletcher & Vaughn, 2009), studies in mathematics instruction and intervention in teacher preparation programs are certainly warranted.

There are several widely accepted components that are heralded to promote a successful RTI program in math including universal screening, continuous progress monitoring, and research-based instruction (National Research Center on Learning Disabilities, 2007; National Center on Response to Intervention [NCRTI], 2010; Gersten, Chard, et al., 2009). This is vital within the context of a pre-service teacher (PST) preparation program since implementation should begin within the context of a general education program.

Universal Screening

Universal screening is the first step in identifying students who are at-risk for learning difficulties in math (NCRTI, 2010; Lembke, Hampton, & Beyers, 2012). Screening is a form of a quick assessment given to a class or school-wide group of students, typically within the first month after a school year has started and follows again in the middle and end of the year. The purpose is to identify students who perform moderately to severely below a set standard or criterion on a math measure in order to identify learning needs and to select children needing a higher level of targeted instruction or intervention. There are a variety of mathematics screening measures available and research has demonstrated many of them as effective measures to identify at-risk learners (Fletcher & Vaughn, 2009). Many of these include components of Curriculum Based Measurement (CBM), in which screeners are given in the areas of early numeracy, computation, algebraic equations, and measurement (Lembke, Hampton & Beyers, 2012).

Progress Monitoring

Once universal screening has occurred, teachers must continually monitor student performance response in relation to the academic instruction and intervention being provided. This phenomenon has become known as progress monitoring. Using progress monitoring measures, teachers can monitor academic progress of students to compare target or expected rates of learning to that of the actual rate of learning (Stecker, Fuchs, & Fuchs, 2008). Progress monitoring occurs on a regular basis, typically on a weekly, bi-monthly, or monthly basis depending on the assessment measure being used. Teachers can then use the information gained about a student's progress or lack of response to an intervention to make decisions and problem-solve next steps for a student's educational programming. Effective progress monitoring tools are easily accessible and administrable, are available in alternate and differing forms, and are representative of the actual interventions being implemented (Fuchs, Compton, Fuchs, Bryant, & Davis, 2008).

The National Council of Teachers of Mathematics (NCTM, 2008) reported that mathematics assessment should be more than just a summative, end-of-unit assessment. Rather, assessment should be ongoing, informational, and indicative to future intervention as part of an integral feature of mathematics instruction. Mathematics based CBM tools can be used not only as screeners indicative of potential difficulties, but also as a method to monitor student progress within the context and alignment of the mathematics instructional objectives that are being taught (Lembke et al., 2012).

Research-Based Intervention

Scientific, research-based instruction is a cornerstone of RTI (Gersten, Chard, et al., 2009). Without research-sound practices, measures to evaluate and determine response to instruction are inconsequential. Provisions in NCLB 2001, supported by amendments in Individuals with Disabilities Improvement Act (IDEIA), 2004, specifically outline a general definition of scientific, research-based instruction including, "Research that involves the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs" (NCLB § 7801(37)). The inclusion of scientific, research-based intervention and instruction in NCLB legislation served to bridge the research to practice gap between those conducting research about educational practices and those delivering instruction in the classrooms (Zirkel & Rose, 2009).

In mathematics instruction and intervention, the National Mathematics Advisory Panel's (2008) synthesis of research recommends that early mathematics instruction entail concepts such as whole number arithmetic, number sense, fractions, geometry, and measurement in preparation for algebra as a foundation of mathematics proficiency. Specifically, the Panel (2008) reported that explicit, systematic and direct instruction in math is the most significant intervention within the realm of research-based strategies for low-achieving learners. This strategy is a carefully designed instructional approach that provides a specific sequence of instructional tasks and steps, followed by frequent practice opportunities to achieve mastery (Kroesbergen & Van Luit, 2003; Swanson, 2001). Further research in mathematics instruction and intervention purports that explicit instruction in mathematics should include effective teacher modeling, opportunities for guided practice, teacher checks for understanding, feedback to learners, and independent practice by the learner (Doabler, Cary, Jungjohann, Clarke, Fien, Baker & Chard, 2012; Doabler & Fien, 2013). Fuchs and Fuchs (2001) established further components of explicit math instruction including a quick pace with varied instructional activities and high levels of student engagement, challenging instructional standards, opportunities for students to verbalize their learning, and physical and visual representations or models of number concepts or problem solving situations. According the RTI principles, a core math curriculum should have a clearly identified research-base, explicit instructional techniques, and consistent instructional routines to guide teachers as intervention specialists (Gersten, Beckmann, Clarke, Foegen, Marsh, Star & Witzel, 2009; Gersten, Chard, et al., 2009).

RTI in Teacher Preparation Programs

The challenges of RTI implementation are present in both in-service and pre-service teacher development programs (Fuchs & Fuchs, 2006b; Nunn & Jantz, 2009; Richards, Pavri, Golez, Canges & Murphy, 2007). RTI is based on the premise that general educators will deliver evidence-based practices in the classroom setting (Danielson, Doolittle, & Bradley, 2007), and the training of pre-service teachers helps build capacity for future implementation in the schools. Danielson et al. stated, "at this point, there has not been sufficient attention paid to the implications of RTI for the pre-service preparation of personnel who will play critical roles in implementation (i.e. principals, general education teachers, [school] psychologists, and special educators)" (p. 633). If teachers receive preparation in RTI implementation at the pre-service level, there is some evidence that they may implement interventions in the classroom with more integrity and less coaching (Begeny & Martens, 2006).

According to a 2010 survey by the Florida Problem Solving/RTI Statewide Implementation Project, recent pre-service graduates indicated that teacher preparation programs needed to do more to expand the competencies and skills needed to work with struggling students in a problem solving or RTI model (Prasse, Breunlin, Giroux, Hunt, Morrison & Thier, 2012). Other studies have indicated similar reports, with teachers citing a lack of basic knowledge needed to teach struggling students (Hoppey, 2013; Mather, Bos, & Babur, 2001). While researchers often discuss the importance of pre-service training, studies are only beginning to emerge that specifically investigate pre-service teacher training and RTI practices.

