QUALITY OF TIER 1 INSTRUCTION IN AN INTEGRATED MULTI-TIERED SYSTEM OF SUPPORT: A MIXED METHODS STUDY

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

QUALITY OF TIER 1 INSTRUCTION IN AN INTEGRATED MULTI-TIERED SYSTEM OF SUPPORT: A MIXED METHODS STUDY

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and hereby certify that, in their opinion, it is worthy of acceptance.

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For Levi Ross, my pride and joy.

I hope I always make you proud.

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ABSTRACT

To effectively and efficiently address both the academic and behavioral needs of all students, integrated Multi-Tiered Systems of Support (iMTSS) is an initiative gaining strength in elementary schools across the U.S. Tier 1 instruction within an iMTSS, should be evidence-based and differentiated to provide high quality educational opportunities to all students. One established approach to providing accessible and differentiated instruction is Universal Design for Learning (UDL), an instructional planning framework that can be embedded within a tiered prevention system. A mixed methods study was conducted to learn about the state of concurrent implementation of iMTSS and UDL within Tier 1 instruction in elementary schools. Participating schools were found to be either implementing the two initiatives concurrently in Tier 1 or not implementing UDL at all. Follow-up inquiry found additional qualitative characteristics that differentiated these two groups and barriers to implementation were identified.

CHAPTER 1

Introduction

Comprehensive school-wide initiatives present opportunities for large scale impact on improving teacher practices and student outcomes. Important examples are Multi-Tiered Systems of Support (MTSS) like Response to Intervention (RTI) and Positive Behavior Intervention Support (PBIS), which have become widespread in schools across the United States in an effort to prevent and address academic and behavioral needs (Bradley et al., 2011; National Center on PBIS, 2019). These tiered prevention systems have historically operated in parallel--with separate teams supporting implementation, looking at student data in isolation and implementing tiers separately--but with so many common features and underlying theories, there has been a strong push to integrate the behavior and academic systems (Utley & Obiakor, 2012). In addition to the benefits of increased efficiency, there is significant research to support the existence of a relationship between academic struggles and problem behaviors, which would be better supported through an integrated approach (Osher et al., 2010). The integration of academic and behavior tiered systems has been studied by a few key researchers over the past two decades but large-scale empirical research in the area of integration has only recently become a federal priority (Ervin et al., 2006; Ervin et al., 2007; Kuchle et al., 2015; Sadler & Sugai, 2009; Sailor et al., 2020). In 2019, the Institute for Education Sciences (IES) funded a network of research projects focused on the integration of academic and behavior supports in integrated MTSS (iMTSS) at the elementary level (NCSER, 2019). As schools begin to implement integrated behavior and academic tiered

systems, research on the integration of practices, data, and systems will be an important next step in providing guidance for effective implementation.

MTSS, RTI, and PBIS are referred to as tiered prevention models, a concept based on a public health model of prevention that uses data to inform increasingly intensive levels of intervention (Schulte et al., 2016; Sugai & Horner, 2020). In the medical field, the primary tier of prevention is enacted by taking proactive steps like eating healthy, exercising, and visiting the doctor for regular check-ups. At subsequent tiers, minor illness is treated to prevent major illness. In schools, the primary tier of prevention is enacted by providing quality universal instruction to all students to prevent behavior escalation and poor academic achievement. Intervention is provided at subsequent tiers to address behavior and academic needs that arise. The quality of instruction at the universal or Tier 1 level is foundational to the success of the entire system as it provides the greatest opportunity for impact, reducing pressure on subsequent, more resource-intensive tiers (Bailey, 2019). Research has shown that the proportion of students requiring Tier 2 and 3 interventions can be reduced to 10 to 15% if schools provide strong, accessible instruction and behavior management strategies at Tier 1 (Al Otaiba & Fuchs, 2006). In studies of School-Wide PBIS, primary prevention at the Tier 1 level has been associated with improved organizational health, a reduction in reports of problem behavior and in some cases improved academic outcomes (Bradshaw et al., 2015; Horner et al., 2010).

MTSS scholars have stated that quality Tier 1 instructional practices are (a) scientifically or evidence-based, (b) validated (c) and include differentiation, i.e., addressing learner variance and accessibility (Fuchs & Deshler, 2007; Stoiber &

Gettinger, 2016; Subban, 2006). When core instruction is evidence-based, implemented with fidelity, differentiated, and accessible, the needs of the majority are addressed, leading to fewer students requiring more intensive support at the Tiers 2 and 3. Selecting a curriculum that is evidence-based can be done by reviewing the data from sources like What Works Clearinghouse, etc., and implementing with fidelity requires training and monitoring implementation. However, differentiating and making instruction accessible is less straight forward. Universal Design for Learning (UDL) is a framework for planning instruction with a goal of reducing barriers to learning that could be implemented within an iMTSS to differentiate Tier 1 instruction.

UDL is intended to support the needs of all students, including students with disabilities and culturally and linguistically diverse learners by building supports and scaffolding proactively into lesson goals, instructional materials and methods, and assessments (Meyer et al., 2014). UDL-based instruction has been shown to increase engagement and access to Tier 1 curriculum and to improve students' academic and behavioral outcomes (Ok et al., 2017). Effect sizes from empirical studies have varied from small to large, as UDL is a framework that can be applied to various curricula (Ok et al., 2017). Pairing this approach with instructional planning with other evidence-based systems is an area in which further efficacy is promising. When considering a push towards integration of academic and behavior supports within Tier 1, UDL has been suggested as especially helpful for increasing the range of students who can access the academic content, in turn decreasing the likelihood of problem behaviors (McIntosh & Goodman, 2016).

Conceptual Framework

The current study draws from a conceptual framework known as the Ecological RTI Framework (Basham et al., 2010). This conceptual framework establishes a basis to consider the concurrent implementation of school-wide initiatives--iMTSS and UDL, as mechanisms to implementation of quality Tier 1 instruction.

Ecological RTI Framework

Basham et al. (2010) proposed a more comprehensive ecological approach to the RTI framework that embeds UDL as a complimentary framework and includes assistive technology at Tiers 2 and 3. Though the authors used the term RTI, they often made connections to PBIS as well, and as such I'll use the term MTSS to encompass both academic and behavior tiered systems. Basham et al. (2010) suggest that UDL has the same goal as tiered systems based on a public health model of prevention and proactivity, and that a more comprehensive ecological approach would better address these goals by designing the tiers of instruction to meet the needs of all students, including students with and without disabilities, students who would benefit from enrichment and culturally and linguistically diverse students. This framework suggests that incorporating UDL as the foundation for core instructional design will promote positive academic and behavioral outcomes for all students. Tiered levels of instruction move from more proactive and group focused, incorporating UDL into scientifically based core instructional practices, to more individualized and intensive interventions that incorporate both UDL and assistive technology. Instructional strategies and materials are designed to support multiple means of engagement, knowledge representation, and assessment within Tier 1. Within Tiers 2 and 3, the same approach is used with an additional effort to reduce the specific barriers

faced by the student's receiving intervention without compromising the intervention efficacy.

In an MTSS, the goal of Tier 1 is that core instructional practices are effective for at least 80% of students (Fuchs & Fuchs, 2017). Not meeting this goal results in increased needs at the tier 2 and 3 levels, which require more resources in the form of staff, time, funding and materials which is often not feasible for schools to manage (Splett et al., 2018). Thus, an important focus of improving the efficiency and effectiveness of MTSS is to implement differentiated core instructional practices with increased accessibility so that Tier 1 is effective for the most students possible. Currently, UDL is the most coherent, comprehensive framework for implementing accessible instructional design (Meyer et al., 2014). The Ecological RTI framework provides the basis for the current study to consider the potential for complimentary prevention initiatives, iMTSS and UDL to be implemented concurrently as mechanisms to achieve quality instruction in Tier 1.

Rationale and Purpose for Current Study

The purpose of this study is to learn about the state of concurrent implementation of iMTSS and UDL within Tier 1 in elementary schools. This mixed methods study will uncover the patterns of implementation within Tier 1 reading and mathematics instruction through a latent class analysis and provide clarifying descriptions of the emergent classes. A secondary purpose is to understand the alignment of indicators of quality instruction in an iMTSS and UDL in practice including potential barriers to concurrency. This secondary purpose will be achieved through a qualitative analysis of follow-up interview data from a representative sample of each emergent class.

In alignment with the IES network of research projects focused on iMTSS that the present study is situated within, instructional quality will be considered at the elementary level within reading and mathematics instruction. Academic tiered systems typically address one or both content areas, as early reading and mathematics skills are considered pivotal to future academic success (Hanover Research, 2016). As such, the quality of instruction will be considered specifically within these content areas.

The present study aims to contribute to the current literature on quality Tier 1 instruction, in particular informing future efforts and implications for the inclusion of UDL as a mechanism to achieve quality universal instruction with an iMTSS and the factors that serve as barriers to that concurrent implementation.

CHAPTER 2

Review of the Literature

The purpose of this chapter is to situate the present study within the current literature on quality instruction, iMTSS, and UDL. First, the context and rationale for iMTSS will be presented by describing the parallel academic and behavioral frameworks that comprise MTSS, and the current literature that exists on the integration of these frameworks. Next, indicators of quality instruction found in the literature will be described in the context of Tier 1 classrooms. Then, the current research on UDL will be described. Finally, what is currently known and remains to be learned regarding concurrent implementation of integrated MTSS and UDL within universal Tier 1 instruction will be presented.

Multi-tiered Systems of Support

MTSS can be described as a comprehensive approach to one or more domains of education (e.g., reading, mathematics, behavior, mental health, etc.) that incorporates instruction, assessment and decision-making within a tiered model of service-delivery (Kansas MTSS Project, 2012). It is often used as an overarching term that includes two parallel frameworks: RTI to address academic needs and PBIS to address behavior needs. Both tiered models are based on a public health model of prevention. The public health model of prevention is based on three tiers, primary (practices across the population to prevent health issues), secondary (early detection and intervention for those at risk of health issues) and tertiary (intensive treatment for those with health issues) (Gordon, 1983). Similarly, multi-tiered systems within schools integrate assessment and increasingly intensive levels of intervention to support a school-wide approach to

improving student outcomes (Schulte et al., 2016; Sugai & Horner, 2020). In the next section, the most common tiered systems in academics and behavior, RTI and PBIS, will be described including some key overlapping features within tiered models of support that support the case for integration.

Response to Intervention

RTI is a framework used to prevent, identify and address academic learning difficulties (Fuchs et al., 2010). RTI gained popularity in schools when IDEA was reauthorized in 2004 and included response to intervention as an alternative path to identifying students with learning disabilities instead of the traditional discrepancy model (Swanson et al., 2012). The key elements of RTI include quality core instruction in Tier 1 for all students, the use of a screening assessment to identify struggling students, research-based interventions, and continual progress-monitoring to facilitate data-based decision making in Tiers 2 and 3 (Lembke et al., 2012). In addition to identifying students with learning disabilities, RTI is a structure used by schools to identify and address the academic needs of all students, primarily in reading and mathematics. The NAEP's 2019 Nation's Report Card reported that only 41% of fourth grade students are proficient in math and only 35% are proficient in reading. With these concerning statistics, methods to prevent academic failure and intervene in cases of unresponsiveness are needed and many schools are looking to tiered systems to address this need.

Positive Behavior Intervention and Supports

PBIS is a tiered framework for preventing and addressing behavior needs. The focus of PBIS is to prevent problem behaviors by teaching and reinforcing appropriate behaviors. The key elements of PBIS include quality core instruction of behavior

expectations in all settings for all students with positive reinforcement as the primary tier, research-based interventions, and continual progress-monitoring to facilitate data-based decision making for students struggling to meet behavior expectations at Tiers 2 and 3. Positive behavioral interventions and supports was first referenced in the 1997 reauthorization of IDEA, with the concept borne out of a concern around exclusionary and aversive practices for addressing behavior (Sugai, 2015). As of 2018, over 26,000 U.S. schools were implementing PBIS (Sugai & Horner, 2020). Research has established that PBIS has positive effects on academic performance, school suspensions, and the frequency of office discipline referrals (Bradshaw et al., 2010).

PBIS researchers have noted the similarities in the RTI and PBIS conceptual frameworks, with both models emphasizing data-based decision making, prevention, problem-solving, and evidence-based practices and support a movement toward a combined academic and behavioral approach (Sugai & Horner, 2009).

Shared Features of Tiered Systems of Support

Assessment and Data-Based Decision Making

A key feature of both academic and behavior tiered systems are the mechanisms of assessment and data-based decision making used to make decisions about how students move between tiers to receive the appropriate services. There are three main types of assessments included in a tiered framework. First, universal screeners are employed to identify students at-risk who may benefit from further instruction or intervention (Ketterlin Geller et al., 2019; Wixson & Valencia, 2011). Second, diagnostic assessments are used to determine what type of intervention would be appropriate. These may include student interviews, analysis of student work samples, functional behavior

assessments (Lembke et al., 2012). Third, progress-monitoring, which consists of quick and frequent data collection during intervention administration, is graphed and analyzed regularly to better understand student response and inform instructional decision making (Deno, 2005; Jung et al., 2018). Although there are different models of tiered systems, the majority involve three tiers of support (Donovan & Shepherd, 2013), described in more detail below.

Tier 1

Vital to the success of any tiered prevention program is the first tier of instruction, which in academic tiered systems like RTI includes quality classroom instruction for all students (Witzel & Clarke, 2015). Quality instruction includes instructional design features supported by research to prevent difficulties and support struggling learners (Jitendra & Dupuis, 2016). In Fuchs et al.'s (2007) study of a third grade RTI program, it was found that even with only one tier of validated instruction, non-responsiveness in math problem-solving dropped from 86% to 29% on immediate transfer items and from 100% to 54% on near transfer items. A recent meta-analysis found significant positive effects of Tier 1 reading instruction on comprehension and vocabulary outcomes (Swanson et al., 2017). Similarly, the universal or Tier 1 level of PBIS includes establishing and teaching school-wide positive behavior expectations, and monitoring and reinforcement of positive behavior (Utley & Obiakor, 2012). When these practices are implemented with fidelity, universal screening data can then be used to determine the need for additional, more intensive intervention.

