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Supporting Middle School Students in Tier 2 Math Labs: Instructional Strategies

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Abstract

Response to Intervention (RtI) has become a common support system for students; yet, no universal RtI model exists, especially for mathematics and specifically at the secondary level. This article focuses on a specific model for delivering Tier 2 mathematics supports and services at the secondary level: math labs. Evidence–based and research–supported interventions are discussed that support the delivery of Tier 2 services within a math lab secondary RtI structure. A fictionalized vignette, drawing from multiple actual cases, is presented to highlight the use of a Tier 2 math lab within a middle school setting.

Response to Intervention

Response to intervention (RtI) is defined as a systematic approach to providing early intervention for struggling students and identifying students in need of targeted, intensive, and/or special education services. With RtI, students receive multiple tiers of support depending on their needs and response to instruction and intervention (Cusumano, Algozzine, & Algozzine, 2014). RtI has become a common support system for students – as well as a means of carrying out the child find process for determining students with disabilities – yet, no universal RtI model exists (Yell, 2012). Common RtI models include three or four tiers (Mellard, McKnight, & Jordan, 2010). Tier 1 in RtI is a universal intervention, meaning all students receive Tier 1 service and interventions through their involvement in the general education curriculum. Tier 1 is intended to consist of research–based, high–quality materials provided by a general education teacher at a whole class level of instruction intervention (Fuchs, Fuchs, & Compton, 2012; Mellard et al., 2010). Tier 2 is often referred to as targeted interventions; Tier 2 involves instruction to students deemed not responding to Tier 1 services and/or suggested by a universal screening assessment to be below grade level in the areas of literacy or math (Fuchs et al., 2012). Tier 2 is conceptualized to be a service provided to students concurrently with Tier 1 (Shapiro, 2015). Tier 3 is often considered intensive interventions and services are for those students who fail to response to Tier 2 interventions (Berkeley, Bender, Gregg Peaster, & Saunders, 2009). Depending on the model, Tiers 3 or 4 can be considered special education and/or student who need a referral to special education (Mellard et al., 2010).

Tier 2. Tier 2 services in RtI are designed to address the challenges students face early in their learning progression and prevent students from needing more intensive services and/or receiving special education support unless a true disability is present (Wanzek & Vaughn, 2011). As such, researchers hypothesize about 15–20% of the student population may need Tier 2 services, of which the majority are presumed to respond to intervention and return to only Tier 1 services (Shapiro, 2015). Tier 2 services can be administered by a range of individuals, including the general education teacher, aids (i.e., paraprofessional), or RtI interventionists (Dennis, Bryant, & Drogan, 2015).

The vast majority of the research involving Tier 2 and mathematics focuses on elementary students and particularly early elementary students (i.e., kindergarten, first grade, second grade; Dennis et al., 2015). The literature on Tier 2 interventions to support at–risk or struggling elementary students in mathematics is overwhelmingly positive with regards to the impact of the interventions on the mathematical understanding and achievement of the student participants (e.g., Clarke, Doabler, Cary, Kosty, Baker, Fien, & Smolkowski, 2014; Clarke, Doabler, Smolkowski, Baker, Fien, & Cary, 2016; Dennis et al., 2015; Fuchs, Fuchs, &

Hollenbeck, 2007). Much of the Tier 2 mathematics interventions examined involved explicit instruction and occurred in a traditional small group setting, with pull–out models as the means of providing services (Dennis et al., 2015). Although published Tier 2 mathematics intervention packages exist to support elementary students (cf., ROOTS [Clarke et al., 2016] and Fusion [Clarke et al., 2014]), little research has examined Tier 2 RtI services and interventions involving mathematics at the middle school level.

RtI at the Middle School Level

Limited research and models exist regarding the implementation of RtI in secondary schools in general, let alone in mathematics specifically and within middle schools (Fuchs, Fuchs, & Compton, 2010; Prewett, Mellard, Deshler, Allen, Alexander, & Stern, 2012). Within the limited literature and attention to implementation of RtI for mathematics at the middle school level, a few models emerged for schools to consider: small group pullout support, alternative mathematics class, and additional mathematics instruction or class (i.e., math lab) (Bouck & Cosby, 2017).