A study by Grogg (2009) found that PSTs who participated in pre-referral training reported significant changes in knowledge about instructional interventions, including positive changes in perceptions of the assessment process, making decisions based on the data, and responding to individual student needs and attributed focused training in pre-referral activities to the pre-service teachers' ability to generalize this knowledge to future instructional settings. Hawkins, Kroeger, Musti-Rao, Barnett, and Ward (2008) found that effective RTI training models included several important components such as interdisciplinary training in specific RTI prevention or tier one practices, using assessment and progress monitoring data to make decisions, participation in team problem-solving, and selecting effective research-based interventions appropriate for specific student needs. This study emphasized the significance and challenges of placing pre-service professionals in field experiences that provide experiences in implementing an RTI program. In systemic program review of coursework, McCombes-Tolis and Spear-Swerling (2011) discovered that elementary PSTs were not routinely receiving explicit instruction regarding key RTI terminology, theoretical models and best practices of RTI, and research-based reading interventions. Inadequacies in preparing pre-service teachers to implement early reading interventions were confirmed again in a later study (Otaiba, Lake, Greulich, Folsom, & Guidry, 2012). Pre-service special education teachers who participated in an online RTI training system known as the IDEA '04 and Research for Inclusive Settings (IRIS) model were found to have significant positive changes in their reported knowledge about RTI as compared to pre- and post-participation in the modules (Kuo, 2013). Furthermore, the modules were shown to increase background knowledge about RTI although the sustainability of this knowledge in classroom settings remains unknown. Finally, a study by Neal (2013) set out to discover general and special education pre-service teachers' perceptions of RTI and their perceived ability to implement an RTI program in future settings. While most pre-service participants perceived RTI as a necessary and crucial part of assisting struggling students, there was a significant difference among participants in the reported ability to implement RTI. Special education PSTs reported much higher levels of self-efficacy in implementing RTI, mainly due to differences in coursework and fieldwork experiences compared to the general education program. A common theme seen among all participants in the study was the need for more training and hands-on experiences with implementing RTI in a school setting, suggesting that teacher preparation is a vital component of implementing an effective RTI program in future classroom settings.

In many of these studies, participants primarily included psychology students and special educators rather than general education pre-service practitioners (Hawkins et al., 2008; Kuo, 2013; Neal, 2013). The encompassing RTI literature typically situates RTI as a general rather than special education intervention (Fletcher & Vaughn, 2009; Mastropieri & Scruggs, 2005). Overall, more information is needed about how teacher preparation programs integrate strategies for learning how to diagnose, intervene, and monitor struggling students specific to the RTI framework established formally in NCLB 2001 and IDEA 2004. General education teachers are expected to effectively use assessments, monitor progress, and make sound educational decisions for students who are struggling. When considering the prominent role general educators play in the implementation of RTI, this is cause for concern (Neal, 2013).

Recent emphasis on PST preparation methods and a focus on meeting the academic needs of a diverse student population in the general education classroom has certainly indicated the need for more research in the practices of these programs (National Mathematics Advisory Panel [NMAP], 2008; National Council on the Accreditation of Teacher Education [NCATE], 2010; National Council on Teacher Quality [NCTQ], 2013). Of particular interest is the need to understand how early childhood and elementary education PSTs are prepared to include RTI practices in their mathematics classrooms, and how these PSTs transfer their university preparation by applying the principles of RTI in their fieldwork experiences. The purpose of the study was to examine PSTs' understanding, practice, and generalization of intervention practices in an elementary mathematics methods course assignment that applies RTI methodology. Specifically, the questions that guided this study were:

- What instructional and theoretical knowledge and skills about mathematics intervention taught in a methods course do PSTs transfer to a field-based setting?
- How does the field-based experience facilitate transfer of knowledge about mathematics intervention and RTI?

Theoretical Framework

Research documents that there is an existing transfer problem in the realm of PST education (Korthagen & Kessels, 1999; Wubbels, Korthagen, & Brekelmans, 1997). A synthesis of the literature reveals several documented areas of concern regarding PST education and the transfer of knowledge and experience to actual teaching settings (Bransford & Schwartz, 1999; Stofflet & Stoddart, 1994). Research in teaching and learning reveals that existing or prior knowledge has a major impact on comprehension and learning.

Robert Haskell (1987) developed a theory of learning transfer by synthesizing years of research on transfer within learning contexts applicable to an educational framework. Haskell believed that the transfer of learning refers to application and acclimatization of previous learning to new contexts. Constructivist learning theory idealizes the notion that prior knowledge and experiences are essential for new learning to occur; the issue with transfer arises when new learning is applied to vastly different contexts. Haskell posited that significant transfer could only occur when new learning transpired in order to produce the transfer. He suggested that near, far, and displacement or creative transfer were the highest levels to strive for and insisted that unless new learning occurred, the only thing that resulted was the application of the same learning, rather than the transfer of new learning. Studies in transfer and generalization have corroborated this theory for meaningful transfer (Calais, 2006; Clark & Voogel, 1985; Comier & Hagman, 1987).

Haskell summarized 11 widely accepted educational principles that he found were instigators of significant transfer processes. These include: Principle 1 – Knowledge Base; Principle 2 – Related Knowledge; Principle 3 – Understanding of Transfer; Principle 4 – Understanding of the History of the Topic; Principle 5 – Motivation and a "Spirit of Transfer"; Principle 6 – Think and Encode Learning; Principle 7 – Culture and Context of Transfer; Principle 8 – Theory; Principle 9 – Drill and Practice; Principle 10 – Time to Incubate; and Principle 11 – Study Written Works by Exemplars of Transfer Thinking.

All 11 principles were used to analyze and initially code data in order to determine the type and level of transfer that occurred regarding mathematics intervention practices among PST participants. Transfer is a vital consideration as PSTs apply learning in coursework and field-based experiences to the teaching profession. This is a complex process and requires careful, explicit educational opportunities designed to specifically facilitate transfer (Benander & Lightner, 2005).

Calais (2006) stated that educational learning must consider Haskell's levels to design opportunities for higher, more significant levels of transfer to occur. This study sought to identify the RTI knowledge that was implemented through a teacher education preparation program, in particular, a Mathematics Interaction Project (MIP), that was implemented in the mathematics methods course, through the lens of Haskell's levels and principles of transfer in order to understand how PSTs transfer this learning to a field-based teaching context. In this study, while all transfer principles were considered in the initial coding scheme, only two principles consistently emerged when looking at how PSTs transferred mathematics intervention practices: Principle 1 (knowledge of mathematics intervention and RTI in general) and Principle 9 (drill and practice or authentic field experiences related to the knowledge). The findings in this study are organized within the sub-themes that emerged in the knowledge and understanding of intervention and in the reported experiences that PSTs encountered with mathematics intervention and RTI.

Methods

The research design followed a case study methodology and examined intervention practices that transferred from the mathematics methods course through a field-based assignment known as the Mathematics Interactions Project (MIP). Undergraduate students working toward elementary teaching certification at a north Texas university were recruited as participants. PSTs choose from one of several routes to obtain certification from the university, including: Early Childhood–6th Grade Generalist, or Generalist with a specialization. The specialization areas include English as a Second Language (ESL), Bilingual, or Special Education (SPED). PSTs also participated in field-based experiences known as Professional Development School Cadres with partner school districts while taking methods classes at the university. During this phase, courses taught at the university are designed to interface theory to practice in the field. Assignments from courses align theories presented in class with field experience opportunities to test the theories with young learners. Participants applied field based applications in two different elementary-age settings or placements.