Tier 2

If students are identified on screening measures as at-risk or not making adequate progress, they also receive Tier 2 intervention in addition to continued Tier 1 instruction. The second tier of RTI typically involves scientifically validated interventions delivered in small groups (Gersten et al., 2009). In a meta-analysis of 72 Tier 2 reading interventions, moderate positive effects were found on standardized and non-standardized measures of foundational reading skills (Wanzek et al., 2016). A recent meta-analysis of 39 Tier 2 math interventions revealed an overall weighted mean effect size of 0.41, which is moderate and statistically significant (Jitendra et al., 2021). Similarly in behavior tiered systems at the Tier 2 level, targeted interventions that are evidence-based and can be implemented in small groups are put into place, as well as progress-monitoring measures. These interventions typically involve social skill instruction or greater opportunity for reinforcement of desired behaviors and are already in place or available in schools for immediate implementation (Mallory et al., 2021).

Tier 3

Students who do not show adequate growth on progress-monitoring measures after receiving tier 2 supports are considered for tier 3 which involves more intensive interventions that are typically individually delivered (Donovan & Shepherd, 2013). Fuchs et al. (2014) proposed there are two effective models at this stage, one being the intensification of existing Tier 2 interventions, the other being data-based individualization (DBI) which involves individualizing tailored instruction based on progress-monitoring data. The process is the same in behavior tiered systems, if a student has behavior needs that are chronic or intense, a functional behavior assessment (FBA)

may be conducted to develop Tier 3 individual, intensive behavior support plans (Horner & Sugai, 2015).

Integrated MTSS

While many schools are implementing MTSS frameworks such as PBIS and RTI in parallel, with intervention and school team discussion in academics and behavior occurring separately, students often have needs in both areas and researchers are calling for a shift towards integration (Kulche et al., 2015; Sailor et al., 2020). Behavior and academic needs can be related in several ways, with students displaying low academic performance being more likely to display problem behaviors and vice versa. Coie and Krehbiel (1984) hypothesized four pathways to combined problems that recent research supports. One pathway describes behavior challenges causing a reduction in access to learning including removal from class or preoccupation with social or emotional issues which can cause students to fall behind academically (Gray et al., 2014; Spira et al., 2005). A second pathway exists when underlying attention deficits can cause challenges in both areas, inattention to social cues and teacher instruction can lead to low academic achievement and problem behaviors (Mattison et al., 2013; Metcalfe et al., 2013). The third pathway describes early academic challenges causing increased social rejection from peers or teachers (McIntosh et al., 2014). Finally, the fourth pathway involves inadequate response to academic intervention leading to behavior challenges, for instance when a student copes with increased frustration with academic challenges by using disruptive behavior to avoid the situation (Lin et al., 2013; McIntosh et al., 2008). Each of these pathways could be addressed or mitigated with improved universal instruction.

The related behavioral and academic struggles described in each pathway could be supported by removing irrelevant visual and auditory distractions from the classroom, teaching prosocial behaviors, early identification of academic deficits and quality academic instruction for all students (McIntosh & Goodman, 2016).

Considering the similarities in the key features of academic and behavior tiered systems and the interrelatedness of academic and behavior needs, integration of the systems would not only increase systemic efficiency but also effectiveness in targeting student needs. Within an iMTSS, Tier 1 practices remain the most potentially impactful aspect of a tiered system, as these practices are selected to maximize success for all students in all areas. Academic engagement is one of the PBIS recommended effective classroom level behavior management practices, making academic instruction a top priority for both academic and behavior risk prevention (Reinke et al., 2013).

Instructional Quality at Tier 1 Within an iMTSS

When quality academic instruction is provided to students, students are more successful and engaged, which can in turn reduce problem behaviors, preventing several of the pathways previously described (Osher et al., 2010). An effective Tier 1 program should ensure that all students have the opportunity to learn critical content, leading to fewer students requiring intervention (Vaughn et al., 2009; Riccomini & Witzel, 2010). Indicators of quality Tier 1 instruction that can be found in the literature include scientific or evidence-based curriculum and instructional practices, that are aligned to standards, and differentiated to address individual student needs (Fuchs & Vaughn, 2012; Hughes & Dexter, 2011; Kurz et al., 2015; Stoiber & Gettinger, 2016). Specific to Tier 1 Instruction within an iMTSS, indicators of quality can be found within the criterion identified in the

Integrated MTSS Fidelity Rubric for Tier 1 instruction. Further explanation of the rubric will be described below.

Integrated MTSS Fidelity Rubric

The Measuring Implementation of Multi-Tiered Systems of Support: Integrated MTSS Fidelity Rubric (IMFR) project funded by IES is currently validating a rubric to assess the fidelity of integrated MTSS implementation. As integrated MTSS is a relatively new initiative, the purpose of the development of this tool is partly aspirational, to provide the field with clear exemplars of integrated MTSS implementation. The research team is engaged in an iterative development process that consists of consideration of existing fidelity measurement tools, expert review and psychometric analysis of multiple administrations. Administration of the IMFR has taken place with MTSS teams in 87 public elementary schools located across 13 districts in five states. Using an interview protocol administered by trained data-collectors, information was gathered about the integrated MTSS implementation in each school, allowing the data-collectors to rate the level of fidelity of various components of integrated MTSS. The IMFR consists of 4 domains: Instruction and Intervention, Assessment, Data-Based Decision Making, and Infrastructure. Within the Instruction and Intervention domain there are 3 constructs: Tier 1, Tier 2, and Tier 3. The IMFR defines Tier 1 integrated MTSS fidelity as such: Tier 1 curriculum and instructional practices are (a) evidence-based, (b) differentiated to address needs of all learners, and (c) delivered with fidelity to all students (Gandhi et al, 2019). These criteria were developed through an iterative process of reviewing the literature, existing measures, and consulting with an expert advisory board. The evidence supporting each criterion will be described below.

Evidence-based Instruction

High-quality evidenced-based instruction has been defined as instruction that has been demonstrated through scientific research and practice to produce high learning rates for most students (NASDSE, 2005; Stoiber & Gettinger, 2016). The evidence base is established by applying specific criteria to empirical literature, typically related to the quality of the research design, quantity of research and effect sizes (Cook & Cook, 2013). In many schools implementing MTSS, evidence-based instruction is assumed, and resources are directed at supporting Tier 2 and 3 processes (Kurz et al., 2015). However, a survey of K-2 reading teachers found that most reading curricula used at Tier 1 is not evidence-based, although many could be considered evidence-informed, or based on effective practices but not empirically studied and a significant proportion of schools had no reading curriculum at all (Kretlow & Heff, 2013).

Fidelity

Fidelity of implementation is a concept often considered by researchers to ensure that the results of the studied implementation are accurate and can be reported as such. Within tier 1 instruction, fidelity typically refers to teachers using the curriculum as it was intended to be used. Schools implementing SW-PBIS are asked to self-assess fidelity, as higher SW-PBIS implementation fidelity is associated with better student outcomes (Mercer et al., 2017). In a study of targeted reading instruction, teacher adherence to strategies was directly related to student outcomes in reading and vocabulary (Varghese et al., 2021).

Differentiated Instruction

Even within an evidence-based, effective core curriculum, teachers will need to adjust, or differentiate instruction to meet the needs of diverse learners (Fuchs & Vaughn, 2012). In a review of Tier 1 instructional programs in mathematics, Jitendra & Dupuis (2016) found that core programs could meet the needs of a range of learners when the instruction was differentiated to match content to the needs of students. In a professional development study in which kindergarten teachers learned about differentiating instruction, students of teachers that increased their differentiation showed significantly improved word reading outcomes (Al Otaiba et al., 2016).

Differentiation is often recommended in Tier 1 instruction and even included in practice guides for schools for both reading and math RTI developed by top researchers in the field and distributed by the Institute for Education Sciences (Gersten et al., 2009; Gersten et al., 2009b). The general recommendation is to vary time, content, and degree of support and scaffolding—based on students' assessed skills, but specific guidance is limited (Walker-Dalhouse et al., 2009; Jones et al., 2012). A clearer approach to defining differentiation when considering the practices of an entire school is to use an established framework for accomplishing such inclusive design, like UDL. UDL is a concrete, established framework that teachers can use to design inclusive, differentiated instruction with principles that can be clearly implemented and measured (Rao & Meo, 2016).

Universal Design for Learning

UDL was developed in 1998 by Ann Meyer, David Rose and their colleagues at the Center for Applied Special Technology (CAST) to adapt the architectural concept of universal design to the learning environment (Rose & Meyer, 2002). Universal design, developed in the 1980's, encouraged architects and designers to design spaces to meet the

needs of all persons, rather than adapting them after the fact (Connell et al., 1997). A common example of this includes curb cuts, the change made to sidewalks to support disabled veterans that turned out to be useful for many people with vision impairments or mobility issues, but also people carrying objects and parents pushing strollers, etc. Making spaces accessible from the outset not only reduces barriers for some but can be beneficial to all who use the space.

As an educational planning framework, UDL similarly encourages teachers to design instruction and learning environments with the needs of all in mind, reducing barriers to learning proactively rather than planning instruction for the average student and then reacting to barriers that arise after the instruction. Considering UDL in the instructional planning stage does not mean that separate lessons are developed for each individual based on preferences, rather, predictable learner variability is considered, and flexible pathways are built in to provide multiple means of accessing and processing information and assessing learning. Rao & Meo (2016), describe a systematic UDL planning cycle in which teachers first unpack the relevant standard to develop a clear goal, develop varied formative and summative assessments in which students can demonstrate goal achievement, and then develop flexible methods and materials that include supports and scaffolds.

Student diversity is at an all-time high, including exceptionalities such as disabilities, receiving special education or gifted education services, cultural backgrounds and linguistic differences (e.g., Thomas et al., 2020). This wide variation in student backgrounds and needs can be challenging to address. UDL has been described as a framework that can support the varied instructional needs of students including culturally

and linguistically diverse students as well as those with disabilities (Chita-Tegmark et al., 2012; Rao, 2015).

UDL has an intuitive appeal to educators working towards more inclusive and equitable instruction and though the components are conceptually sound, the principles can be interpreted and applied in various ways making the establishment of an empirical basis challenging. In a systematic review of the research on UDL, Ok et al. (2017) found that there were a limited number of studies that used true experimental designs. Outcomes of the 13 included studies showed that UDL-based instruction has the potential to help teachers support the varied academic needs of students and improve student outcomes, with effect sizes ranging from small to large (Ok et al., 2017). In a meta-analysis of 18 empirical studies on UDL, Capp (2017) found that all included studies supported the claim that UDL is an effective teaching methodology for improving learning for all students but that the studies lacked empirical evidence to demonstrate impact on educational outcomes. Although further empirical study is needed to fully validate UDL as an effective instructional framework, the findings currently available indicate UDL is a promising approach to more formally address the instructional differentiation needs of modern teachers. Illustratively, UDL has become a common part of the vernacular of effective instruction in teacher education programs and textbooks (e.g. Cressey, 2020; Raymond, 2016; Scheuermann & Hall, 2016).

Connecting Integrated MTSS and UDL

The use of UDL within iMTSS, MTSS or RTI has been proposed as a practical approach to inclusive and equitable education in an effort to move the operational definition of inclusion from place-based to include educational programming (Basham et

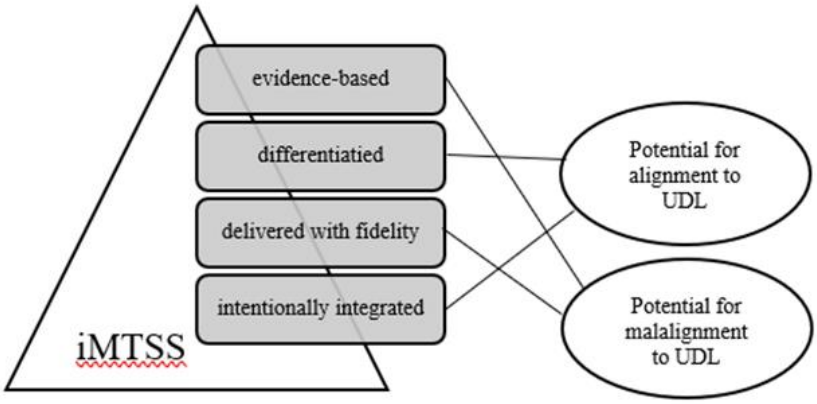
al., 2010; Rogers-Adkinson & Fridley, 2016; Sailor, 2015; Sailor, 2017; Sailor et al., 2021). A schoolwide applications model (SAM) of inclusive education reform that includes UDL as one of several aspects of equitable instruction within an MTSS found that students mathematics outcomes improved more significantly than in comparison schools, and a follow-up study found that the same was true of students with IEPs (Choi et al., 2017; Choi et al., 2020). These few studies indicate the potential for concurrent implementation of UDL and iMTSS, however, the inclusion of several other factors confounds the implications, thus UDL-based instruction within an iMTSS remains largely unexplored at this time.

Implementing UDL within Tier 1 classrooms requires a shift in how teachers think about their role as educators. In a typical tiered system the standard approach has been to teach to the average students and anyone not keeping up would receive intervention outside of the general education classroom in a Tier 2, 3, or special education setting. To think of the instruction of all students, even those with disabilities, as the responsibility of general education teachers requires an additional skill set and purposeful, proactive planning. When considering the indicators of quality instruction in Tier 1 of an iMTSS (evidence-based, differentiated, and delivered with fidelity to all students) and the focus on the whole-child (academic and behavioral needs) there is both clear alignment to UDL practices and potential for malalignment. As seen in Figure 1, UDL potentially aligns well with the intentional integration of academic and behavioral instruction and differentiated instruction but may conflict with a focus on implementing evidence-based curriculum. If a school has adopted a packaged curriculum and is being asked to implement it with fidelity, teachers may not feel they have the flexibility or

autonomy to apply UDL practices (Rao & Meo, 2016). The following section will address each of the indicators of quality Tier 1 instruction within iMTSS and what can be found in the extant literature about the potential for concurrent implementation with UDL.