The small group "pullout" method is similar in instruction to RtI Tier 2 supports often seen in elementary schools. With the pull-out method, teachers or interventionists provide support to a small group of students struggling with the same or similar math concepts for a short period of time (e.g., 20 minutes), pulling them from a general education class or other instructional time period (Bouck & Cosby, 2017). In this approach, students would receive Tier 1 mathematics, but not necessarily receive Tier 2 daily, nor for a whole year or even semester in length. Students would receive targeted interventions in a small group (e.g., 5–7 students) and for a set period of time (e.g., 20 minutes 2–3 times per week for 10–12 weeks; Calhoon & Fuchs, 2003; Fuchs et al., 2007). With a pullout approach, students receive targeted, specific interventions in the area of mathematics in which she or he is struggling (e.g., place value). A concern at the middle school level is finding the personnel to provide the intervention; middle schools may need to consider hiring an RtI interventionist to provide such services (Mellard et al., 2010). Other drawbacks include the issue of students being pulled from general education instruction, including core content areas (e.g., social studies or science) or electives (Bouck & Cosby, 2017), and thus missing chunks of lessons, which can easily lead to other learning challenges. An alternative to pulling students out of general education courses, but still allowing for a pullout approach to providing Tier 2 services, is to shift the timing of class periods to create a 20–minute period each day that can be used as RtI for students struggling in literacy or mathematics and a study hall or enrichment period for those not in need of additional interventions (Harlacher, Sanford, & Walker, 2015).

In contrast to the small group pullout targeted services, another option for Tier 2 intervention for mathematics in middle schools is to create an alternative class (Bouck & Cosby, 2017). An alternative mathematics class occurs when students receive an alternative curriculum or alternative pace to a Tier 1 course (e.g., Algebra 1). In this scenario, students would not be in a Tier 1 mathematics class; the Tier 2 class would serve as their only mathematics class as well as their mathematics support. Note, the lack of receipt of Tier 1 math is not in accordance with RtI principles, and hence the use of an alternative class as a Tier 2 option is questionable. The class size in these settings is most often smaller than a general education mathematics class, in an effort to create more opportunities for individual attention between students and the teacher (Bender, 2012). Concerns with the alternative class as a Tier 2 service option include the lack of fluidity to move between tiers inherent in a RtI model and the potential for the alternative class to serve as a means of ability tracking students (Stecker, Fuchs, & Fuchs, 2008).

A third delivery option for Tier 2 services at the middle school level in mathematics is an additional period of math, often referred to as a "math lab" (Bender, 2012; Shinn, Windram, & Bollman, 2016). With a math lab approach to delivering Tier 2 services, students are not pulled out of another course and yet are still receiving Tier 1 math instruction (e.g., Vaughn et al., 2010). In other words, students receive two periods of mathematics. Students receive services and support in mathematics with the math lab class, and there is the potential for movement between tiers at the end of semesters (e.g., 18 weeks) or potentially even at the end of marking periods (e.g., 9 weeks) (Calhoon & Fuchs, 2003; Fuchs et al., 2007).

Potential issues with a math lab delivery option includes larger student–teacher ratios then typically found in small, pullout groups. Ideally, a math lab should be significantly smaller in student enrollment than a Tier 1 mathematics class, but predictably larger than small, pullout groups (Riccomini & Witzel, 2010). Other concerns include personnel issues and the potential impact on general education Tier 1 mathematics class sizes as well as issues of credit. If general education teachers are teaching a math lab course, their class sizes for their Tier 1 classes may increase as the same number of students need to be served in math. Of course, a special education teacher could provide the Tier 2 services, which may have potential implications for meeting the needs of all students receiving special education services, or the school could hire an interventionist, pending funding. Also, course credits for progression to the next grade are an issue. While districts may allow students to receive a credit for math lab courses, it may not be math credit; students would need to pass both their math lab class (Tier 2) and general mathematics class (Tier 1) to accumulate the need credits for promotion (Shinn et al., 2016).

Math Lab

Math lab is essentially a second math course taken at the same time as a student takes his or her Tier 1 general mathematics class. When a student is taking a math lab, she or he is taking two mathematics classes – one focused on the grade level or mathematical content area (e.g., seventh–grade math, algebra [i.e., Tier 1]), and one that provides additional interventions or supports to help the student be successful in the Tier 1 mathematics class and also address gaps in their understanding and skills in mathematics (Bender, 2012; Shinn et al., 2016). Although not specifically exploring math labs, researchers examined students participating in two math classes, sometimes referred to as receiving a double–dose (Martinez, Bragelman, & Stoelinga, 2016; Nomi & Allensworth, 2009, 2012). Martinez et al. (2016) found taking two mathematics courses concurrently improved students' content knowledge. Nomi and Allensworth (2009, 2012) examined data from the implementation of the double–dose ninth–grade algebra policy implemented in Chicago Public Schools. Although assessment scores improved, more students were not passing classes. Also, the double–dose policy resulted in the occurrence of more tracking, creating more classes where students were assigned to classes by perceived abilities in mathematics. Piper, Marchand-Martella, & Martella (2010) found at–risk middle school students who received a 25–minutes per week double dose relative to specific math content (e.g., ratios, proportions) improved in their mathematics performance when the double–dose extra math time used explicit instruction.