Participants

During the spring 2016 semester, all students registered for the Mathematics Methods course were recruited as potential participants. Approximately 85 PSTs were enrolled in coursework, from which 22 candidates participated in all aspects of the study by submitting copies of relevant coursework for data collection purposes and participating in three sequenced focus group interviews. The participants included one Bilingual candidate, six SPED candidates, and 15 ESL candidates across four sections or cadres of the mathematics methods courses.

Table 1. *Demographic Characteristics of Participants*

Participant	Degree Plan	Cadre	Rotation 1	Rotation 2	Age	Gender	Ethnicity
A1	ESL	A	6th math	K	22	F	Hispanic
A2	ESL	A	5th	K	24	F	Asian
A3	ESL	A	4th	K	22	F	White
A4	ESL	A	1st	5th	22	F	Asian
A5	SPED	A	4th	Resource	26	F	Asian
A6	ESL	A	K	4th	22	F	Mixed
B1	SPED	B	Life Skills	1st	28	F	White
B2	ESL	B	5th	2nd	23	F	White
B3	Bilingual	B	4th	2nd	24	F	Hispanic
B4	ESL	B	4th	2nd	22	F	White
B5	SPED	B	2nd Grade	Life Skills	22	F	White
C1	SPED	C	1st	SPED	25	F	White
C2	ESL	C	2nd	5th	25	F	White
C3	SPED	C	Resource	K	22	F	White
C4	SPED	C	Resource	K	22	F	White

Participant	Degree Plan	Cadre	Rotation 1	Rotation 2	Age	Gender	Ethnicity
C5	**ESL**	**C**	**K**	**4th**	**22**	**F**	**White**
D1	ESL	D	4th	5th	22	F	White
D2	ESL	D	K	3rd	22	F	Hispanic
D3	ESL	D	2nd	5th	23	F	White
D4	ESL	D	K	4th	22	F	White
D5	ESL	D	5th	K	23	F	White
D6	ESL	D	3rd	5th	22	F	White

Data Sources

Data were derived from document analysis of the PSTs' MIP field based assignment and focus group interviews during the first student teaching semester. The MIP is a required assignment in the mathematics methods course. In this project, PSTs work with a supervising or mentor teacher to select and implement an appropriate assessment and intervention protocol that will be delivered to a student or small group of students over a four to six week timeframe. As part of this protocol, teacher candidates interact directly with a small group of students using mathematics intervention processes, sometimes known as tutoring, as the center of the interactions.

The outline of the MI Project mimics an RTI process by requiring teachers to analyze data in order to make appropriate instructional decisions for their students. Specifically, in the first week of the interaction, PSTs give a pre-assessment (universal screening) to a small selection of students that have been identified as struggling or in need of further academic assistance in a particular math area. Once the pre-assessment data has been gathered, PSTs analyze the information (progress monitoring) in order to create lessons specifically addressing a weak instructional math skill. PSTs are required to use research-based strategies learned in their mathematics methods class as methods to intervene with students (concrete manipulatives, symbolic drawings, formula representations, etc.). The project is designed so that PSTs deliver at least one lesson per week on the same targeted skill to document whether or not students demonstrate progress. Concurrent with the intervention processes, PSTs are also required to implement formative assessments (progress monitoring) after each tutoring session to determine if students are making adequate progress in learning the targeted skill. If students are not making progress, PSTs have to reflect on the reasons why and make instructional adjustments as necessary. Finally, PSTs complete a summative, post-assessment to determine overall learning progress at the end of the six-week interaction compared to the first week, pre-assessment. PSTs are expected to continually reflect on this process of assessment, intervention, and monitoring as a simulation of a campus based RTI procedure. As the final MIP submission, students are required to turn in all formative and summative assessments used, lessons detailing the instructional activities, screenshots of materials and resources used during the lessons, and reflection notes on each stage of the intervention project. Additionally, students submitted a final written reflection that detailed the process, what they learned about their students, and what they learned about mathematics instruction in general.

Focus group interviews were conducted with small groups of PSTs during concurrent enrollment in the mathematics methods course to further explore how they were able to transfer mathematical knowledge from the methods course to the active fieldwork context. The structure for the interview sequence followed Seidman's (2006) three-interview series. In this format, each interview in the series follows a specific concentration. These included: participants' educational histories, details of the MIP experience, and reflections on the meaning. The interviews occurred approximately three to nine days apart from each other and questions were open-ended so as to allow participants to reconstruct experiences within the confines of the topic of study.

Data Analysis

A document analysis approach was used to examine data gathered from the MIP documents and focus group interviews. The interviews were digitally recorded and transcribed to a digital form. Both the MIP documents and transcribed interviews were uploaded into NVIVO 11 for analysis. NVIVO 11 is a qualitative data analysis software package that facilitates the organization of unstructured data by classifying, sorting, and arranging information to determine relationships, patterns, and/or trends in the data (QSR International, 2016). Data from the interviews and MIPs were analyzed using coding categories from the principles aligning with RTI practices. Sub-themes emerged through a frequent word count analysis as participants discussed several consistent topics such as assessment, intervention, use of manipulatives, and mathematics best practices.

Findings

Assessment

The assessment process was repeatedly cited as a tool that was necessary in identifying student learning needs and as a way to determine whether student learning had occurred during the MIP interactions. In many cases, PSTs discussed how this project actually allowed them to understand an authentic view of a classroom teacher through using assessment data to drive instructional practices. The following quote exemplifies the “ah-ha” moments that many PSTs had about the value of assessments in planning meaningful instructional interactions:

> Through my interactions with these students, I was able to understand the value of assessment, determining what students know and also what they do not know. Assessment is not simply another activity to check off the lesson plan when a teacher is presenting a lesson; rather, it is a tool to help that teacher see if students understood what was being taught. Assessment is a valuable key in lesson planning because assessments guide the teacher toward her next lesson (Participant C2).

PSTs consistently used a pre-and post-test in addition to ongoing formative assessments as part of the MIP to determine student capabilities and growth and reflected upon their learning and the purposes of each.

Pre-test. PSTs were required to initiate a series of mathematical interactions or lessons with one to four students by completing a pre-assessment to determine student instructional needs. This was usually done in collaboration with the mentor teacher as the highest source of knowledge about the students’ instructional background. In most cases, the mentor teacher assigned a particular mathematics topic or skill (i.e. place value to the ones, tens, and hundreds place or adding and subtracting fractions with unlike denominators). The PST then had to select or create a pre-assessment to determine students’ areas of weakness and plan a course of action to mathematically intervene for that group of students. Based upon reflections from the MIP, PSTs saw value in the use of a pre-assessment to determine instructional needs. For example:

> I was able to create a pre-test that would involve students completing all three parts of the TEKS [sic]. After this was created, I started to map out when I wanted to teach/reteach the subparts to the concept. I decided on starting with identifying, then moving to representing, and finally writing numbers 10-20. This was a challenge in and of itself. It was difficult to have to pick and choose activities that I thought would be most beneficial to students. I was not very confident in this because I have never actually had to teach math

> lessons prior to this. Yes, I could write a pretty awesome lesson on paper, but I have never been required to actually execute that lesson (Participant C3).