Figure 1

Considerations for Concurrent Implementation of UDL and iMTSS



Potential for Alignment or Malalignment of Integrated MTSS and UDL

Integration and Differentiation

One of the indicators of quality instruction in an integrated MTSS is differentiated instruction, which has conceptual overlaps with UDL in the focus on proactive instructional design to increase access to a wider range of learners. UDL can be viewed as a systematic approach to differentiation. The more formal Differentiated Instruction (DI) is both a philosophy and a model of instruction developed by Carol Ann Tomlinson, that encourages teachers to be proactive in anticipating student needs and modifying lesson content, process, and/or products (Tomlinson, 2005).

A systematic analysis of the conceptual overlap of DI and UDL in the literature found three approaches to understanding the connections between these two models: complementary, embedded, and distinctive (Griful-Freixenet et al., 2020). Authors that engaged in a complementary view of DI and UDL, described the relationship as one concept supporting the other, for instance, DI was viewed as a set of practices that could be used within the pedagogical framework of UDL or UDL was a set of practical guidelines used to implement DI. In an embedded approach, authors conceived of DI more as the generic term *differentiated*, which is used in UDL literature regularly. Therefore, DI is a practice encompassed within the UDL framework. In the third conception of distinctiveness, authors viewed the two models as independent, having similarities in their paradigms of inclusive education but incompatible differences in design, for instance DI was described as starting from a baseline and gearing up or down for individuals whereas UDL is more focused on benefits to the whole community. Depending on the viewpoint and understanding of school personnel, they may view the two initiatives as well-aligned, UDL achieving the goals of differentiation or as two differing and incompatible approaches. The potential alignment of iMTSS and UDL within this indicator of quality instruction will be explored in this study by considering the view of differentiation held by school MTSS teams.

Evidence-Based Curriculum and Fidelity

A key feature of Tier 1 instruction in an iMTSS is implementing an evidence-based curriculum with fidelity to ensure that all students are receiving instruction that has been scientifically vetted and proven to be effective for most students. Fidelity of implementation, particularly curriculum implementation, can be viewed as rigid

adherence to the full curriculum as written, or a loose adherence to the intention or spirit of the curriculum with room for flexibility, or somewhere in between. The field of education research lacks consensus of which aspects of fidelity are most critical to report or how to measure them, thus translating those expectations to teacher implementers remains ambiguous (Bos et al., 2022; Dane, 1998; Defouw et al., 2019). In a seminal review of fidelity as a concept, it was noted that fidelity and adherence were frequently defined in the same or similar ways but that as curricula moves from conception to classroom, adaptations are inevitable and necessary (O'Donnell, 2008). It was recommended that researchers operationally define the critical components and processes necessary to fidelity of the core program and focus measurement of fidelity on those criteria.

Included in the legal definition of UDL in the Higher Education Opportunity Act (HEOA) of 2008 is the following statement "... [UDL] provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged." Here we find a potential for malalignment of the two initiatives within Tier 1 instruction. Schools may interpret the need for fidelity of curriculum implementation more strictly than necessary and be unwilling to allow teachers the autonomy to adjust the curriculum based on student need. The potential alignment of iMTSS and UDL within this indicator of quality instruction will be explored in this study by considering the perception of instructional autonomy held by school MTSS teams.

Summary

Based on this review of the literature it can be hypothesized that both UDL and iMTSS initiatives would be enhanced and more effective if implemented concurrently. Research indicates that UDL can have positive outcomes, however, the variation in how UDL is used and described makes empirically determining effectiveness challenging (Ok et al., 2017; Rao et al., 2014). One approach that can support this effort is to use established evidence-based practices and apply UDL enhancements and modifications that are clearly described, as well as how and for whom the approach was effective (Cook & Rao, 2018). UDL being applied to evidence-based curriculum and instructional practices currently used within iMTSS would increase access for students with disabilities, and culturally and linguistically diverse students, making Tier 1 instruction more effective. Increased access at the Tier 1 level of an iMTSS, would reduce the strain on subsequent, more resource-intensive tiers. Within an integrated MTSS, UDL could be an effective approach to designing Tier 1 instruction to increase access to academic content, therefore reducing problem behaviors. Supporting the overall purpose of the integration of MTSS, which is to increase efficiency and effectiveness and better meet the needs of the whole child. Yet, the concurrent implementation of these initiatives—iMTSS an UDL--has not yet been studied. The potential for concurrent implementation of these initiatives will be explored through the following research questions.

Research Questions

The following research questions will be addressed:

1. What patterns emerge in the implementation of iMTSS and UDL in Reading and Math within Tier 1 instruction?
    a. What characterizes each emergent class?

b.What aspects of the initiatives act as potential barriers to concurrent implementation?

CHAPTER 3

Methods

The purpose of this study was to determine and describe the patterns that exist in the implementation of iMTSS and UDL in reading and mathematics Tier 1 instruction in elementary schools and to determine factors that pose barriers to concurrent implementation of these two initiatives. This chapter will detail the research methodology employed to achieve this purpose, including a description of study design, sampling and participants, information on measures and data collection procedures and analysis.

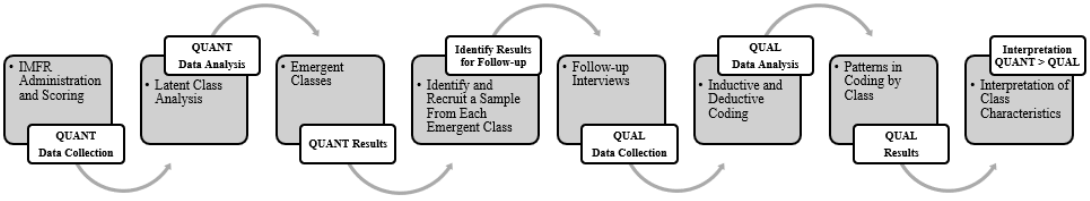
Study Design

This study was an explanatory sequential mixed-methods design, specifically a variation called a follow-up explanations model. In this model, the researcher first collects and analyzes quantitative data, identifies quantitative findings that require additional information for explanation, then collects qualitative data from participants that can best help explain the findings (Creswell & Plano Clark, 2011). An explanatory sequential mixed methods design is appropriate for this study because although the quantitative portion of the study produced subgroups with shared characteristics, few conclusions could be drawn from the results without additional investigation. The quantitative results support the identification of appropriate follow-up qualitative data collection, which played a supporting role in explaining the characteristics of each sub-group. The combined interpretation of quantitative and qualitative data will clarify the implications of the respective findings, specifically how the findings should be considered by researchers and schools interested in ensuring quality instruction in an integrated MTSS.

Figure 2 provides a visual representation of the steps of the follow-up explanations model with the correlating steps of this study. An overview of each step is described below, with more in-depth explanation of the methods throughout the chapter.

Figure 2

Study Design



Note. Explanatory Design: Follow-up Explanations Model adapted from *Choosing a Mixed Methods Design* by Creswell & Plano Clark (2011) aligned with steps of the current study below.

Quantitative data collection took place in conjunction with another study that will be described in the next section. The quantitative analysis consisted of a latent class analysis (LCA) to determine the patterns of initiative implementation, variables included in the analysis include the degree of fidelity of integrated instruction as indicated by the IMFR Tier 1 instruction construct (degree of integration of academic and behavior evidence-based universal curriculum and instructional practices delivered with fidelity) and the degree of implementation of UDL in reading and mathematics, respectively. A representative sample of schools was then recruited to participate in qualitative follow-up based on the classes that emerged from the LCA.

Follow-up qualitative data collection was then conducted through semi-structured interviews with the identified school teams. During the follow-up interview, school teams

were presented with vignettes describing each of the emergent classes and asked to choose the vignette that best represented their school. This data was analyzed as secondary confirmation of class membership. Additional protocol questions were developed and provided in these interviews to gain more in-depth insight into Tier 1 instructional practices in each class including potential factors of alignment or malalignment of iMTSS and UDL, quality indicators identified by the IMFR tool related to MTSS fidelity and integration, as well as perceptions and practices related to UDL.

Setting

This study was conducted in conjunction with an existing measurement study focused on the psychometric development of a rubric. The Measuring Implementation of Multi-Tiered Systems of Support: Integrated MTSS Fidelity Rubric (IMFR) project, funded by IES is currently developing and validating a rubric to assess the fidelity of integrated MTSS implementation in elementary schools. Using an interview protocol administered by trained data-collectors, information is being gathered about the integrated MTSS implementation in each school, allowing the data-collectors to rate the level of fidelity of various components of integrated MTSS.

Specifically, the results of the Tier 1 construct within the Instruction and Intervention domain of the IMFR were collected as a variable of interest for this study. In addition, for the purposes of this study, two quantitative questions were added to the existing IMFR interview protocol. The responses to these questions were utilized to assess the perceived level of UDL implementation within Tier 1 instruction in reading and mathematics, respectively.

Participants

Participants in the quantitative portion of this study included school MTSS teams from 87 elementary schools. The school demographic variables (see Table 1) were assessed to ensure the sample was representative and varied to support generalizability. Each MTSS school team consisted of three or more school staff, including an administrator involved in the MTSS practices and procedures of the school so that they were able to address processes accurately. Consent to participate in the IMFR study was previously obtained from each school and MTSS team member, an amendment with the updated protocol including the UDL section was added to the original IRB application (See Appendix A).

Follow-up Interview Participants

Prior to recruitment and consenting of follow-up interview participants, additional Institutional Review Board as well as IMFR Primary Investigator approval was obtained (See Appendix B). School teams were contacted via email requesting participation in a follow-up interview via video conference and offered compensation for their time in the form of a $50 gift card for use by the team. All 87 school teams were contacted in five waves of recruitment efforts based on response rates from the previous wave to avoid taxing school teams with requests unnecessarily, however response was minimal and as such all schools needed to be contacted to obtain an appropriate sample size. 12 school teams participated in the follow-up interviews, see Table 1 for additional demographic information.

Table 1

Sample Demographics

	Full Sample N=87	Interview Participants

			N=12
		n (%)	*n (%)*
State			
	Michigan	11 (13)	3 (25)
	Missouri	54 (62)	5 (42)
	Montana	9 (10)	3 (25)
	Ohio	9 (10)	1 (8)
	Washington	4(5)	0 (0)
Enrollment			
	100-300 students	20 (23)	3 (25)
	301-600 students	49 (56)	8 (67)
	601-800 students	18 (21)	1 (8)
Percent Receiving Free and Reduced Lunch			
	0-25%	49 (56)	7 (58)
	25-50%	21 (24)	3 (25)
	51-75%	8 (9)	0 (0)
	76-100%	9 (10)	1 (8)
English Language Learner Percent			
	0-5%	61 (70)	10 (83)
	6-10%	12 (14)	0 (0)
	11-20%	10 (11)	1 (8)
	21-35%	4 (4)	1 (8)
Percent Receiving Special Education Services			
	0-5%	42 (48)	3 (25)
	6-10%	14 (16)	3 (25)
	11-20%	29 (33)	6 (50)
	21-30%	2 (2)	0 (0)
Race/Ethnicity			
Asian			
	0-5%	74 (85.1)	11 (91.6)
	6-10%	3 (3.4)	0 (0)
	11-20%	5 (5.7)	0 (0)
	21-30%	1 (1.1)	0 (0)
	31-40%	2 (2.3)	1 (8.3)
	41-50%	1 (1.1)	0 (0)
Black			
	0-5%	54 (62.1)	6 (50)
	6-10%	12 (13.8)	0 (0)

	11-20%	11 (12.6)	5 (41.7)
	21-30%	4 (4.6)	0 (0)
	31-40%	4 (4.6)	1 (8.3)
	41-50%	2 (2.3)	0 (0)
Hispanic			
	0-5%	65 (74.7)	6 (50)
	6-10%	17 (19.5)	3 (25)
	11-20%	4 (4.6)	2 (16.7)
	21-30%	1 (1.1)	1 (8.3)
	31-40%	0 (0)	0 (0)
	41-50%	0 (0)	0 (0)
Multi-Racial			
	0-5%	17 (19.5)	2 (16.7)
	6-10%	43 (49.4)	10 (83.3)
	11-20%	27 (31)	0 (0)
	21-30%	0 (0)	0 (0)
	31-40%	0 (0)	0 (0)
	41-50%	0 (0)	0 (0)
White			
	0-5%	0 (0)	0 (0)
	6-10%	0 (0)	0 (0)
	11-20%	1 (1.1)	0 (0)
	21-30%	3 (3.4)	1 (8.3)
	31-40%	8 (9.2)	1 (8.3)
	41-50%	7 (8)	0 (0)
	>50%	68 (78.2)	10 (83.3)

Measures

Integrated MTSS Fidelity Rubric

The first variable included in the LCA was the fidelity of Tier 1 instruction within an integrated MTSS. This variable was measured via a construct of the IMFR that assesses the level of fidelity of each tier of instruction on a 5-point scale (ranging from "Beginning" or not meeting all of the indicators in at least one area [reading, math or behavior] to "Sustaining" or meeting all the indicators in both academic and behavior areas, and implemented in an integrated manner for at least two years; see Appendix C for full construct). The criteria considered in scoring this construct on the IMFR rubric

include that the tier 1 curriculum and instructional practices are a) evidence-based, b) differentiated and c) delivered with fidelity to all students. These criteria were developed by consulting existing MTSS fidelity rubrics and content experts in the field, and are considered in the areas of mathematics, reading and behavior.

Universal Design for Learning

The second and third variables included in the LCA were the extent of UDL implementation in math and reading. This data was collected via the IMFR interview protocol but was not considered in the scoring of fidelity. To clarify, UDL implementation was not considered by data collectors when scoring the Tier 1 construct and thus is a separate variable. The additional protocol items addressing UDL implementation were developed by the primary researcher and then were reviewed as a form of pre-testing by three expert researchers who study UDL with specific attention paid to the development of an accurate but teacher-friendly definition of UDL. School teams were provided a definition of UDL and then asked to rate their schools' level of implementation in reading and math respectively on a 4-point scale (ranging from 1) not at all to 4) to a great extent and to provide an explanation of their ratings (see Appendix D for full items).

Follow-Up Interview Protocol

The follow-up interview protocol consisted of two parts. First, a series of vignettes modeled after class membership characteristics (determined from the LCA) were presented to the school teams and interviewees were asked to choose the vignette that most aligned with their school and explain why. The vignettes were developed to represent the data associated with each emergent class. Although two classes were found,

multiple combinations of initiative implementation were included in each class and thus two vignettes per class were developed in order to encompass all possibilities. The vignettes were reviewed for alignment to class membership by experts familiar with both the IMFR and UDL. All four vignettes were presented on a single slide in the same order in each interview. The class membership confirmation was included to ensure the classes determined by the LCA were accurate and meaningful, considering the variables used were scores obtained from objective scoring procedures—the IMFR score based on interpretation of a qualitative interview and the UDL scores being self-ratings.