Given there is not one universal approach to math lab, the enacted math lab can look different from school to school. When using the math lab model, a school must decide who is going to teach math lab. Because math lab is a Tier 2 intervention within RtI, and it remains unclear who delivers Tier 2 interventions at the middle school level (Fuchs & Deshler, 2007). A school must decide if a general education mathematics teacher, a special education teacher with experience in mathematics, or a specifically hired RtI interventionist will teach the math lab (National Center on Response to Intervention, 2011). Also, a school must determine how often the math lab will be meet and when. Given the issues with middle school schedules, finding time for intervention is a major obstacle to implementing any RtI services and supports in middle schools. Because of this, math labs would most likely need to be implemented on a daily basis, except for schools with A–B block scheduling, where all courses meet every–other day (Shinn et al., 2016). Of course, schools can get creative and change the length of all course times to operate an RtI period that might last 20–25 minutes a day, rather than a more traditional 45–60–minute period (National Center on Response to Intervention, 2011). This arrangement creates different challenges, including what to do with the 80 to 85% of the student population not in need of Tier 2 interventions. Although study time can be provided as an option, one needs to question the effects of this arrangement for such a large group of the student population.

Instructional strategies and interventions in math lab. Although little–to–no research systematically examines interventions for Tier 2 mathematics at the middle school level, educators can use other research–based or supported strategies to guide their interventions. In other words, educators can pull from research–based targeted or intensive elementary mathematics interventions, intensive secondary interventions, and best practices for supporting struggling students to understand and succeed in mathematics (National Center on Intensive Intervention [NCII], 2016).

Explicit instruction. Explicit instruction is a form of systematic instruction in which the teacher first models how to solve a mathematics problem, then cues students to solve the problems, and last allows the student to solve problems independently (Doabler & Fien, 2013). When engaging in explicit instruction in mathematics, the teacher begins by using think–alouds to demonstrate how to solve a few problems. Next, students move into solving problems with teachers providing prompts or cues as needed. Last, students solve problems independently without any supports. Explicit instruction is considered an evidence–based intervention for supporting students with disabilities or those who struggle with mathematics (NCII, 2016).

Explicit instruction is not recommended for all mathematics teaching and learning; it is not, for example, the recommended Tier 1 – or general education – instructional approach (National Mathematics Advisory Panel, 2008). However, explicit instruction is recommended and a strong body of evidence exists to support its appropriateness and effectiveness for supporting students who struggle in mathematics, such as students receiving Tier 2 services (NCII, 2016). Hence, math lab can be a place for teachers to make their own conceptual understanding of the mathematics and solving problems explicit to students while also allowing students multiple opportunities to practice and receive feedback about their understanding of the concept and the solving of problems. In a math lab small group setting, the teacher could implement explicit instruction at the whole class level, particularly with the modeling and think aloud portion, or else work to create smaller groups within the setting for implementation of the teaching model.

Concrete–Representational–Abstract. The Concrete–Representational–Abstract (CRA) instructional approach is a sequential strategy that uses. explicit instruction (Agrawal & Morin, 2016). The CRA approach involves the teacher modeling, guiding, and then letting students independently solve problems but implements these across three phases: concrete, representational, and abstract. Students use concrete manipulatives (e.g., base 10 blocks, fraction pieces) to solve the mathematical problems in the concrete phase. Once a student obtains mastery with concrete manipulatives (e.g., 80% correct on three consecutive independently solved problems), the student moves to using pictorial representations – or

drawings – to solve the problems. Once mastery is obtained from representational phase, the student moves to solving the problems abstractly (or symbolically) without drawings or concrete manipulatives. The CRA is considered an evidence–based practice for students with learning disabilities (Agrawal & Morin, 2016; Bouck, Satsangi, & Park, 2018).

The CRA approach is generally implemented with individuals or small groups. However, in a math lab, a teacher could implement the CRA approach at a whole class level via differentiated instruction. To do so, the teacher would begin instruction with all students using concrete manipulatives. After individual students demonstrate mastery with concrete manipulatives, they could move those students into the representational phase. Again, the individual analysis would allow certain students to move to the abstract phase. Hence, a teacher may have students working individually and simultaneously at the concrete, representational, and abstract levels on a specific mathematical topic.