In other cases, the PSTs saw how they failed to design or create a pre-assessment that provided adequate information about student knowledge and needed to conduct additional assessments or monitoring as part of a lesson to specifically determine student mastery and developing skills.

> I was disappointed that the pre-assessment was so easy for the students because it did not give me much to look at in regard to what improvements the students needed to make. That is the reason why my lessons bounced around in regard to concepts. I was continually trying to get a feel for what exactly it was that my students needed (Participant D6).

The implemented pre-tests did not follow an identical or consistent format since PSTs had a range of grade levels, students, environments, and math skills that they were implementing as part of the MIP. However, it became evident that some sections of the course were encouraged to use technology in their pre- and post-assessment. These pre-tests came in the form of iPad applications such as Splash Math, Moose Math or Smash Subtraction. Other sections of the mathematics methods course used a variety of pre-assessment designs including formal multiple-choice tests or open answer worksheets, board games, technology applications, or a series of math problems with manipulatives. Perceptions about using technology in the assessment process was mixed; some PSTs liked incorporating these tools, while others did not observe the value acquiring information about the students' level of mathematics ability.

Formative assessment. PSTs often stated that formative assessments, or assessments that are informal, ongoing, and primarily used to monitor student progress in order to drive instruction, were often more helpful than the pre-assessment at determining student learning needs. In many cases, the PSTs discussed in their MIP reflections about how they were not able to specifically identify what students needed to work on through the pre-assessment alone and depended upon additional informal assessment data or information gained from the first interaction lesson to truly pinpoint or target student instructional needs. The following quote best exemplifies this point:

> I was not able to take much from the pre-assessment to apply it to the interactions. I saw that the students were mastering their addition facts and I wanted to reinforce it by presenting different strategies they could use. Other than that, I was not sure on how to go about the lesson. I did not use much of the pre-assessment as a reference. Once I finished the lesson, I realized that the first interaction served more as a pre-assessment. From that, I was able to take notes on what the students needed to work on (Participant A2).

Other thoughts demonstrated how the pre-service students used informal data and formative measures of assessing students as a way to better understand student learning and make instructional decisions about what is being learned:

> Having students solve problems and then show the steps they took was the best way to check for understanding and accuracy. I was able to see where mistakes were made when students showed their work while solving a problem. Observations throughout, rather than pop-quizzes at the end of each lesson, helped keep the stress of testing away from students, eliminating test anxiety as a factor (Participant D4).

In all cases, PSTs were required to explain how they would informally assess student progress during the math interactions. These informal assessments included written worksheets, acting out problems with teacher checklists, having the students play games, or taking written notes of observations about students during the interaction time. In many cases, students were required to take pictures as proof of the mathematical interaction and formative assessments being implemented. These assessments were used at all stages of the MIP to make instructional decisions about what students were learning, mastering, or needed to continue working on or regarding individual student needs and how best to work with students. It was clear that formative assessment was understood as a way to monitor progress of student learning in order to make future plans and decisions about instruction. PSTs wrote about formative assessment:

> I intend to continue working on this [sic] topic because the students still showed room for improvement based on the scores of the formative assessment taken using the Moose Math App. Although I am remaining on this topic, I did see the students making connections between the app, the previous dice activity, and the addition problems we had been working on in class (Participant C4).

Almost all PSTs repeatedly gave statements and reflections such as these to indicate how assessments influenced their ability to provide appropriate instruction for their students. Continuous assessment played an important role in the PSTs' ability to make decisions regarding the instructional needs of their learners.

Post-test analysis. All MIP samples included a summary, discussion, and reflection of student growth within the context of a pre- and post-test analysis. The primary difference in the post-assessment results compared to the pre-test and formative assessment sections, is that the post-test was used as a summative or ending assessment to determine overall growth of the students at the conclusion of the MIP. The MIP findings regarding post-test results indicate that PSTs categorized the growth of their students in one of four ways:

1. Students made significant progress from pre- to post-test. The PST attributed growth to student-demonstrated use of specific strategies that were taught as part of the mathematical interactions or interventions. For example:

   > The children learned from my Mathematical Interaction Project. The pretest and posttest had a huge change in results. The children I had been working with went from getting all the questions wrong on the pre-test to getting almost all correct (Participant C5).

2. Students made significant progress from pre-to post-test. The PST was unsure if progress was attributed to mathematical intervention or regular classroom instruction, as in this case:

   > Learning did occur. Whether it had anything to do with me, that is unknown. I did see progress in student A's work. Although he completed less of the games, he was able to understand the concept more. The numbers of games completed declined between each child (Participant A2).

3. Students did not demonstrate progress or showed minimal progress from pre- to post-test. The PST thought that students made progress or learned according to formative assessments and observations in the interactions.

   > If I graded students' post-test on their numbers and operations Girl #3 would have gotten them all wrong, and Girl #2 would be the only one with a right answer. If I graded the tests on processes and problem-solving, then each of the girls would have gotten a one-hundred. Just looking at scores, the pre and the post tests are practically in the same box. However, for these tests, since I taught a new strategy I chose to grade on whether or not they used their steps correctly instead of grading on their multiplication, subtraction, and division operations. If the question is, did learning occur? The answer would be yes (Participant D1).

4. Students did not demonstrate progress or showed minimal progress from pre- to post-test; the PST attributed the lack of growth to factors such as student behavior, lack of motivation, student absences during the interventions, or student background information such as the student having a learning or other disability. For example:

> Between the pre-test and the post-test, I think that my student did better on the pre-test. I believe that the results were affected due to the fact that my student was reluctant to learn. The student did the bare minimum to complete the lessons. I feel that the student was stressed out because of the State test and this assignment made her tired. The student did not master the learning objectives (Participant D3).

Table 2 shows the relative percentages of the PSTs' perceptions of student growth within the four categories using PSTs' reflections about formative assessment growth and final reflections from the pre/post-test analysis.