Second, school teams were asked a series of interview questions developed with a goal of establishing a deeper understanding of the defining features of class membership, specifically the Tier 1 instructional approaches aligned to integrated MTSS, UDL and potential barriers to concurrent implementation (See Appendix E for interview protocol).

Data Collection and Procedures

For the IMFR administration, school teams participated in a semi-structured interview that lasted approximately 2-3 hours over a video conference call between January and February of 2021. Each interview was conducted by one of 13 trained data collectors--including the primary researcher of this study—recorded, and transcribed. Data collectors were trained over a week of intensive instruction and practice in using the administration materials and scoring. Administration and scoring reliability were established for all data collectors prior to the administration window. The administering data collector then used the information obtained in the interview to score the school on the IMFR and scores were entered into RedCap (an electronic, secure, data entry tool). Data collectors' scoring fidelity was evaluated before beginning interviewing procedures

to ensure reliability, with all data collectors scoring at least 80% fidelity before conducting administrations. Administration fidelity was assessed at the beginning and mid-points of data collection. The first administrations of all data collectors were checked for fidelity, average administration fidelity was 98%. On the mid-administration period fidelity checks, average fidelity was 97%. 20% of the interviews were scored by a second data collector and inter-rater reliability was determined upon completion of data-collection. 82.4% of all double scored ratings were consistent within one rating, with 56.4% being exact agreement.

The portion of the interview that is specific to UDL took place at the end of the interview and was explicitly structured rather than semi-structured and was delineated as separate in the scripted introduction. Data collectors were trained to conduct that portion of the interview with fidelity to the scripted protocol. The researcher conducted a separate administration fidelity check for that section upon completion of data-collection by reviewing a randomly selected 20% of the transcripts with a checklist (see Appendix F), average administration fidelity was 76%.

For the qualitative portion of this study, follow-up interviews were conducted between July and October of 2021 by the researcher using a semi-structured interview protocol that lasted between 22 and 42 minutes over a video conference call that was recorded and transcribed. Table 2 provides information about the follow-up interview administrations; all were completed with participants who had also been present during the IMFR administration.

Table 2

Follow-Up Interview Participants

School MTSS Team	Class Membership	Team Members Present	Team Member Positions	Length of Administration
1	A	2	Teacher, Administrator	43:15:00
2	B	2	Teacher, Instructional Coach	31:05:00
3	B	2	Teacher, Teacher	33:06:00
4	A	1	Instructional Coach	25:48:00
5	B	1	School Psychologist	30:19:00
6	A	1	Instructional Coach	31:52:00
7	B	2	Administrator, Administrator	22:47:00
8	B	1	School Psychologist	29:46:00
9	A	1	Administrator	42:50:00
10	A	1	Administrator	40:24:00
11	B	4	Teacher, Teacher, Administrator, Counselor	33:19:00
12	A	1	Administrator	33:17:00

Data Analysis

Quantitative Data Analysis

The quantitative analysis was intended to create multi-dimensional discrete latent classes based on a cross-classification of three categorical variables. Such latent class analysis allows for previously unknown typologies to aid in understanding the relationships between the variables as well as allow for further predictive factor analysis (Schreiber, 2017). The goal of this analysis was to consider patterns in the implementation of initiatives in Tier 1 instruction through the consideration of three specific variables, (a) the fidelity of Tier 1 instruction in an integrated iMTSS, (b) the extent of UDL implementation in reading, (c) and the extent of UDL implementation in math.

Descriptive analysis was conducted including means and standard deviations to describe the characteristics of the participants' integrated MTSS instruction as well as the demographic characteristics of the sample. To keep the parameters of the latent class models at a manageable level relative to the available number of observations or school

teams scored, the IMFR Tier 1 fidelity scores were kept as continuous variables, but the UDL variables were dichotomized (0=not at all/very little, 1=somewhat/to a great extent) prior to latent class modeling.

The LCA was conducted using MPlus 6.0 (Muthén & Muthén, 2010). There are several statistical indicators of model fit used in LCA, and the best model is chosen based on these indicators. To determine the relative fit of the models, models with differing numbers of classes were compared using the Akaike information criterion (AIC; Akaike, 1987), the Bayesian information criterion (BIC; Schwarz, 1978), and the sample-size adjusted Bayesian information criterion (aBIC; Sclove, 1987). Typically, the smaller the information criteria, the better the model fits the data. In addition, the classification precision was evaluated as indicated by estimated posterior class probabilities, or the probability of assigning observations to classes given the data, by considering the entropy measure. Entropy values close to 1.0 indicate higher classification precision (Muthén, 2004). Further, the Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR LRT) is another indicator of model fit that was evaluated, providing a p value of the model strength over a model with one fewer class. Because the number of classes was unknown a-priori, a series of LC models with 1 to 6 classes were estimated. Significant p values on the VLMR LRT indicated that the current model is a significantly better fit for the data than a model with one fewer class (Nylund et al., 2007).

Qualitative Data Analysis

The follow-up interview recordings were transcribed and analyzed. First, deductive coding was applied to pull out the relevant excerpts related to the research questions including (a) understanding of/familiarity with UDL, (b) UDL in practice, (c)

Tier 1 integrations of MTSS, (d) differentiation, (e) fidelity vs flexibility, and (f) barriers to implementation. Each of the excerpts within those primary codes were subjected to a secondary coding using a constant comparative method in which codes are compared with codes to create categories to connect them (Glaser, 2005; See Appendix G for full coding scheme). A secondary coder participated in the axial code refinement by coding 20% of the same excerpts within each primary code using the initial coding scheme derived from the data by the primary researcher. The primary and secondary coders then resolved any disagreements and revised the coding scheme for clarification. Both coders then independently coded the full sample of excerpts with 84% agreement and resolved any remaining discrepancies.

The codes were then grouped according to transcript and then classes and compared to discover patterns that provided explanation of class characteristics. The researcher also determined the percentage of sample schools who chose the vignette that appropriately matched their class membership.

Summary

Integrated MTSS is an emergent initiative poised to address both the academic and behavioral needs of all students. Tier 1 or universal instruction in an integrated MTSS should be evidence-based and differentiated to provide accessible and inclusive educational opportunities, decreasing the need for services at the Tiers 2 and 3 level for most students. One established approach to providing accessible and differentiated instruction is Universal Design for Learning (UDL), another emergent initiative that can be embedded within a tiered prevention system. The present study hypothesizes that fidelity of integrated practices (measured by the IMFR) and implementation of UDL are

both indicators of quality instruction at the Tier 1 level, and that schools implementing both initiatives at a high level can be characterized as having high quality universal instruction. Secondarily, this study aims to explore the potential barriers for concurrent implementation of these two initiatives that may prevent achievement of high-quality universal instruction (see Figure 1 for factors of potential malalignment).

The current study tested this hypothesis using a latent class analysis that considered integrated MTSS fidelity at Tier 1, and level of UDL implementation in reading and math respectively. Once class membership was determined, qualitative data collected from follow-up interviews of a sample of school teams that fell into each class were utilized to confirm class membership and to provide a deeper understanding of class characteristics, and the factors that influence concurrent implementation of iMTSS and UDL.

Chapter 4

Results

The purpose of this explanatory sequential mixed-methods study is to (a) determine what patterns emerge in the implementation of iMTSS, UDL-R, and UDL-M in Tier 1 instruction, (b) be able to describe those patterns, and (c) describe the barriers that exist to concurrent implementation. In this chapter, the findings from the current study including quantitative and qualitative findings will be shared. First, descriptive statistics for the different measures used in the quantitative analysis will be presented. Then, the findings of each of the analyses will be described. Finally, a summary of the findings in relation to the specific research questions asked will be provided.

Descriptive Statistics

Quantitative data was collected on three variables described in greater detail in Chapter 3. Provided below are descriptive statistics on each variable including, state, student enrollment, socioeconomic status, special education and English Language Learner populations. These descriptive factors were considered in relation to the score distributions to determine if any ecological factors play a role in the implementation of iMTSS or UDL.

Integrated MTSS Fidelity Rubric (IMFR)-Instruction and Intervention-Tier 1

The Integrated MTSS Tier 1 Fidelity rating was determined by a trained data collector on a 5-point scale (ranging from “Beginning” or not meeting all of the indicators in at least one area to “Sustaining” or meeting all the indicators in both academic and behavior areas, implemented in an integrated manner for at least two years. The score distribution of the overall sample can be seen in Table 3.

Table 3

IMFR Tier 1 Score Distribution

	Frequency (%) *N=87*
Beginning (0)	7 (8)
Exploring (1)	11 (12.6)
Aligning (2)	14 (16.1)
Integrating (3)	29 (33.3)
Sustaining (4)	26 (29.9)

IMFR Tier 1 scores by State. Descriptive statistics indicated that Michigan and Missouri which represent a large portion of the sample (65; 74.7%) had a greater proportion of schools rated Integrating (*M*=36.4; *M*=38.9) or Sustaining (*M*=36.4; *M*=33.3) on the IMFR, than the other states (Montana, Ohio, and Washington) which had a more even distribution across the score scale (see Table 4).

IMFR Tier 1 scores by Student Enrollment. IMFR scores were also considered by the size of schools, indicated by total student enrollment (See Table 4). Schools that had 100-300 students (20; 23%), or 301-600 students (49; 56%) had a greater proportion of schools rated Integrating (*M*=40; *M*=40.8) on the IMFR, than larger schools with 601-800 students (18; 21%) which had the majority of schools rating Aligning (*M*=27.8) or Sustaining (*M*=38.9).

IMFR Tier 1 scores by Socioeconomic Status. Table 4 provides IMFR scores by socioeconomic status (SES) as indicated by the population of students receiving free and reduced lunch. Across all SES categories, 50% or more of schools scored Integrated and Sustaining, suggesting that SES may not be a factor impacting IMFR scores.

IMFR Tier 1 scores by Special Education and English Language Learner and Population. IMFR scores were also considered by the population of students

identified as English Language Learners (ELL) or receiving special education services (See Table 4). Schools that had low populations of ELL students (0-5%) or students receiving special education services (0-5%), were more likely to score Integrating (*M*=36.1; *M*=40.5) or Sustaining (M=31.1; M=28.6).

Table 4

IMFR Tier 1 Scores by School Demographics

		Beginning 7 (8%)	Exploring 11 (12.6%)	Aligning 14 (16.1%)	Integrating 29 (33.3%)	Sustaining 26 (29.9%)
		n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*
State						
	Michigan 11 (13%)	1 (9.1)	1 (9.1)	1 (9.1)	4 (36.4)	4 (36.4)
	Missouri 54 (62%)	3 (5.6)	3 (5.6)	9 (16.7)	21 (38.9)	18 (33.3)
	Montana 9 (10%)	1 (11.1)	4 (44.4)	2 (22.2)	0 (0)	2 (22.2)
	Ohio 9 (10%)	1 (11.1)	2 (22.2)	1 (11.1)	3 (33.3)	2 (22.2)
	Washington 4 (5%)	1 (25)	1 (25)	1 (25)	1 (25)	0 (0)
Enrollment						
	100-300 students 20 (23%)	2 (10)	2 (10)	3 (15)	8 (40)	5 (25)
	301-600 students 49 (56%)	3 (6.1)	6 (12.2)	6 (12.2)	20 (40.8)	14 (28.6)
	601-800 students 18 (21%)	2 (11.1)	3 (16.7)	5 (27.8)	1 (5.6)	7 (38.9)
Percent Receiving Free and Reduced Lunch						
	0-25% 49 (56%)	4 (8.2)	6 (12.2)	8 (16.3)	17 (34.7)	14 (28.6)

	25-50% 21 (24%)	3 (14.3)	3 (14.3)	3 (14.3)	6 (28.6)	6 (28.6)
	51-75% 8 (9%)	0 (0)	1 (12.5)	1 (12.5)	3 (37.5)	3 (37.5)
	76-100% 9 (10%)	0 (0)	1 (11.1)	2 (22.2)	3 (33.3)	2 (22.2)
English Language Learner Percent						
	0-5% 61 (70%)	6 (9.8)	8 (13.1)	6 (9.8)	22 (36.1)	19 (31.1)
	6-10% 12 (14%)	0 (0)	0 (0)	4 (33.3)	4 (33.3)	4 (33.3)
	11-20% 10 (11%)	0 (0)	3 (30)	2 (20)	3 (30)	2 (20)
	21-35% 4 (4%)	1 (25)	0 (0)	2 (50)	0 (0)	1 (25)
Percent Receiving Special Education Services						
	0-5% 42 (48%)	3 (7.1)	2 (4.8)	7 (16.7)	17 (40.5)	12 (28.6)
	6-10% 14 (16%)	1 (7.1)	3 (21.4)	3 (21.4)	3 (21.4)	4 (28.6)
	11-20% 29 (33%)	3 (10.3)	6 (20.7)	4 (13.8)	7 (24.1)	9 (31)
	21-30% 2 (2%)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)

In summary, two details from the descriptive statistics stood out. First, the full sample had more schools falling in the “integrating” (29; 33.3%) and “sustaining” (26; 29.9%) ratings of the IMFR scale than in the other three ratings lower on the scale. Second, schools that had low populations of ELL students or students receiving special education services (0-5%; 61; 42), were more likely to score Integrating (*M*=36.1;

M=40.5) or Sustaining (M=31.1; M=28.6) than schools with greater populations of student receiving those services. This suggests that schools that have lower populations of students with needs may be more likely to or more successful at integrating tiered services.

Universal Design for Learning-Reading; Math

The Universal Design for Learning–Reading and the Universal Design for Learning– Math ratings were self-reported. The school teams were provided a definition of UDL and then asked to rate their schools' level of implementation in reading and math respectively on a 4-point scale (ranging from 1) not at all to 4) to a great extent. The score distribution of the overall sample is in Table 5. Universal Design for Learning-Reading (UDL-R) rated as being implemented at somewhat higher levels than Universal Design for Learning-Math (UDL-M), with ratings of 3-4 making up 78.2% of the total sample for UDL-R vs 62% for UDL-M.