Number talks. Number talks are an instructional intervention that can be used in conjunction with many other interventions. Through their design to be shorter activities (e.g., 5–15 minutes) teachers can use number talks to launch a lesson (Boaler, Williams, & Confer, 2015; Parrish, 2011). With a number talk, a teacher shares a mathematics problem and students mentally solve the problem. The focus of the number talk is on the conversation among the students and the teacher, with the students sharing the multiple strategies they each used to solve the problem. Number talks are a means to address gaps in students' understanding as well as fluency with conceptual understanding (Boaler et al., 2015). The goal of number talks is to promote students' deeper and broader understandings and become efficient and flexible in how they solve problems (Parrish, 2011). Math lab teachers can use number talks to start their instruction one-to-five times a week, then moving into other interventions addressed in this article.

Preteaching and/or reteaching. Outside of a special approach, teachers may use math labs to preteach or reteach the mathematics from students' Tier 1 (i.e., general education) math class. Preteaching is when the basic mathematics idea or the prerequisite mathematics concepts connected to an idea are presented before actual instruction; in other words, students receiving Tier 2 instruction could be exposed to the math content they will be learning in the Tier 1 mathematics class in advance of the general education teachers presenting it (Watt & Therrien, 2016). Preteaching can be effective when the math lab occurs before the Tier 1 math class, such as students attending math lab early in the day (e.g., first or second period) and then having their mathematics class later in the day. Preteaching itself can include multiple strategies, including presenting vocabulary, developing background knowledge, and helping to organize information via an advanced or graphic organizer (Lally & Miller, 2006; Watt & Therrien, 2016). Preteaching is

considered a research–supported practice, although research on the effects of preteaching in mathematics are limited (Watt, Kaldenberg, & Therrien, 2013). Struggling students have reported a preference to preteaching as opposed to reteaching or supplemental instruction because it builds their confidence and knowledge to participate in the general education setting (Munk, Gibb, & Caldarella, 2010).

Reteaching typically occurs when students have math lab after their Tier 1 mathematics class. When reteaching, the focus of math lab can involve the teacher answering questions, clarifying concepts, addressing misconceptions, and tackling common errors presented in the Tier 1 mathematics class (Martinez et al., 2016). With reteaching the math lab teacher is not simply presenting the same content in the same manner, but using different instructional strategies (e.g., explicit instruction) to present the material or address student challenges. Of course, teachers can do both preteaching and reteaching in their math lab.

Vignette[1]

Mr. Jones was a middle school mathematics teacher. He taught seventh grade math at Haslett Middle School. Towards the end of one school year, Mr. Jones was informed that in addition to his typical math classes, Mr. Jones would be teaching a "math lab" course the following year. Mr. Jones's school was trying to implement response to intervention (RtI) at the middle school level for literacy and mathematics. The administrator of the middle school and the RtI coordinator for the district determined the main approach taken for supporting struggling students in mathematics (i.e., those determined to need Tier 2 interventions) was going to be a math lab.

Prior to the math lab implementation, Mr. Jones, his principal, and the RtI coordinator for the district made structural decisions based on the limited research and information available about RtI at the middle school level and mathematics e. These three individuals decided the math lab course would meet daily, for one class period, and all students selected for the intervention would first attend math lab (i.e., Tier 2) in the morning and then attend their general education Tier 1 mathematics class later in the day. The decision was to use math lab to target students struggling in mathematics, as determined by their previous mathematics teachers' recommendation as well as based on the results of a universal screener administrated to all students the past spring. Mr. Jones, the principal, and the RtI coordinator decided students would stay in math lab for at least one semester;

[1] The vignette of Mr. Jones is a fictionalized account drawn from multiple authentic situations and put together as an aggregated scenario; the name is a pseudonym.

students could transition out of or into math lab at the semester, although they could also remain in math lab for the entire school year.

Mr. Jones was also charged with determining the content for math lab. After reading and speaking with others, Mr. Jones determined a plan for this math lab – at least an initial plan. Mr. Jones recognized that his instructional activities may need to shift once math lab begins; also, he realized he cannot implement all the evidence–based or research–supported instructional approaches he found for supporting students needing Tier 2 mathematics interventions and supports. Mr. Jones's plan for this math lab included the use of Number Talks; preteaching; reteaching (only as needed); and the CRA approach, which involves the use of explicit instruction, to start. Although, Mr. Jones felt other interventions would improve his students' knowledge and mathematical understanding he chose to implement a few instructional approaches the first year, evaluate their success or struggles, and then make revisions in subsequence years, as necessary based on data and reflection. Mr. Jones was aware that implementing too many new instructional strategies at one time might result in both he and his students feeling overwhelmed and confused.