Table 2. *PST Perceptions of Student Growth*

Category 1 – Pre/Post Test Growth using MI Strategies 55% 12/22 teachers	Category 2 – Pre/Post Test Growth, Cause Unknown 14% 3/22 teachers
Category 3 – Minimal Pre/Post Test Growth, Learning Occurred 23% 5/22 teachers	Category 4 – Minimal Pre/Post Test Growth, Attributed to Other Factors 8% 2/22 teachers

According to the table, the majority of PSTs were able to observe how students were specifically using strategies that were taught as part of the MI lessons during the weekly formative assessments and demonstrated on the post-test results. Some saw that progress occurred but were not sure if the progress was a result of receiving instructional time in general classroom instruction on the topic or from the MI tutoring. PSTs in the second category tended to be working with students who were identified by the mentor teacher as needing extra help during the instructional time rather than students who were behind or consistently struggling with specific math concepts. PSTs in categories three and four discussed varying levels of learning although no specific results were demonstrated on students' pre- and post-test comparison. Five PSTs were still able to observe how learning occurred through observation and ongoing student progress monitoring while two PSTs attributed the little growth to factors outside of their control, including student intrinsic motivation, absences, and/or identified academic or behavior disabilities. In all cases, it is evident that PSTs were able to use the information gained from the pre- to post-test comparison, in conjunction with formative assessment data gained during the interactions to make educational judgments and to guide the decision making process of a teacher during an instructional cycle.

Information provided by PSTs during the focus group interviews echoed sentiments expressed on the MIP submissions. Many cited that they had technology issues or other unanticipated concerns which skewed their results, such as students demonstrating behavior issues, guessing answers rather than authentically attempting the activity, or shutting down and refusing to work when the activity was too difficult. PSTs also found that in some cases the pre-assessment was not specific enough in pinpointing student weaknesses in the mathematics content. For example:

> For my pre-assessment, I used the district benchmark test. I almost feel like using the standardized test helped me more than doing my own pre-assessment because they align those with what Texas Essential Knowledge and Skills are supposed to be using and the supporting TEKS that need to be there. It really clarified exactly what I needed to work on

> as opposed to decimals in general – for instance, what part of decimals? (Focus Group A, Interview 2).

Additional assessment opportunities were crucial in helping PSTs plan appropriate learning activities. Some teachers learned the importance of aligning the pre- and post-assessment to accurately measure student growth on a particular concept; many participants found that their alignment was not specific enough regarding the particular math skills that were being taught and assessed, which led to inaccurate results and conclusions about student learning.

Mathematics Instructional Practices

Understanding of best math practices. PSTs frequently reflected on how an understanding of best teaching practices in mathematics instruction was vital in helping students' progress in the learning process. Specifically, PSTs discussed pacing of lessons, how mathematics concepts build upon one another, and how mathematics learning is often about the varied processes rather than the content of arriving at a correct answer.

The pacing of a lesson was the most frequently cited topic within the realm of best teaching practices. Several PSTs discussed how the MI lessons taught them the importance of making sure to slow down and fully explain a topic or concept before moving on or making sure to review prior concepts and assess whether a student had mastery of a topic before moving on.

> I learned that it is important to pace my instruction accordingly to the student's level of understanding. The student may lose focus or become lost during critical points of teaching. Therefore, I would always have to go back a few more steps to confirm the student's understanding of a particular step. I have realized that because the pacing of the lesson is different for students, then I may or may not need to work with one student a little longer (Participant A4).

Another frequent topic PSTs discussed was how mathematics teachers needed to understand that math concepts build on one another; in other words, it is vital that teachers know how some mathematics knowledge requires the learner to have a foundational knowledge or skill before the acquisition or development of a new skill. These quotes exemplify this point by discussing how mathematics foundational knowledge was important when teaching skills such as place value and division:

> Getting a student to learn about something new may require me as the teacher to refresh a student's memory a little bit to get them back on track moving on to a newer math concept. For this lesson, since I wanted the students to work with numbers in the hundreds place, I have to make sure the student fully understands the ones and tens places first before moving on to the hundreds place. Having prior knowledge in math is key to moving upwards to a higher level of math. I feel that as a math teacher, it is important to give the student opportunities to make connections between math concepts (Participant A4).

PSTs discussed mathematics process skills as an important understanding for teachers' mathematical knowledge. Specifically, the participants observed how some students needed to have mathematics concepts explained in numerous ways before they could see mastery or needed to emphasize the process of solving a problem rather than the solution. For example:

> I learned that as a mathematics teacher, it is essential to teach our students the process and reasoning of "why" a problem is solved in a certain way. Otherwise, students would never fully grasp mathematics concepts. To build a more solid foundation for any topic,

> the teacher should effectively ensure students understand the process, not just a means to arrive at a correct answer (Participant A5).

Other topics that PSTs discussed in their MIP reflections related to having a strong understanding of best mathematics processes included connecting learning opportunities to real life experiences, activating prior background knowledge, the importance of using inquiry based questions to help guide students in the learning process and making sure that the teacher had a solid mathematics knowledge of the concept and how it needed to be taught.

Lesson planning. PSTs were required to implement a series of three to four lessons as part of the MIP. A review of the lesson plans within the MIP submissions contained relatively consistent common elements including the student information and grade level, the state curriculum standard(s), the National Council of Teachers of Mathematics or NCTM Content and Process standards, student learning objective(s), manipulatives and/or technology, activities, formative and summative assessment, and a brief reflection on the lesson. There were some differences seen in the essential elements of the lesson plans that varied by each course section. About half of the lesson plans had a general description of the lesson activities while the remaining contained very specific steps such as the lesson introduction, developmental activities, and a closing. One group of MIPs did not have a written reflection with each lesson, but did require a summative reflection about the process at the end of the MIP assignment; the other sections had written reflections, either with the lesson plan or in the form of journals after each lesson was written and implemented. It became immediately apparent that the use of manipulatives and/or some form of technology during the lesson sequence was a prerequisite since all PSTs used these in their lessons. Overall, PSTs produced relatively similar lesson components in the format required as part of the MIP.

Curriculum alignment was a topic that PSTs discussed to some degree. Since PSTs were required to include the state curriculum objectives on their lesson plans, this was something that many of them reflected upon within the context of understanding how to plan for the instructional needs of their students. For example:

> One of the duties of being an effective teacher consists of reflecting on my own teaching. I believe in order to improve as a math teacher, I need to be aware of the Texas Essential Knowledge and Skills (TEKS) for the grade level above and below of the grade that I will teach. It’s important for teachers to be aware of the TEKS below and above the current grade level they are teaching so they know what to expect of the students and what the students are expected to learn the following year (Participant B4).