Table 5

Universal Design for Learning Implementation Self-Rating Distribution

	Frequency (*N=87*)	Mean (%)
Reading		
Not at all (1)	8	9.2
Very little (2)	11	12.6
Somewhat (3)	48	55.2
To a great extent (4)	20	23
Math		
Not at all (1)	11	12.6
Very little (2)	22	25.2
Somewhat (3)	43	49.4
To a great extent (4)	11	12.6

UDL-R and UDL-M ratings by State. Descriptive statistics indicated that Ohio which represents a very small portion of the sample (4; 5%) had the majority of its

schools indicating that UDL-R was implemented to a great extent (*M*=44.4), compared to the other states (Michigan, Missouri, Montana, and Washington) that had the majority of its schools indicating that UDL-R was somewhat implemented (*M*=36.4; *M*=61.1; *M*=55.6; *M*=100) (see Table 6). For UDL-M, Michigan had the majority of its schools indicating that UDL-M implemented very little (*M*=45.5), compared to the other states (Missouri, Montana, Ohio, and Washington) that had the majority of its schools indicating that UDL-M was somewhat implemented (*M*=55.6; *M*=55.6; *M*=44.4; *M*=50) (See Table 7).

UDL-R and UDL-M ratings by Student Enrollment. UDL-R and UDL-M scores were also considered by the size of schools, indicated by total student enrollment (See Tables 6 and 7). Schools that had small student populations of 100-300 (20; 23%), had the smallest percentage of schools indicating that they were implementing UDL-R (*M*=5) and UDL-M (*M*=0) to a great extent.

UDL-R and UDL-M ratings by Socioeconomic Status. Tables 6 and 7 provide UDL-R and UDL-M ratings by socioeconomic status (SES) as indicated by the population of students receiving free and reduced lunch (FRL). Schools with low SES, 51-75% of students receiving FRL (8; 9%) were least likely to be implementing UDL, with 62.5% of schools rated as implementing not at all or very little in UDL-R, and 87.5% rated as implementing not at all or very little in UDL-M (See Tables 6 and 7).

UDL-R and UDL-M ratings by Special Education and English Language Learner Population. UDL-R and UDL-M ratings were also considered by the population of students identified as English Language Learners (ELL) or receiving special education services (See Tables 6 and 7). Schools that had high populations of

ELL students (21-35%) (4; 4%) or students receiving special education services (21-30%) (2; 2%), were least likely to rate themselves as implementing UDL-R (0; 0%) or UDL-M (0; 0%) to a great extent.

Table 6

Universal Design for Learning-Reading Self-Ratings by School Demographics

		Not at all 8 (9.2%)	Very little 11 (12.6%)	Somewhat 48 (55.2%)	To a great extent 20 (23%)
		n (%)	*n (%)*	*n (%)*	*n (%)*
State					
	Michigan 11 (13%)	2 (18.2)	3 (27.3)	4 (36.4)	2 (18.2)
	Missouri 54 (62%)	5 (9.3)	4 (7.4)	33 (61.1)	12 (22.2)
	Montana 9 (10%)	0 (0)	2 (22.2)	5 (55.6)	2 (22.2)
	Ohio 9 (10%)	1 (11.1)	2 (22.2)	2 (22.2)	4 (44.4)
	Washington 4 (5%)	0 (0)	0 (0)	4 (100)	0 (0)
Enrollment					
	100-300 students 20 (23%)	3 (15)	3 (15)	13 (65)	1 (5)
	301-600 students 49 (56%)	5 (10.2)	4 (8.2)	27 (55.1)	13 (38.8)
	601-800 students 18 (21%)	0 (0)	4 (22.2)	8 (44.4)	6 (33.3)
Percent Receiving Free and Reduced Lunch					
	0-25% 49 (56%)	3 (6.1)	6 (12.2)	25 (51)	15 (30.6)

	25-50% 21 (24%)	1 (4.8)	3 (14.3)	16 (76.2)	1 (4.8)
	51-75% 8 (9%)	3 (37.5)	2 (25)	3 (37.5)	0 (0)
	76-100% 9 (10%)	1 (11.1)	0 (0)	4 (44.4)	4 (44.4)
English Language Learner Percent					
	0-5% 61 (70%)	6 (9.8)	9 (14.8)	32 (52.5)	14 (23)
	6-10% 12 (14%)	1 (8.3)	0 (0)	8 (66.7)	3 (25)
	11-20% 10 (11%)	0 (0)	1 (10)	6 (60)	3 (30)
	21-35% 4 (4%)	1 (25)	1 (25)	2 (50)	0 (0)
Percent Receiving Special Education Services					
	0-5% 42 (48%)	4 (9.5)	2 (4.8)	27 (64.3)	9 (21.4)
	6-10% 14 (16%)	0 (0)	4 (28.6)	6 (42.9)	4 (28.6)
	11-20% 29 (33%)	4 (13.8)	4 (13.8)	14 (48.3)	7 (24.1)
	21-30% 2 (2%)	0 (0)	1 (50)	1 (50)	0 (0)

Table 7

Universal Design for Learning-Math Self-Ratings by School Demographics

	Not at all 11 (12.6%)	Very little 22 (25.2%)	Somewhat 43 (49.4%)	To a great extent 11 (12.6%)
	n (%)	*n (%)*	*n (%)*	*n (%)*
State				

	Michigan 11 (13%)	3 (27.3)	5 (45.5)	2 (18.2)	1 (9.1)
	Missouri 54 (62%)	6 (11.1)	10 (18.5)	30 (55.6)	8 (14.9)
	Montana 9 (10%)	0 (0)	3 (33.3)	5 (55.6)	1 (11.1)
	Ohio 9 (10%)	2 (22.2)	2 (22.2)	4 (44.4)	1 (11.1)
	Washington 4 (5%)	0 (0)	2 (50)	2 (50)	0 (0)
Enrollment					
	100-300 students 20 (23%)	3 (15)	8 (40)	9 (45)	0 (0)
	301-600 students 49 (56%)	6 (12.2)	9 (18.4)	27 (55.1)	7 (14.3)
	601-800 students 18 (21%)	2 (11.1)	5 (27.8)	7 (38.9)	4 (22.2)
Percent Receiving Free and Reduced Lunch					
	0-25% 49 (56%)	5 (10.2)	8 (16.3)	30 (61.2)	6 (12.2)
	25-50% 21 (24%)	2 (9.5)	8 (38.1)	8 (38.1)	3 (14.3)
	51-75% 8 (9%)	3 (37.5)	4 (50)	1 (12.5)	0 (0)
	76-100% 9 (10%)	1 (11.1)	2 (22.2)	4 (44.4)	2 (22.2)
English Language Learner Percent					
	0-5% 61 (70%)	6 (9.8)	17 (27.9)	32 (52.5)	6 (9.8)
	6-10% 12 (14%)	2 (16.7)	2 (16.7)	5 (41.7)	3 (25)

	11-20% 10 (11%)	1 (10)	3 (30)	4 (40)	2 (20)
	21-35% 4 (4%)	2 (50)	0 (0)	2 (50)	0 (0)
Percent Receiving Special Education Services					
	0-5% 42 (48%)	5 (11.9)	5 (11.9)	25 (59.5)	7 (16.7)
	6-10% 14 (16%)	0 (0)	6 (42.9)	7 (50)	1 (7.1)
	11-20% 29 (33%)	6 (20.7)	9 (31)	11 (37.9)	3 (10.3)
	21-30% 2 (2%)	0 (0)	2 (100)	0 (0)	0 (0)

In summary, relevant findings from the descriptive analysis include that the overall sample most often rated themselves as a 3 out 4 in both UDL-R (48; 55.2%) and UDL-M (43; 49.4%). In addition, like the IMFR ratings, schools with high populations of students requiring special education or ELL services were less likely to be implementing UDL-R or UDL-M to a great extent. Although these school represent only a small part of the sample (2-4%) this warrants further consideration. Next, the results from the primary research questions will be addressed.

Research Question 1: What patterns emerge in the implementation of iMTSS and UDL in Reading and Math within Tier 1 instruction?

A Latent Class model was utilized to examine the patterns of implementation across the sample of elementary schools. Table 8 summarizes the Latent Class model fit indices. While several models were explored, the two-class solution had the lowest AIC (437.590), BIC (469.647) and aBIC (436.627) values indicating model fit. The two-class

solution also had the highest entropy value (0.921) indicating classification precision. The VLMR Likelihood Ratio Test indicated a two-class solution is a better fit than a one-class or three-class solution.

Table 8

Model Fit Indices for One- Through Four-Class Solutions of Implementation Classes

Latent Class	AIC	BIC	aBIC	VLMR LRT	Entropy
One-class solution	477.268	492.064	473.132	-	-
Two-class solution	437.590	469.647	428.627	0.00	0.921
Three-class solution	450.108	499.427	436.320	0.5656	0.827
Four-class solution	464.108	530.688	445.494	0.8951	0.578

Note: *AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; VLMR = Vuong–Lo– Mendall–Rubin; LRT = likelihood ratio test. Entropy summarizes the posterior probabilities. Entropy values close to 1.0 indicate higher classification precision.*

Descriptive characteristics for the two latent classes are summarized in Table 9. Class 1 can be described as "concurrent implementation" with all schools in that group implementing UDL-R somewhat (72.1%) or to a great extent (29.4%), most schools implementing UDL-M somewhat (63.2%) or to a great extent (16.2%), and a higher likelihood of scoring Integrating (36.8%) or Sustaining (32.4%) on the IMFR-Tier 1. Class 2 can be described as "not implementing UDL" with 0 schools rated as implementing UDL-R or UDL-M somewhat or to a great extent, and a fairly equal distribution (15.8% to 21.1%) of scores across the IMFR-Tier 1 rating scale.

Table 9

Descriptive Statistics of Variables by Latent Class Membership

	Class 1 "concurrent implementation" 68 (78.2)	Class 2 "not implementing UDL" 19 (21.8)

	n (%)	*n (%)*
IMFR-Tier 1 Score		
Beginning (0)	3 (4.4)	4 (21.1)
Exploring (1)	7 (10.3)	4 (21.1)
Aligning (2)	11 (16.2)	3 (15.8)
Integrating (3)	25 (36.8)	4 (21.1)
Sustaining (4)	22 (32.4)	4 (21.1)
UDL-R Rating		
Not at all (1)	0 (0)	8 (42.1)
Very little (2)	0 (0)	11 (57.9)
Somewhat (3)	49 (72.1)	0 (0)
To a great extent (4)	20 (29.4)	0 (0)
UDL-M Rating		
Not at all (1)	1 (1.5)	10 (52.6)
Very little (2)	13 (19.1)	9 (47.4)
Somewhat (3)	43 (63.2)	0 (0)
To a great extent (4)	11 (16.2)	0 (0)

Note: *M=Mean, SD=Standard Deviation*

To confirm class membership, during follow-up interviews 12 school teams were asked to review four vignettes that described schools that would fall into either of the latent classes and select the vignette that most aligned to their school (See Appendix H). Table 10 summarizes the results of that qualitative confirmation. Of the six interviewed school teams identified as belonging to the "concurrent implementation" class, four chose a vignette that confirmed class membership (66.7%). Of the six interviewed school teams identified as belonging to the "not implementing UDL" class, three chose a vignette that confirmed class membership (50%). Overall, 58.3% of the sample confirmed class membership indicating that either the vignettes did not adequately align to the class characteristics, or the initial ratings used to conduct the LCA were not adequately representative of actual school practices. Alternatively, not randomizing the order in

which the vignettes were presented may have resulted in a tendency for school teams to select one of the first they read and not consider all options.

Table 10

Qualitative Class Membership Confirmation

Class 1 "concurrent implementation" *n=6*			Class 2 "not implementing UDL" *n=6*		
School Team	Vignette Selected	Class Indicated	School Team	Vignette Selected	Class Indicated
1	C	2	2	A	1
4	A	1	3	A	1
6	A	1	5	C	2
9	A	1	7	C	2
10	A	1	8	D	2
12	C	2	11	A	1
	Rate of confirmation	66.7%		Rate of confirmation	50%

Research Question 1a: What characterizes each emergent class?

To broadly address Research Questions 1a and 1b, qualitative analysis of follow-up interview scripts was conducted. First, the relevant excerpts related to the research questions were separated from the full transcripts, including (a) understanding of/familiarity with UDL, (b) UDL in practice, (c) Tier 1 integration of MTSS, (d) differentiation, (e) fidelity vs flexibility, and (f) barriers to implementation. Each of the excerpts within those primary codes were subjected to a secondary axial coding using a constant comparative method in which codes are compared with codes to create categories to connect them (Glaser, 2005). Two coders independently coded the full sample of excerpts with 84% agreement and resolved any remaining discrepancies to achieve 100% agreement (see Figure 3 for an abbreviated version or Appendix G for the

full coding guide). As some primary codes (*Barriers to Implementation, Differentiation, and Fidelity vs Flexibility*) included multiple secondary codes that could be applied to a single excerpt, 183 codes were applied to 143 excerpts from the follow-up interview transcripts.