Mr. Jones decided to implement one-to-two number talks per week to focus on building fluency with conceptual understanding. He also decided his time in math lab was going to focus on preteaching concepts, including activating the student's background knowledge as well as introducing vocabulary. While not a main focus, Mr. Jones decided he would use this math lab hours, as needed, to reteach concepts that the students in his math lab and general education math class found challenging. Mr. Jones wanted math lab to be an opportunity for the students – in a smaller setting – to express their thinking of the problem so Mr. Jones could determine and work to debug any misconceptions. Mr. Jones also determined he could use the math lab class to present different, additional problems during this time to help students further develop their conceptual understanding. Last, Mr. Jones decided to try to implement the CRA instructional approach. Being a general education teacher, the CRA approach was a somewhat new instructional strategy for him. He chose to try to implement the CRA sequence at a whole class level, where all students would start with concrete and then move into representational and abstract phases at an individual pace. Given the inherent inclusion of explicit instruction of explicit instruction in the CRA approach, Mr. Jones resolved to implement explicit instruction within his math lab. To aid in making data-based decisions, Mr. Jones decided to engage in progress monitoring to determine how his students responded to the interventions in this Tier 2 math lab. Mr. Jones planned to administer short progress monitoring assessments aligned to the standards every other week, and use the data to make data-based decisions about student understanding as well as their need for Tier 2 services. Mr. Jones also

elected to give all students – in Tier 1 general education as well as Tier 2 math lab – a pretest and posttest on the course content so he and the school district could evaluate the effectiveness of math lab in terms of student achievement.

After Mr. Jones's first year of implementing math lab, he was asked to share his experience with other middle school mathematics teachers and administrators in his county who were contemplating implementing a Tier 2 math lab. Mr. Jones decided one way to share his information is through a simple take-away of recommended dos and don'ts (please see Table 1 for Mr. Jones's recommended dos and don'ts for developing a Tier 2 math lab in a middle school). Overall, Mr. Jones shared that implementing the math lab resulted in improved student achievement and mathematical understanding; students understanding of math has increased as a result of the math lab and its focus on preteaching and number talks. Mr. Jones shared the slope data for each of the students in the math lab on the progress monitoring assessments; each student's data presented an overall positive slope, although – and not surprising – there was some variable individual data. Mr. Jones also collected pre- and post-test data for his students in both math lab as well as his student in general education math who were not receiving math lab. While the posttest scores for the students in math lab were lower than the students not receiving math scores, the two groups had comparable (i.e., not statistically significant different) gain scores from pre-test to post-test. He also shared that some students were able to move out of Tier 2 after the first semester and successfully complete Tier 1 without additional support during the second semester of the year. Mr. Jones disclosed that teaching the math lab was challenging – rewarding but challenging. He often struggled with helping students who presented with lower foundational skills while trying to preteach the more advanced concepts covered in Tier 1. Related, Mr. Jones expressed that it was often difficult to cover everything in he wanted to in one class period and to keep the focus on preteaching, rather than reviewing. He noted that he had to learn some new teaching approaches – such as the CRA approach. Despite the challenges, Mr. Jones was excited to share with his colleagues that he is teaching another section of math lab the next coming year.

Table 1. *Recommendations for Implementing a Middle School Tier 2 Math Lab*

Do	Don't
• Schedule the Tier 2 math lab to occur before students' general education Tier 1 math class, so the focus can be on pre-teaching.	• Make the focus of the class on doing the "homework" for the Tier I class or just worksheets that *drill and grill* facts, rules, and procedures.
• Focus on building and developing students' conceptual understanding, not the memorization of facts and procedures.	• Make the Tier 2 math lab the only math class students receive; all students receiving a Tier 2 math lab should also receive a Tier 1 math class.
• Implement evidence-based strategies for teaching and supporting students.	• Make class size as large as Tier 1 classes. Large classes defeat the purpose of a Tier 2 math lab.
• Work for students to have the same teacher for their Tier 2 math lab and their Tier 1 class.	• Have courses taught by teachers who are not knowledgeable in mathematics and the teaching and learning of mathematics.

Conclusion

As middle schools increasingly implement RtI in mathematics to address struggling students, they need guidance and resources about options. Despite the increase attention and use of RtI – particularly Tier 2 – in middle schools, limited research and discussions of best practice exist to help guide educators. For middle school mathematics teachers and the struggling students they educate, math labs represent as a viable option. However, as the vignette illustrates, simply implementing a math lab is insufficient; teachers must also determine the interventions and instructional elements of the math lab.

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