Since instructional interventions were developed in collaboration with the mentor teacher, typically there was very little choice in the math topics that PSTs implemented with students; PSTs worked on math skills according to student needs data from the pre-assessment and the mentor teacher oversight. However, there were some trends that emerged related to the student grade levels that PSTs were assigned to. PSTs working in kindergarten typically designed lessons around numbers and operations TEKS, such as learning to correctly count, write, and identify numbers to 20 or basic addition and subtraction properties. In the lower to middle level grades, such as second or third grade, teachers often worked on TEKS involving place value identification and regrouping of numbers to the ones, tens, and hundreds place. Participants assigned to the upper elementary grades frequently worked on comparing, order, adding, and subtracting fractions with uncommon denominators. While PSTs had little control over these topics, it is noteworthy that participants assigned to the same grade levels had relatively similar experiences within curriculum implementation of the math TEKS.

Participant written reflections about the lesson planning process repeatedly stressed the importance of being prepared and planning in order to facilitate a successful mathematics interaction with students. PSTs discussed how the planning process in the MIP allowed them to better understand the importance of accommodating for student learning needs.

> I realized when students work at different paces, it is essential to have something else (related to the topic, of course) prepared for the faster working student (Participant A5).

PSTs discussing accommodations and modifications to lessons often cited the failure of students to identify concepts immediately because the teacher had not fully considered an explanation or had not anticipated the individual learning needs within the small group of students; thus, planning was seen as a vital process of considering how to work with individual learning styles and needs.

Reflections about lesson planning also discussed how effective planning led to more successful lessons while ineffective planning or a failure to design, organize or adequately structure learning activities led to complications or challenges within the interactions. This quote demonstrate reflections in this category:

> I had imagined students playing the game and I could assess them on their addition while they played. From my reflections, I could see that turned out to be a big flop! I had planned out one perfect world scenario and nothing else. What I have learned to do is to plan for the worst and expect the best (Participant A2).

Often, activities that were implemented with students did not go according to the written lesson plan and the PSTs found themselves in a position needing to adjust accordingly; the sentiments that were repeated over and over in the reflections stated, "it did not go as planned." This led participants to the conclusion that effective planning, including anticipation of challenges or additional student needs, is more than just a piece of paper. The following quote validates many of these conclusions about the lesson planning process:

> The takeaways from this project revolve around lesson planning, assessments, and my teachings. In designing, executing, analyzing, and reflecting on each individual lesson and the entire project, I learned how much time, planning, effort, and research math lessons can take (Participant C3).

In the focus group interviews, PSTs continually reflected on the real nature of lesson planning through the MIP since participants were actually implementing the plans with students. Reflections emphasized the instructional adjustments that students needed or how the MIP helped them to gain personal experience implementing written lessons.

> I know that it is important to assess, but I learned how to reflect on my lessons and assess in order to make and address some modifications. I do not have a lot of experience implementing the modifications. I know how to write them in a lesson plan, but I never had to actually modify lesson plans to differentiate for students (Focus Group B, Interview 2).

Overall, lesson planning was a significant part of participant reflections as the PSTs struggled to understand the planning and instructional process in action with students.

Engaging math activities. Nearly every PST commented in some form on having engaging math activities as part of their lessons. Many of the teachers reflected on how creating engaging learning activities facilitated math learning and student progress. Creating engaging learning opportunities allowed the students to demonstrate interest in the lessons and active involvement in the learning process, which led to learner growth. Many of the participants also found a connection between engaging activities and challenging content; if an activity or lesson was not challenging, then it was also not engaging. The trend was that engaging learning opportunities were both fun in format and challenging in content. For example:

> In my first interaction, I was challenged because it was too easy…students were bored. They had mastered number identification and counting, so my next challenge was planning something that would be engaging and more challenging. I did not want them to be able to fly [sic] through it and I wanted them to think critically…this experience taught me the value of patience and planning. It taught me the importance of pretesting to get an idea of where students are academically. I learned that it is incredibly difficult to come up with math activities that are equally as entertaining, as they are quality and challenging (Participant A3).

Engaging math activities were usually discussed within the context of active hands-on games, technology applications such as iPad apps, and the tools of math also known as manipulatives. Additionally, many PSTs noticed a relationship between the content and application of a hands-on learning method such as playing a game and reduced issues with behavior concerns since students were more actively involved in their learning.

> During this lesson, I saw that student engagement was high. Normally, in the whole group setting, these three students quickly became off task and unengaged. This is because they do not understand the material, they become bored, or they are simply uninterested. I saw the students eager to work with these activities and learn in my project! (Participant C3).

As mentioned, manipulatives were foundational tenets of the MIP lessons; PSTs used manipulatives or technology in their lessons with students while abandoning paper and pencil and rote memorization techniques as methods for teaching mathematics. There were a variety of manipulatives used, depending on the particular math skill being taught. A few of the specific manipulatives included: counting objects (bears, circles, cars, etc.), snap cubes, base ten blocks, ten frames, Cuisenaire rods (fraction sticks), fraction circles, dominos, and rekenreks. PSTs commented on the value of using manipulatives in their lessons or attributed student success directly to the use of such manipulatives in the interactions:

> I think the successful outcome of this lesson would not have been possible without the use of the base ten blocks and the place values mat. The lesson would not have been successful without these manipulatives, and the student would have a very hard time grasping the concept of "carrying over to the tens place" when they see an excessive number of ones (Participant A4).

Mathematics instructional practices was also a focus in the group interviews and was related to how PSTs learned to teach the mathematics content and the use of manipulatives as tools to help students learn. PSTs continually referred to the differences in how they were taught mathematics compared to the expectations of learning mathematics now. Many appeared to be reluctant or hesitant to use manipulatives in order to teach math conceptually or shared that they were unfamiliar with the manipulatives in their own experiences. However, as the manipulatives were shared as a requirement of the project, these attitudes seemingly changed as PSTs realized the difficulty in getting students to understand certain concepts within the realm of mathematics.

> I used the flats, rods and units for students to work on decimals. We used whiteboards to write the numbers and what I saw is that these kids did not understand that decimals are

> parts of ones. They did not see them as fractions. Instead, they saw them [sic] as these huge numbers such as .52 might actually mean fifty-two million. They did not really understand that a decimal is less than one. I feel like I need to use a third grade TEKS for that. I feel like the TEKS in fourth grade, I can't even get to those because they're still stuck on lesson one (Focus Group A, Interview 2).

A comprehensive understanding of best mathematics instructional practices was present throughout the MIP reflections and focus group interviews. PSTs understood that effective instruction in mathematics required an understanding of best practices including pacing, content knowledge and pedagogy; effective lesson planning that anticipates challenges and student needs; and active learning activities that incorporate engaging lessons using manipulatives and other effective tools of math.

Conceptions of RTI

During the focus group interviews, participants were asked about their prior experiences and coursework about RTI including their understanding of the concept of a tiered model of intervention, assessment practices, and progress monitoring. It quickly became apparent that there was a distinction in the number of classes and preparation that PSTs had about RTI. Students in the Bilingual and ESL plans shared their relative inexperience with RTI as their courses focused on preparing students for linguistic differences while students in the SPED program communicated the exact opposite. The following quotes exemplify just two cases of the varying experiences with RTI:

> Looking back on my classes, I remember seeing the term, but no one ever really covered RTI… they just hit key points and moved on… (Focus Group D, Interview 1, ESL Participant).