Figure 3

Abbreviated Coding Scheme

Primary Code	Secondary Codes	Explanation of Code
Familiarity with UDL		
	No Awareness	School team member(s) are not familiar with UDL
	Basic Awareness	School team member(s) are aware of, but not familiar with UDL
	Inaccurate Understanding	School team member(s) inaccurately describe UDL
	Accurate Understanding	School team member(s) (at least somewhat) accurately describe UDL
UDL in Practice		
	Not in Practice	School team member(s) suggest that UDL principles are not implemented in instructional planning
	Some Implicit Implementation	School team member(s) describe that UDL principles are implemented unintentionally, sporadically, or are "just what good teachers do"
	Conflation	School team member(s) describe UDL practices in such a way that they are clearly conflating the concept with something else (e.g., differentiation, MTSS, intervention, learning styles)
	Unclear Explanation	School team member(s) describe practices in a way that they are not clearly UDL, or not enough information is provided to make a determination
Tier 1 MTSS Integration		
	Integrated	School team member(s) indicate explicitly that the Tier 1 systems are

		integrated or describe an integrated system
	Not Integrated	School team member(s) indicate explicitly that the Tier 1 systems are not integrated or describe siloed systems
	Not Tier 1	School team member(s) describe aspects of their MTSS that are not about tier 1 or universal instruction
Barriers to Implementation		
	Knowledge/Awareness	School team member(s) identified a lack of knowledge or awareness of the concepts as a barrier to implementation
	Shared Terminology	School team member(s) identified a lack of shared or common language as a barrier to implementation
	Staff Buy-in	School team member(s) identified a lack of staff buy-in as a barrier to implementation
	Overwhelmed/ Too Many Initiatives	School team member(s) identified being overwhelmed or having other focuses as a barrier to implementation
	Unnecessary	School team member(s) felt it unnecessary to implement, felt they were already meeting needs, or were unenthusiastic about implementation
	Other/School Specific Challenges	School team member(s) identified a barrier to implementation that was specific to their school and does not otherwise fit into another code
Differentiation		
	Data-Based	Differentiation is described as based on assessment data
	Small Groups	Differentiation is described as provided in a structure of pulling small groups or individuals for additional instruction
	Other Structure	Differentiation may be provided in a structure other than small group instruction
	Struggling Students	Differentiation is described as provided for struggling students
	Enrichment	Differentiation is described as provided for students who require enrichment

Fidelity vs Flexibility		
	Curriculum Expectations	School team member(s) describe that the district or school has expectations about the use of specific curriculum materials
	Adherence	School team member(s) describe either no flexibility for teachers to adjust or change instruction, an expectation of adhering to the curriculum, or an intention to implement with strict fidelity
	Minimal Autonomy	School team member(s) describe limited flexibility for teachers to adjust or change instruction based on teacher judgement or student need
	Autonomy	School team member(s) describe flexibility for teachers to adjust or change instruction based on teacher judgement or student need

Familiarity with Universal Design for Learning

To learn about school MTSS team member(s) knowledge and understanding of UDL, interview participants were asked, "Are you familiar with Universal Design for Learning?" If yes, a follow up question of, "Tell me about your understanding and experiences with UDL?" was asked. Responses to these questions were coded as *no awareness* if the school team member(s) indicated that they were not familiar with or aware of UDL. Responses were coded *basic awareness* if the school team member(s) indicated that they were aware of UDL, but not familiar with it. Reponses were coded *inaccurate understanding* if the school team member(s) described their understanding of UDL in a way that clearly indicated they did not have an accurate understanding. Finally, responses were coded *accurate understanding* if the school team member(s) described their understanding of UDL in a way that clearly indicated they did have an accurate understanding.

Table 11 summarizes the codes related to familiarity with UDL, separated by latent class for comparison. About half of the excerpts related to familiarity with UDL in each class indicated basic awareness of UDL (*concurrent implementation* 57.1%; *no UDL implementation* 50%). Something that differentiates classes in this primary code is that 25% of excerpts in the no UDL implementation class were inaccurate understandings of UDL, indicating a potentially relevant characteristic of this class. For example, one school team member said, "you know, maybe they only are visually able to gather things are there only able to hear auditorily, so we are able to offer that the other thing," which suggests an inaccurate understanding of UDL as aligning instruction with preferred learning styles rather than providing multiple means of engagement, representation, and assessment to reduce barriers to accessing content and providing evidence of learning.

Table 11

Familiarity with Universal Design for Learning by Class

Primary Code	Secondary Codes	Class 1 "concurrent implementation" *n* (%)	Class 2 "no UDL implementation" *n* (%)
Familiarity with UDL			
	No Awareness	2 (28.6)	1 (12.5)
	Basic Awareness	4 (57.1)	4 (50)
	Inaccurate Understanding	0 (0)	2 (25)
	Accurate Understanding	1 (14.3)	1 (12.5)

Universal Design for Learning in Practice

To learn about if and how schools are implementing UDL in reading and math, interview participants were asked, "Is UDL something your school is implementing or

working to implement?" If yes, a follow up question of, "Tell me about what that looks like?" was asked. Interview participants were also asked specifically, "Are UDL principles part of instructional planning for reading?" and "Are UDL principles part of instructional planning for math?" with follow up questions of, "Is that explicit or implied?" Responses to these questions were coded as *not in practice* if the school team member(s) indicated that UDL practices are not implemented in instructional planning. Responses were coded *some implicit implementation* if the school team member(s) indicated that UDL practices are implemented unintentionally, sporadically, or is "just what good teachers do". Reponses were coded *conflation* if the school team member(s) described UDL practices in such a way that they were clearly conflating the concept with something else (e.g., differentiation, MTSS, intervention, learning styles). Finally, responses were coded *unclear explanation* if the school team member(s) described practices in a way that they are not clearly UDL, or not enough information is provided to make a determination.

Table 12 summarizes the codes related to UDL in practice, separated by latent class for comparison. About half of the excerpts related to this in each class indicated some implicit implementation of UDL (*concurrent implementation* 60%; *no UDL implementation* 50%), though no excerpt indicated explicit intentional implementation of UDL practices. Something that differentiates classes in this primary code is that 33.3% of excerpts in the no UDL implementation class were descriptions of UDL in practice that were conflating UDL with other practices, similar to inaccurate understandings in the prior code, indicating a potentially relevant characteristic of this class. For example, in this excerpt, a school team member is describing UDL practices as, "[we] pick like what

we call the heavy hitters, so we're going to look at certain standards that we know are really, really important for first graders to be able to master, and then we've tried to think of different strategies and ways of teaching that." This school team member is conflating UDL with power standards, a popular approach to instructional mapping in which schools select and focus on teaching a smaller set of standards they deem crucial for advancement (Ainsworth, 2003).

Table 12

Universal Design for Learning in Practice by Class

Primary Code	Secondary Codes	Class 1 "concurrent implementation" *n* (%)	Class 2 "no UDL implementation" *n* (%)
UDL in Practice			
	Not in Practice	4 (26.7)	1 (5.6)
	Some Implicit Implementation	9 (60)	9 (50)
	Conflation	0 (0)	6 (33.3)
	Unclear Explanation	2 (13.3)	2 (11.1)

Tier 1 MTSS Integration

To learn about school MTSS team member(s) conception of integration in Tier 1, interview participants were asked, "So, the work you're doing with the IMFR team is about integrated MTSS. Now that you've gone through that interview experience and gotten a score report, would you describe your MTSS as integrated? By that I mean behavior and academic systems work together rather than separately." If yes, a follow up question of, "What does that look like in Tier 1?" was asked, with "Can you give me an

example?" as an additional probe. Responses to these questions were coded as *integrated* if the school team member(s) indicated explicitly that the Tier 1 systems are integrated or described an integrated Tier 1. Responses were coded *not integrated* if the school team member(s) indicated explicitly that the Tier 1 systems are not integrated or describes siloed systems. Reponses were coded *not tier one* if the school team member(s) described aspects of their MTSS that were not about tier 1 or universal instruction, which was not relevant to this research question.

Table 13 summarizes the codes related to the integration of MTSS in Tier 1, separated by latent class for comparison. A notable percentage of the excerpts in each class indicated that the interview participants perceived their Tier 1 as integrated (*concurrent implementation* 60%; *no UDL implementation* 66.7%) which aligns with the IMFR score distribution of the sample (Table 3). Something that differentiates classes in this primary code is that 25% of excerpts in the no UDL implementation class expressed that they were not integrating academic and behavior practices at Tier 1, indicating a potentially relevant characteristic of this class. For example, one school team member said, "Our academic and behavior [tier 1] are not fully integrated if that makes sense, I think we have a strong behavior system and strong academic, but we talked about integration I'm not sure, I don't know if we're there."

Table 13

Tier 1 MTSS Integration by Class

Primary Code	Secondary Codes	Class 1 "concurrent implementation" *n* (%)	Class 2 "no UDL implementation" *n* (%)
Tier 1 MTSS Integration			

Integrated	6 (60)	8 (66.7)
Not Integrated	1 (10)	3 (25)
Not Tier 1	3 (30)	1 (8.3)

The potential characteristics of each class that emerged from the qualitative data will be summarized at the end of this chapter. The remaining qualitative codes were analyzed in the same fashion to answer research question 1b.

Research Question 1b: What aspects of the initiatives act as potential barriers to concurrent implementation?

Barriers to Implementation of Initiatives

To learn about the barriers to concurrent implementation of iMTSS and UDL, excerpts related to any barriers perceived by school MTSS team member(s) to implementation of either initiative were pulled. Interview participants were asked several questions as follow up to responses indicating a lack of implementation or a lack of implementation at a high level, for example, “Why do you think that is?” or “What are barriers to that happening?” Excerpts were also pulled from any spontaneous explanation of barriers in addition to direct responses. Excerpts could have multiple codes applied within this primary code.

Responses to these questions were coded as *knowledge/awareness* if the school team member(s) identified a lack of knowledge or awareness of the concepts as a barrier to implementation. Responses were coded *shared terminology* if the school team member(s) identified a lack of shared or common language as a barrier to implementation. Reponses were coded *staff buy-in* if the school team member(s) identified a lack of staff buy-in as a barrier to implementation. Reponses were coded *overwhelmed/too many initiatives* if the school team member(s) identified being

overwhelmed or having other focuses as a barrier to implementation. Reponses were coded *unnecessary* if the school team member(s) felt it unnecessary to implement, felt they were already meeting needs, or were unenthusiastic about implementation. Finally, responses were coded *other/school specific* if the school team member(s) identified a barrier to implementation that was specific to their school and does not otherwise fit into another code.

Table 14 summarizes the codes related to barriers to implementation, both the full sample and separated by latent class for comparison. Schools cited several barriers to implementation of these initiatives with such similar explanations they were easily sorted into five categories with similar rates of occurrence in the transcripts: *knowledge/awareness* (21.2%), *shared terminology* (15.2%), staff buy-in (21.2%), *overwhelmed/too many initiatives* (18.2%), or *unnecessary* (15.2%), and only three excerpts falling into an*other* category (9.1%). Something that differentiates classes in this primary code is the self-awareness of a lack of knowledge in the *concurrent implementation* class (45.5%), that appears to be lacking in the *no UDL implementation* class (9.1%). In addition, all of the excerpts coded *unnecessary* (5) were in transcripts from the *no UDL implementation* class. In response to being asked if interested in implementing UDL, one school team member said, “I feel like that's always something that would be great is to like you know better differentiate learning between our students. I think, like that's something that's always fun, but I feel at the same time, I feel like we're also doing it, I suppose, so right.” which suggests a lack of enthusiasm or recognition of any added value of the implementation of UDL.

Table 14

Barriers to Implementation of Initiatives

Primary Code	Secondary Code	Full Sample *n* (%)	Class 1 "concurrent implementation" *n* (%)	Class 2 "no UDL implementation" *n* (%)
Barriers to Implementation of Initiatives				
	Knowledge/ Awareness	7 (21.2)	5 (45.5)	2 (9.1)
	Shared Terminology	5 (15.2)	2 (18.2)	3 (13.6)
	Staff Buy-in	7 (21.2)	1 (9)	6 (27.3)
	Overwhelmed/ Too Many Initiatives	6 (18.2)	1 (9)	5 (22.7)
	Unnecessary	5 (15.2)	0 (0)	5 (22.7)
	Other/School Specific Challenges	3 (9.1)	2 (18.2)	1 (4.5)

Differentiation

To learn about school teams' conceptions of differentiation to be either a well aligned aspect of iMTSS and UDL or a potential barrier, interview participants were asked, "How is reading instruction differentiated at the Tier 1 level, within the general education classroom?" and "How is mathematics instruction differentiated at the Tier 1 level?" Excerpts could have multiple codes applied within this primary code.

Responses to these questions were coded as *data-based* if the school team member(s) described differentiation as being based on assessment data. Responses were coded *small groups* if the school team member(s) described differentiation as being provided in a structure of pulling small groups or individuals for additional instruction. Reponses were coded *other structure* if the school team member(s) describe

differentiation as being provided in a structure other than small group instruction, for example one school described an “accelerated math” program in which they send students to other grade levels to receive their core math instruction. Reponses were coded *struggling students* if differentiation was described as being provided for struggling students. Reponses were coded *enrichment* if differentiation was described as being provided for students who require enrichment.

Table 15 summarizes the codes related to differentiation, both within the full sample and separated by latent class for comparison. Notably, within both classes and considering the full sample of excerpts related to differentiation, conceptions of differentiation lean heavily on small groups (45.5%) provided to struggling students (23.8%). Something that differentiates classes in this primary code is that the *concurrent implementation* class had a few mentions of enrichment (3) being included in their conceptions of differentiation as opposed to no mentions in excerpts from the *no UDL implementation* class. For example, one school team member said, “all kids are being exposed to their grade level content and then the teacher is providing extra support for the students who need it and are providing enrichment opportunities.” This may indicate more consideration of the needs of all students, necessary for the implementation of UDL, is happening in the *concurrent implementation* class.

Table 15

Differentiation

Primary Code	Secondary Codes	Full Sample	Class 1 “concurrent implementation” *n* (%)	Class 2 “no UDL implementation” *n* (%)
Differentiation				
	Data-Based	7 (16.7)	5 (20.8)	2 (11.1)

Small Group	19 (45.2)	9 (37.5)	10 (55.6)
Other Structure	3 (7.1)	1 (4.2)	2 (11.1)
Struggling Students	10 (23.8)	6 (25)	4 (22.2)
Enrichment	3 (7.1)	3 (12.5)	0 (0)

Fidelity vs Flexibility

To learn about the potential for fidelity to be a potential barrier to the concurrent implementation of iMTSS and UDL, questions were asked about school teams' perception of the level of autonomy teachers have in instructional design. Interview participants were asked, "Do teachers have the autonomy to decide how reading/mathematics instruction is approached in your school or does the district or building administration decide?" and "Are the majority of teachers using the same instructional practices in reading/mathematics?"

Responses to these questions were coded as *curriculum expectations* if the school team member(s) described that the district or school has expectations about the use of specific curriculum materials. Responses were coded adherence if the school team member(s) described either no flexibility for teachers to adjust or change instruction, an expectation of adhering to the curriculum, or an intention to implement with strict fidelity. Reponses were coded *minimal autonomy* if the school team member(s) described limited flexibility for teachers to adjust or change instruction based on teacher judgement or student need. Reponses were coded *autonomy* if school team member(s) described flexibility for teachers to adjust or change instruction based on teacher judgement or student need.