> Most of the special education classes that we take in some aspect have RTI within them, whether it's creating a lesson plan or going into the classrooms and seeing the tiers and what the teachers are doing. Most classes, if not all of them integrate RTI. (Focus Group C, Interview 1, SPED Participant).

After all interviews were conducted and transcribed, individual quotes about experiences with RTI were directly coded into the NVIVO system and categorized as either positive or negative according to the processes and experiences leading to RTI knowledge. Positive quotes indicated an extensive knowledge, shared example, specific assignment or other opportunity that students had to experience a tenet of RTI in their preparation coursework, prior to the MIP. Alternately, quotes coded in the negative category typically indicated a lack of experience, or insufficient knowledge of the topic; quotes about RTI knowledge in this category contained phrases such as, "I'm not sure, I don't know much about, I didn't really cover this in my class, I didn't learn this, etc." Table 3 illustrates the wide variance in RTI understanding or experiences according to student quotes on the different types of degree plans.

Table 3. *PST Reported Experiences with RTI in Prior Coursework*

ESL/Bilingual Participants		**Special Education Participants**	
Positive	Negative	Positive	Negative
9 comments	18 comments	6 comments	0 comments
33%	67%	100%	0%

Furthermore, participants in the final round of focus group interviews were asked questions about their confidence to implement mathematics intervention and RTI in their future classrooms after having completed the MIP. While both SPED and ESL/Bilingual candidates shared relative confidence with mathematics intervention, only the ESL/Bilingual participants shared hesitations about implementing RTI in a future context. For example:

On Mathematics Intervention

> During the span of this project I gained a greater sense of confidence in myself when it comes to teaching mathematics to struggling students. I believe that this math project has really helped me grow as a teacher and has helped me accomplish and solidify a doubt that I have always had, which was that I can never like teaching math or be good at doing it. (Participant A6, ESL Participant).
>
> I feel this project will greatly help me in the future, I believe that this will remind me that not all children get a concept the first or even the fifth time you show it to them. It takes different approaches and different activities to help the child find the one that makes sense to them. (Participant C4, SPED Participant).

On RTI

> I feel confident. When you're writing an IEP in a classroom setting, it's just completely different than what you see the teacher doing. I feel like I've learned a lot more just this semester even though we've talked about it a lot in class, but I'm able to see now firsthand what's really going on. So, I feel more confident (Focus Group B, Interview 3, SPED Participant).
>
> I feel a little nervous about just going through that [RTI] process just because I haven't seen it in real life. I have not witnessed meetings, or paperwork, or anything like that. I'm an ESL major, so I haven't got to see a whole lot of special education things that I think would have really helped. (Focus Group C, Interview 3, ESL Participant).

It is evident that in order for students conceptualize the MIP as RTI in action, explicit teaching of both the tenets of RTI and prior experiences is necessary in assisting this transfer process.

Discussion

PSTs demonstrated a foundational understanding of mathematical instructional practices including using assessment data to plan meaningful interventions, making necessary instructional adjustments according to student learning needs, using manipulatives and engaging learning opportunities to facilitate conceptual learning about math, and implementing appropriate pedagogical practices to maximize the learning experiences. Participants engaged in a pre-assessment process that served to specifically pinpoint student learning needs within a particular curricular topic. This is similar to the RTI phenomenon known as screening where an assessment identifies students with deficiencies in a particular concept. Once PSTs identified the learning weakness, candidates created an instructional plan and implemented it with the students. This plan involved the use of research-based instructional practices by creating engaging learning opportunities, using manipulatives to help teach math conceptually, and using teacher modeling and practice opportunities to help guide students in their learning. These are all components of generally recommended practices in explicit mathematics instruction (Fuchs & Fuchs, 2001). During the intervention process, PSTs continued to monitor student progress by conducting formal and informal assessments in order to make instructional decisions about student learning. This is known as progress-monitoring in the RTI model.

PSTs demonstrated knowledge and skills acquired in the mathematics methods course (informal and formal assessment, intervention practices, use of manipulatives, etc.) and applied this knowledge to the field-based context of the MIP assignment with students. Knowledge about mathematics intervention was connected to the larger context of the field-based classroom environment, but was not explicitly connected to an RTI process in either verbal or written participant statements. There was little data suggesting that PSTs realized connections or relationships between the MIP and the RTI process that would indicate transfer mechanisms of their work in the MIP as RTI in action, especially among students in the ESL program. In fact, when asked questions about their existing knowledge with RTI, ESL participants frequently indicated that they had very little experiences with RTI and that more information was needed. This was evidenced in participant responses related to confidence in intervening mathematically, but not through RTI more generally. Since the MIP epitomizes the foundational tenets of the RTI process and is generally heralded as a general education rather than special education program (Fletcher & Vaughn, 2009), this is especially noteworthy. In other words, PSTs implemented a project specifically mimicking an RTI process, but due to a lack of experience and foundational knowledge of what RTI was, ESL participants still shared their hesitations and confusion about implementing RTI as part of a mathematics intervention program. Special education candidates shared a more foundational understanding of RTI which contributed to more positive discussions on implementing and using RTI in future interactions. Overall, PSTs demonstrated a high degree of learning and reflection about the nature of mathematics and assessment applied to a field-based setting with students, but did not specifically connect this process to RTI unless they had previous experience and depth of understanding about what RTI was. This is best exemplified in the final refection quote of an ESL student on her project reflection. She wrote:

> One suggestion I have is to familiarize the student teachers with RTI prior to the math interaction project. I say this because as a future ESL teacher, I came into this math methods class knowing nothing about RTI, except that it was divided into three tiers of learning when working with a child. However, I wish I had a deeper knowledge about RTI and how to weave it into math intervention strategies with various grade levels of students. I feel like I could have learned much more about RTI at a deeper level if I was able to learn some of the strategies in class. (ESL Participant C5).

The MIP assignment met three of the five accepted practices of RTI: universal screening, progress-monitoring and research-based instruction. Participants in the study, while not using the "official" RTI language mentioned above, included reflections regarding these processes throughout their reflections on the mathematical intervention process. When learning about mathematical instructional practices, PSTs experienced high levels of knowledge and support in mathematical understandings of the importance of assessment in making instructional decisions, using engaging learning strategies for students, the use of hands-on learning and manipulatives, and pedagogical practices that drive good instruction. Mathematical learning was also strongly supported by candidates' responses regarding how they were supported in the methods course and field based setting to implement the MIP. It is evident that while some knowledge of mathematical intervention practices were transferred to classroom practice, a deeper level of understanding about RTI, its practices and purposes, requires more explicit teaching in the context of teacher preparation coursework.

Implications

There appears to be a discrepancy between what RTI was intended to do and how PSTs are prepared to apply RTI principles. RTI has been repeatedly positioned as a general education intervention system intended to immediately target students struggling to achieve mastery in the regular curriculum (Fletcher & Vaughn; 2009; Mastropieri & Scruggs, 2005). Thus, it is expected that general education teachers will have the primary responsibility to implement screening, assessment, intervention, and monitor interventions that comes as part of RTI. In this case, PSTs in the ESL degree program demonstrated little to no background knowledge of RTI in coursework, and despite implementation of the MIP, were unable to demonstrate transfer of learning about the tenets of the MIP to a wider application of RTI in the MIP (transfer principles 1 & 9) despite demonstrating a solid understanding of assessment, intervention, and monitoring practices that are a foundational part of RTI. SPED candidates appeared to achieve a greater degree of transfer through a more thorough knowledge, understanding, and experience of RTI. The discrepancy is that SPED candidates will almost exclusively teach students who have already been identified for special education services and will not actually implement RTI interventions with general education students. Confusion about RTI and its purpose in the general education venue will continue; while RTI is widely heralded as a general education intervention, it is sometimes seen as a process that still falls under special education authority, as in the apparent reports in this study.

These findings are consistent with prior studies in PST education and RTI practices (Begeny & Martens, 2006; Kuo, 2013; Neal, 2013) where SPED PSTs typically receive more in-depth preparation than their general education counterparts. Specifically, Neal's (2013) study included both general education and special education PSTs in the sample and similarly found that special education PSTs demonstrated higher levels of self-efficacy in implementing RTI due to more extensive coursework and implementation opportunities.

A danger in creating specialized degree plans (ESL, Bilingual, SPED), is that while teacher preparation programs are training a generation of teachers who are highly skilled to work with certain groups of students, these same programs might inadequately address the skills and knowledge to work with students who are not under that criteria. It appears that a thorough understanding of RTI and its practices is greatly needed among all general educators as a fundamental component of being prepared to work with a diverse group of students in our schools today. In other words, had the mathematics methods course explicitly included RTI, its foundations and processes, before incorporating the MIP field experience, would all PSTs end up on the same page regarding the purposes and function of RTI in general?

Instrumental in achieving this point, it is necessary that RTI be consistently included within the context of general education intervention. RTI learning did not appear to be an explicit component of the mathematics methods course, although features of the MIP assignment were aligned with its principles. It is recommended that RTI be a foundational tenant of all education courses at the university in helping PSTs understand the important components of the intervention process. ESL classes, pedagogy, and methods/content coursework can achieve this point by simply incorporating the features of RTI within already existing instruction. In the case of the mathematics methods course, the MIP was an ideal assignment that exemplified the features of RTI in action and helps teachers in their understanding of how to use assessment data and interactions with students in order to make decisions and drive future instruction. As evidenced by the SPED candidates, strengthening the foundational knowledge, contextual supports, and increasing the opportunities for drill and practice (principles 1 and 9) can increase the level of learning transfer.

According to the latest report of the Office of Special Education Programs (2013), students with learning and other moderate disabilities are increasingly receiving all or the majority of their instruction in the general education classroom. Current educational trends emphasize general education interventions and differentiation as the way to meet individual learning needs rather than sending students to specialized classrooms. RTI serves as the “gatekeeper” between general education interventions and special education identification and requires that the general education teacher be familiar with the best instructional practices to work with diverse learning needs. Effective RTI practices are necessary to assist students, rather than just referring for special education placement, especially if all the students’ require is small group or one-on-one interventions to master the curriculum. A deep knowledge and understanding of RTI is crucial at the university level so that PSTs can transfer these practices when confronted with diverse learning needs on a regular basis in the classroom.

In the case of PSTs’ understanding of mathematics intervention, the MIP was a model assignment that exemplified dynamic nature of assessment and intervention and facilitated an understanding of how to use assessment data to make decisions and drive future instruction. As evidenced by PST participants, exercises that allowed them to experience planning lessons derived from student assessment data provided a vital opportunity to learn about assessment and intervention. What is unknown at this point is how the interaction between best instructional practices and RTI interventions through the MIP assignment will extend into the future classroom setting when participants are not being guided by their mentor teachers and methods course instructors at the university. Future studies should focus on how these practices are being applied once the PST makes the transition to the sole-source of educational decision making for students in the classroom.

Limitations

Prior coursework was not used as a data source for this study. While differences in the ESL and SPED degree programs were informally reported by the participants in the study, coursework was not specifically evaluated. Therefore, assignments, practices, and knowledge on the range of preparation methods used in these courses is relatively unknown. In looking at the background knowledge of RTI learning from the SPED and ESL candidates, the main gauge for measuring transfer principles 1 and 9 was from responses to questions in the focus group interviews and written reflections on the MIP.

Furthermore, cultural and contextual supports of RTI learning in field-based settings is something that the university has little control over outside of coursework. The university can most definitely oversee coursework and learning about RTI in specific courses such as SPED, ESL, and methods classes, but cannot guarantee that all PSTs experience identical settings in the field. PSTs were assigned to a variety of districts, campuses, grade-levels and teachers that all accounted for a wide variety of experiences according to the individual policies and practices of that district. Field-based contextual supports of RTI learning are deeply dependent upon participating districts and cooperating teachers; these settings cannot always be regulated to provide consistent experiences for PSTs. Thus, it is the job of the university to support teachers in their learning about RTI implementation and any field-based support should be considered as a bonus learning opportunity. Results of the study support the need for increased preparation in RTI practices for pre-service teachers through coursework, theoretical understandings, and field application, regardless of the degree program, but especially for teachers pursuing the general education classroom as a future career.

Conclusion

RTI is a vital component of supporting at-risk students in schools today. Students come from a variety of backgrounds with an array of languages and learning needs. General education teachers must be prepared to handle this diversity in their classrooms. RTI is the accepted practice to assist students who struggle to master the curriculum by immediately identifying, targeting, and monitoring learning needs. As seen in this study, much of a teacher's preparation to implement mathematics interventions came from their pre-service preparation through an assignment in the mathematics methods course. PSTs shared positive reflections and learning through their experiences of implementing a mathematics intervention protocol through the MIP. Participants learned about formative assessments, lessons that valued math content knowledge and good pedagogical practices, and understanding how mathematical tools or manipulatives improved student understanding of concepts. University preparation programs and further research should consider transfer of learning and generalization to future teaching practices as the ultimate goal for PSTs by incorporating assignments such as the MIP as part of the preparation experience, including explicit teaching and experiences that center on RTI as a theoretical framework for providing such interventions.

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