Table 16 summarizes the codes related to fidelity, both of the full sample and separated by latent class for comparison. Something that differentiates classes in this primary code is that the *concurrent implementation* class had a smaller proportion of mentions of district or school-imposed curriculum expectations (38.1%) as opposed to half of the excerpts from the *no UDL implementation* class (50%). An example of curriculum expectations includes this school team member's response, "So the district makes the choice, you are doing Benchmark...and that's what we're going to use, that's mandatory, you can't choose around that." This may indicate less flexibility in the use of instructional materials and approaches within the *no UDL implementation* class.

Table 16

Fidelity vs Flexibility

Primary Code	Secondary Codes	Full Sample	Class 1 "concurrent implementation" *n* (%)	Class 2 "no UDL implementation" *n* (%)
Fidelity vs Flexibility				
	Curriculum Expectations	16 (42.1)	8 (38.1)	8 (50)
	Adherence	10 (26.3)	8 (38.1)	2 (12.5)
	Minimal Autonomy	4 (10.5)	3 (14.3)	1 (6.3)
	Autonomy	8 (21.1)	3 (14.3)	5 (31.3)

Summary

LCA was conducted to determine patterns in the implementation levels at Tier 1 of integrated MTSS, Universal Design for Learning in reading and Universal Design for Learning in math. The AIC, BIC, aBIC indices were considered for 1 to 6 classes, with smaller values indicating best fit. In addition, entropy was considered in the

determination (see Table 8). The two-model solution emerged as the best model fit for this data, as evidenced by the lowest AIC, BIC and aBIC values of the possible solutions. In addition, the VLMR-LRT indicated that the two-class solution was a better fitting model than the one or three-class solutions and the entropy was close to one indicating classification precision. In follow-up interviews of a sample of school MTSS teams from each class, only 58.3% of the sample confirmed class membership indicating that either the vignettes used to determine class confirmation did not adequately align to the class characteristics, or the initial ratings used to conduct the LCA were not adequately representative of actual school practices.

Characteristics of Latent Classes

Class labels were assigned based on the overall pattern of data. Class 1 was labeled *concurrent implementation* and consisted of 68 schools with data that indicated higher levels of implementation of UDL-R, UDL-M, and iMTSS at Tier 1. Additional characteristics of the *concurrent implementation* class gathered from the qualitative analysis include less district or school-imposed curriculum expectations, the inclusion of a greater range of student abilities mentioned when discussing differentiation, and more awareness of a need for additional knowledge about UDL.

Class 2 was labeled *no UDL implementation* and consisted of 19 schools with data that indicated little to no implementation of UDL-R, UDL-M, and equal distribution of Tier 1 iMTSS fidelity scores across the IMFR scale. Additional characteristics of the *no UDL implementation* class gathered from the qualitative analysis include some inaccurate understanding of UDL, or conflation of UDL with other school initiatives and a belief that UDL is unnecessary to implement.

Barriers to Implementation of Initiatives

Finally, regarding the barriers to implementing these initiatives, participants indicated several concerns including a lack of knowledge and awareness, a lack of shared terminology, a lack of staff buy-in, being overwhelmed/having too many initiatives, finding implementation unnecessary, or other school specific reasons. In consideration of potential malalignment of the two initiatives being a barrier to concurrent implementation, fidelity to district or school-imposed curriculum expectations and a narrow view of differentiation may in fact be barriers to the implementation of UDL in reading and math but does not necessarily indicate incompatibility with integrated MTSS.

CHAPTER 5

Discussion

To effectively and efficiently address both the academic and behavioral needs of all students, integrated Multi-Tiered Systems of Support (iMTSS) is an initiative gaining strength in elementary schools across the U.S. (McIntosh & Goodman, 2016). Tier 1 instruction, received by all students within an iMTSS, should be evidence-based and differentiated to provide high quality educational opportunities, decreasing the strain on services at the Tiers 2 and 3 level (Stoiber & Gettinger, 2016). One established approach to providing accessible and differentiated instruction is Universal Design for Learning (UDL), another initiative gaining in popularity, that can be embedded within a tiered prevention system (Basham et al., 2010). The purpose of the current study was to learn about the state of concurrent implementation of iMTSS and UDL, within Tier 1 instruction in elementary schools by addressing the following research questions:

1. What patterns emerge in the implementation of iMTSS and UDL in Reading and Math within Tier 1 instruction?
    a. What characterizes each emergent class?
    b. What aspects of the initiatives act as potential barriers to concurrent implementation?

Outcomes from this mixed methods study revealed three main findings. First, two patterns were found in the participating elementary schools' various levels of implementation iMTSS and UDL in reading and math within Tier 1 instruction based on the quantitative results. Second, qualitative analysis resulted in clear differentiating characteristics of the two classes; and third, several barriers to concurrent implementation

of iMTSS and UDL in Tier 1 were identified. The following sections will further summarize and interpret the findings related to each research question.

Summary of Findings

The first outcome of this study was that two patterns emerged in the implementation of iMTSS, UDL-R (Universal Design for Learning-Reading) and UDL-M (Universal Design for Learning-Math) at Tier 1. One of the two classes of schools had generally high levels of implementation of UDL-R, UDL-M, and iMTSS at Tier 1, indicating that these schools were implementing both initiatives in Tier 1 instruction and so were labeled as *concurrent implementation* schools. The second class of schools had little to no implementation of UDL-R, UDL-M, and equal distribution of Tier 1 iMTSS fidelity scores across the IMFR (Integrated MTSS Fidelity Rubric) scale, thus these schools were labeled *no UDL implementation.*

Surprisingly, the majority of the sample (68; 78.2%) fell into the *concurrent implementation* class. This large group of schools exemplify that concurrent implementation of iMTSS and UDL is possible, and currently in practice in schools. Basham et al., 2010 described the two initiatives (MTSS and UDL) as being widely accepted approaches to support students with a variety of needs including students with disabilities but that the integration of the two would provide a more seamless support structure. This finding provides the foundation for further exploration that concurrent implementation of iMTSS and UDL within Tier 1 instruction can be characterized as high-quality universal instruction. Choi et al. (2017, 2020), implemented an inclusive school reform program that included UDL embedded within an MTSS and found positive academic outcomes for students with and without disabilities. However, the inclusive

school reform program also included other foci like resource pooling and family partnerships and did not focus explicitly on the embedding of UDL in general education classrooms. The findings of this study contribute to the minimal existing literature on the concurrent implementation of iMTSS and UDL in Tier 1 instruction by confirming that some elementary schools across the U.S. are in fact utilizing this comprehensive approach to universal instruction.

The second major finding of this study was that there were differentiating qualitative characteristics of the two classes. Axial codes were developed based on the qualitative data in relation to the practical implementation of iMTSS, UDL, and the indicators of high-quality instruction that were hypothesized to be potentially well- or mal-aligned (evidence-based, differentiated, delivered with fidelity; see Figure 2). Those codes were then compared between class assignments.

Unique qualitative characteristics of the *concurrent implementation* class include less district or school-imposed curriculum expectations, the inclusion of a greater range of student abilities mentioned when discussing differentiation, and more awareness of a need for additional knowledge about UDL. Characteristics of the *no UDL implementation* class include some inaccurate understanding of UDL, or conflation of UDL with other school initiatives and a belief that UDL is unnecessary to implement. The identification of these characteristics helps us understand the conditions in place in schools in which these different approaches to Tier 1 instruction are taking place. For instance, the characteristics unique to the *no UDL implementation* class include several factors that can potentially explain why there is little to no UDL implementation taking place, teachers cannot implement a practice they are unaware of, untrained on, or uninvested in.

Evidence-based practices are only as successful as allowed by the reach of the information and quality of implementation (Cook & Odom, 2013). This finding provides an increased awareness for researchers of UDL, that a priority for future directions includes a need to ensure that teachers have the knowledge and training necessary to implement the practice.

The third major finding of this study was the identification of barriers to concurrent implementation of iMTSS and UDL in Tier 1 instruction. One of the indicators of quality instruction in an iMTSS is differentiated instruction (Fuchs & Vaughn, 2012), which has conceptual overlaps with UDL in the focus on proactive instructional design to increase access to a wider range of learners. Depending on the viewpoint and understanding of school personnel, they may view the two initiatives as well-aligned, UDL achieving the goals of differentiation or as two differing and incompatible approaches (Griful-Freixenet et al., 2020). Overall, the participating school teams conceptualized differentiation as small group instruction and primarily for students described as struggling rather than as a proactive approach to instructional planning for all students. This viewpoint of differentiation aligns most closely with what Griful-Freixenet et al. (2020) characterized as distinctive and incompatible with UDL rather than embedded or even complementary. These findings indicate that differentiation, while not inherently a mal-aligned aspect of iMTSS and UDL, may act as a barrier to concurrent implementation based on the difference in how it is defined and approached. The few mentions of enrichment in the transcripts were from schools in the *concurrent implementation* class, indicating that a broader view of differentiation may exist within schools embedding UDL in Tier 1 instruction of an iMTSS.

Evidence-based curriculum and instruction implemented with fidelity are additional key indicators of quality instruction in Tier 1 (Hughes & Dexter, 2011). Evidenced-based instruction has been demonstrated through scientific research and practice to produce high learning rates for most students, and is most effective when delivered as intended, or with fidelity (Stoiber & Gettinger, 2016). However, UDL requires flexibility in the materials and methods of instruction and assessment (Rao & Meo, 2016). Schools may interpret the need for fidelity of curriculum implementation more strictly than necessary and be unwilling to allow teachers the autonomy to adjust the curriculum based on student need, making this indicator a mal-aligned factor and therefore potentially a barrier to concurrent implementation. This concern was not supported by the findings of this study, the classes had the same number of excerpts addressing the curriculum expectations of their school or district and the *concurrent implementation* class indicated more expectations of adherence, and the *no UDL implementation* class indicated more autonomy over instructional approaches. Though strict adherence to curriculum fidelity may act as a barrier to concurrent implementation for individual schools or districts, the data does not indicate that it is a mal-aligned aspect of iMTSS and UDL.

In addition to the predicted barriers that were explored in this study, additional barriers to implementation of iMTSS and UDL were indicated by participating school teams. These include a lack of knowledge and awareness of the initiatives, a lack of shared terminology, a lack of staff buy-in, being overwhelmed/having too many initiatives prioritized, finding implementation unnecessary, or other school specific reasons. These school team-identified barriers to implementation are similar to those

identified in other implementation studies (e.g., Castro-Villarreal et al., 2014; Sansosti et al., 2010), and should be considered by future researchers or practitioners interested in pursuing concurrent implementation of UDL and iMTSS.

Limitations

Although several interesting findings emerged in this study, there are limitations that must be acknowledged. The limitations fall into two primary categories: (a) limitations of the measures and (b) generalizability of the findings. First, the UDL ratings were collected via self-report. While self-reporting can be accurate, there is potential that response bias occurred, in which the participants rated themselves higher due to social pressure (Howard, 1980). This concern was compounded by the qualitative class confirmation, in which--of a smaller sample of 12 of the participating schools, only 58.3% confirmed their class assignment. Based on further qualitative findings, it seems that the smaller sample of total participating school teams were unfamiliar with UDL, and only implicit implementation was taking place, suggesting that when making the initial UDL implementation rating selection, school teams may have been basing their ratings on their interpretation of the definition of UDL, rather than an explicit focus on the implementation of the UDL framework or guidelines. The initial UDL ratings used to conduct the LCA may not have been adequately representative of actual school practices, potentially impacting the validity of the LCA. Alternatively, it is possible that the initial ratings are accurate and the methods used to conduct the class confirmation (i.e. not randomizing the order of vignette presentation; providing four options instead of two) impacted the school teams vignette selection. However, the qualitative conformation of classes only included 14% of the total sample and thus may not be fully representative of

the full data set. In addition, the IMFR is currently undergoing iterative change based on psychometric analysis and has not yet been validated.

Second, the generalizability of the findings is restricted by the size and demographic make-up of the sample. The majority of the participating schools had small populations of minority students, English language learners and students with disabilities. As this study is aimed at investigating the quality of instruction in classrooms with varied populations and needs, this presents a limitation. Future replications of this work should include a greater variety of demographics within schools. For the LCA, 3 variables (two dichotomous, one continuous) were considered for 87 schools. For robust latent classes, it has been suggested that 300 observations or more is preferred but that with simplified models, smaller sample sizes can be adequate (Nylund-Gibson & Choi, 2018; Weller et al., 2020). Although the smaller sample size does not invalidate the results of the LCA, a larger sample may have shown patterns in implementation not shown in this study. The results should be considered with caution and replicated with larger samples in the future. Additionally, the follow-up interviews were conducted with only 12 school teams, representing about 14% of the total sample. Thus, the qualitative findings may not be representative of the full sample or elementary schools in general.

Implications for Research

A significant gap in the literature on this subject exists, no previous study has explored the state of concurrent implementation of iMTSS and UDL, within Tier 1 in elementary schools, nor the potential barriers to a combined approach. This work beings to explore the practical possibilities of embedding UDL within an iMTSS recommended by Basham et al. (2010), however further research is certainly needed. First, replication

of this study with larger samples is necessary to confirm the findings and detect any other potential patterns of implementation. To extend this study, further qualitative exploration of schools implementing UDL and iMTSS concurrently in Tier 1 instruction may give insight into the coordination of the initiatives. Further empirical study supporting the positive impact of UDL on student outcomes is essential to moving this research forward and encouraging future inclusion of UDL as an evidence-based practice within an iMTSS. Cook & Rao (2018) recommend an approach of using established evidence-based practices and applying UDL enhancements and modifications that are clearly described in the research, as well as how and for whom the approach was effective (Cook & Rao, 2018).

Additionally, much work has been done in the area of implementation science, the study of methods that promote the uptake of research and evidence-based practices, that could be utilized to develop implementation plans supporting schools interested in concurrent implementation of UDL and iMTSS (Cook & Odom, 2013; Eccles & Mittman, 2006). This study has uncovered several school personnel-perceived barriers that would be relevant to consider in such a future study.

Implications for Practice

It should be reiterated that the goal of this study was to determine the patterns of iMTSS and UDL implementation in schools, based on the assumption that concurrent implementation could improve the quality of universal instruction. Interestingly, within the follow-up participants, UDL appeared to be either unknown to school teams or poorly understood, with only 2 schools indicating an accurate understanding (16%). Further, no participating school team included in the follow-up interviews indicated that UDL was

being implemented explicitly, rather that if implemented, it was happening implicitly and inconsistently. This lack of awareness, understanding, and implementation seems to conflict with the increased presence of UDL in pre-service education courses and textbooks (e.g., Cressey, 2020; Raymond, 2016; Scheuermann & Hall, 2016). These findings support a need for further education and professional development related to UDL for pre-service teachers, research in this area is underway and pivotal to improving teacher practice (e.g., Griful-Freixenet et al., 2021; Lanterman & Applequist, 2018; Lowry et al., 2019).

For schools and districts interested in embedding UDL in the Tier 1 instruction of their iMTSS, this study provides evidence that aspects the two initiatives are well aligned. The indicators of quality instruction (evidence-based, differentiated, delivered with fidelity) do not appear be pose innate barriers to concurrent implementation, however improving teacher understanding of the complexities of differentiation and fidelity of implementation can be supportive of the compatibility of UDL and iMTSS in Tier 1.

Conclusion

Diversity within American classrooms is at an all-time high, including exceptionalities such as disabilities, cultural backgrounds, and linguistic differences (e.g., Thomas et al., 2020). This wide variation in student backgrounds and needs can make instructional planning challenging to address. Comprehensive school-wide initiatives like iMTSS and UDL present opportunities for large scale impact on improving teacher instructional practices and therefore student outcomes.

Implementing these two initiatives—iMTSS and UDL—concurrently presents an opportunity to enhance and improve universal instruction for all students. Applying a UDL framework to evidence-based curriculum and instructional practices currently used within an iMTSS would make Tier 1 instruction more effective by increasing access for students with disabilities, and culturally and linguistically diverse students. Increased access at the Tier 1 level of an iMTSS, would reduce the strain on subsequent, more resource-intensive tiers and reduce problem behaviors--supporting the overall purpose of the integration of MTSS, which is to increase efficiency and effectiveness and better meet the needs of the whole child.

Basham et al.'s (2010) Ecological RTI framework suggests that incorporating UDL as the foundation for core instructional design within tiered systems will promote positive academic and behavioral outcomes for all students. Although few studies have attempted to embed UDL in tiered instruction, those that have, have indeed found positive academic outcomes for students including those with disabilities (Choi et al., 2017; Choi et al., 2020). No previous study has explored the state of concurrent implementation of iMTSS and UDL, within Tier 1 in elementary schools.

In conclusion, this study adds to and extends the field's knowledge and awareness of an approach to achieving high quality Tier 1 instruction, in particular the inclusion of UDL as a mechanism to plan high quality universal instruction with an iMTSS and the factors that serve as barriers to that concurrent implementation. Although questions about the intentionality and extent of UDL implementation remain, it is promising to know that elementary schools are working towards more inclusive instruction in general education classrooms, and that UDL and iMTSS are not discordant initiatives.

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Appendix A

IMFR Institutional Review Board Exemption Letter

AIR®
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Institutional Review Board
IRB00000436 / FWA00003952

AIR IRB *Exemption Notification*

To: Allison Gandhi
From: IRB Administrator
Subject: B&P# 87962
Date: 03/23/2020

B&P# 87962 - IMFR-IES MTSS Research Network_Full Submission has been verified by Kimberly Kendziora as **Exempt** on 03/23/2020.

On the basis of this review, the IRB has determined that the interviews, focus groups, and surveys with teachers, administrators, and other educators, as described in the materials submitted, are exempt on the grounds that the research is with adults and involves only the use of tests, surveys, interviews, or public observation as defined in 45 CFR §46.104 (d) (2). The participants' responses, if inadvertently disclosed, would not place them at risk of criminal or civil liability, nor would their financial standing, employability, educational advancement, or reputation be damaged. The participants' identity can readily be ascertained, directly or through identifiers, and the IRB has conducted a limited review and determined that there are adequate provisions to protect the privacy of participants and to maintain the confidentiality of data. Therefore, these components of the data collection are not subject to IRB oversight.

The IRB has also determined that the collection of student data is exempt on the grounds that the students' identity cannot readily be ascertained directly or through identifiers, the investigator does not contact the participants, and the investigator will not re-identify participants. Therefore, this component of the data collection is also not subject to IRB oversight. Data collection may proceed.

Please note that changes to your protocol may affect its exempt status. Please contact the IRB directly to discuss any changes you may contemplate.

Thank you,
Erin Morrison
IRB Administrator
emorrison@air.org

Please be reminded that all projects must undergo IRB review before initiating any recruitment or data collection/analyses. Material changes to project activities also must undergo review via the Amendments tab.

Appendix B

Institutional Review Board Approval Letter

Institutional Review Board
University of Missouri-Columbia
FWA Number: 00002876
IRB Registration Numbers: 00000731, 00009014

482 McReynolds Hall
Columbia, MO 65211
573-882-3181
irb@missouri.edu

June 14, 2021

Principal Investigator: Elizabeth R. Thomas (MU-Student)
Department: Special Education-PHD

Your IRB Application to project entitled Quality of Tier 1 Instruction in an Integrated Multi-Tiered System of Support was reviewed and approved by the MU Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2047742
IRB Review Number	300885
Funding Source	Department of Special Education
Initial Application Approval Date	June 14, 2021
IRB Expiration Date	June 14, 2022
Level of Review	Exempt
Project Status	Active - Exempt
Exempt Categories (Revised Common Rule)	45 CFR 46.104d(2)(ii)
Risk Level	Minimal Risk
HIPAA Category	No HIPAA
Approved Documents	consent updated 6/14/2021 updated 6/11/21 updated 6/11/21

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

- No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
- All changes must be IRB approved prior to implementation utilizing the Exempt Amendment Form.
- The Annual Exempt Form must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date to keep the study active or to close it.
- Maintain all research records for a period of seven years from the project completion date.

If you are offering subject payments and would like more information about research participant payments, please click here to view the MU Business Policy and Procedure: http://bppm.missouri.edu/chapter2/2_250.html

If you have any questions or concerns, please contact the MU IRB Office at 573-882-3181 or email to muresearchirb@missouri.edu.

Thank you,
MU Institutional Review Board

Appendix C

Integrated MTSS Fidelity Rubric Construct 1.1

Integrated MTSS Fidelity Rubric

Item	Beginning	Exploring	Aligning	Integrating	Sustaining
1. Instruction and Intervention Domain					
1.1 Tier 1 *Tier 1 curriculum and instructional practices are (a) evidence-based, (b) differentiated to address needs of all learners, and (c) delivered with fidelity to all students.*	Tier 1 curriculum and instructional practices are not evidence-based, differentiated to address needs of all learners, or delivered to all students with fidelity.	Tier 1 curriculum and instructional practices are evidence-based, differentiated to address needs of all learners, and delivered to all students with fidelity to all students in either behavior or academic areas.	Tier 1 curriculum and instructional practices are evidence-based, differentiated to address needs of all learners, and delivered to all students with fidelity to all students in behavior and academic areas individually (i.e., areas not integrated).	Tier 1 curriculum and instructional practices are evidence-based, differentiated to address needs of all learners, and delivered to all students with fidelity in an integrated manner across behavior and academic areas.	For at least two consecutive years, tier 1 curriculum and instructional practices have been evidence-based, differentiated to address needs of all learners, and delivered to all students with fidelity in an integrated manner across behavior and academic areas and these curriculum and instructional practices are embedded in school policies and procedures.

Appendix D

Additional Interview Protocol Section F

F. Supplemental Questions on UDL

Directions for Data Collector: Ask questions and read definition *as written*

Before we close today, I'd like to ask you three quick questions related to your Tier 1 instruction, specifically, your school's use of Universal Design for Learning.

81. Please describe what you know about Universal Design for Learning (UDL)?

We would describe Universal Design for Learning as an instructional framework that seeks to reduce barriers and address learner variability. By considering UDL as they design lessons, teachers can build in supports and flexible options from the outset to support student mastery of lesson goals.

1. How would you rate the extent of your school's implementation of UDL in **reading** on a scale of 1 to 4? 1 indicates *not at all*, 2 indicates *very little*, 3 indicates *somewhat*, 4: indicates *to a great extent*.

    a. Why?

2. How would you rate the extent of your school's implementation of UDL in **math** on a scale of 1 to 4? 1 indicates *not at all*, 2 indicates *very little*, 3 indicates *somewhat*, 4: indicates *to a great extent*.

    a. Why?

Appendix E

Follow-up Interview Protocol

Quality of Tier 1 Instruction in an Integrated Multi-Tiered System of Support

Interview Protocol

School Name:

Date of Administration:

Introduction and Purpose

Thank you for taking the time to speak with me. Before I start, I'd like to provide a little background about the process and purpose of this work and answer any questions you might have for me.

- The purpose of this interview is to examine your Tier 1 integrated MTSS practices (Multi-Tiered Systems of Support) and use/non-use of Universal Design for Learning principles.
- This interview is part of my dissertation research study through the University of Missouri.
- This interview will take about an hour. I hope that you will answer these questions to the best of your ability and invite you to provide examples wherever possible.

Confidentiality, Privacy, Informed Consent and Permission to Record

As a reminder, prior to this call I sent you a document that explained our procedures for maintaining your confidentiality. We also asked for and obtained your permission to record this session. Do you have any further questions about that document or anything else about this process?

[Respond to any questions.]

[Start recording now-save to cloud]

I am now recording. If, at any point during our conversation, you would like me to turn off the recorder, please let me know.

Background/Setting Information

I'd like to start with some background information to help me set the stage for what is happening at your school.

1. First, introduce yourselves and tell me about your roles.
2. How familiar are you with MTSS?
    a. Would you define/describe MTSS as it exists in your school?
3. Would you describe your school as implementing MTSS at a high level? Why or why not?
4. Are you familiar with Universal Design for Learning?
    a. If yes, tell me about your understanding and experiences with UDL?
    b. If no, provide definition and visual on the screen.
5. Is UDL something your school is implementing or working to implement?
    a. If yes, tell me about what that looks like.
    b. If no, why do you think that is?
    c. How do you feel about the use or non-use of UDL in your school?

Class Membership Confirmation

6. To get a better idea of your school systems, I'll display 4 vignettes or quotes from example schools and what they are doing in Tier 1 for reading and math and how that relates to their overall systems and initiatives.
    a. Please read through each one, discuss with your team, and tell me which school your school is most similar to and why.

Reading Tier 1 Practices

Next, I'll ask specifically about your Tier 1 practices in reading. By Tier 1, I mean what is happening in the majority of classrooms to provide universal instruction to all students.

7. Do teachers have the autonomy to decide how reading instruction is approached in your school or does the district or building administration decide?
8. Are the majority of teachers using the same instructional practices in reading?
9. What would you say are the key principles of reading instruction in your school? (Examples may include balanced reading, workshop, explicit instruction, vocabulary, etc.)
10. How is reading instruction differentiated at the Tier 1 level, within the general education classroom?
11. Are UDL principles part of instructional planning for reading? (Display visual again for reference)
    a. Is that explicit or implied?

Mathematics Tier 1 Practices

Next, I'll ask specifically about your Tier 1 practices in mathematics.

12. Do teachers have the autonomy to decide how mathematics instruction is approached in your school or does the district or building administration decide?
13. Are the majority of teachers using the same instructional practices in mathematics?
14. What would you say are the key principles of mathematics instruction in your school? (Examples may include I do, We do, You do, explicit instruction, math talks, multiple representations, etc.)
15. How is mathematics instruction differentiated at the Tier 1 level?

16. Are UDL principles part of instructional planning for mathematics? (Display visual again for reference)
    a. Is that explicit or implied?

Integration

1. So, the work you're doing with the IMFR team is about *integrated* MTSS. Now that you've gone through that interview experience and gotten a score report, would you describe your MTSS as integrated? By that I mean behavior and academic systems work together rather than separately.
    a. If yes,
        i. What does that look like at Tier 1?
        ii. Can you give me an example?
    b. If no,
        i. Is that something you want to work towards for Tier 1?
        ii. What would you say are barriers to that integration happening?

Closing

1. Is there anything I haven't asked regarding your Tier 1 MTSS practices or UDL implementation that you'd like to comment on or tell me about?

Thank you very much for your time. It was great talking to you, so interesting! If you have any questions or concerns about this process, please feel free to contact me or on your consent form there is contact info for my advisor and the University.

Appendix F

UDL Protocol Fidelity Checklist

UDL Protocol Fidelity Checklist

Transcript	Asked Q81 as written	Read definition as written	Asked Q1 as written	Asked for an explanation if not provided	Asked Q2 as written	Asked for an explanation if not provided	% of fidelity
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Appendix G

Full Coding Scheme

Primary Code 1: Familiarity with UDL	**These segments give information about the interviewee's awareness and familiarity with Universal Design For Learning**	
Secondary Codes	**Operationalized Definition**	**Example**
No Awareness	School team member(s) are not familiar with UDL	"No, that is a new term to me."
Basic Awareness	School team member(s) are aware of but not familiar with UDL	"Yeah I've heard of it but I don't think we use it here."
Accurate Understanding	School team member(s) somewhat accurately describe UDL (proactively designing instruction to reduce barriers and provide access to all learners, may use terms: framework, access, reducing barriers, all students, diversity, inclusion, multiple means of engagement, representation, action and expression, options, choice, etc.)	"Yeah, I think it's a framework for planning instruction that focuses on making sure all students can participate and show their learning."
Inaccurate Understanding	School team member(s) inaccurately describe UDL (examples: describe learning styles {kids learn visually or kinesthenically} or general differentiated small group instruction)	"Oh yeah, it's the thing with multiple intelligences, right? So you provide kinestetic learning for some kids and visual learning for others."
Primary Code 2: UDL in Practice	**These segments give information about 1) whether or not UDL prinicpals are implemented in reading and/or math and 2) what it looks like in practice**	
Secondary Codes	**Operationalized Definition**	**Example**
Reading	The excerpt is clearly referring to reading instruction, or reading instructional planning.	"Our reading program has a lot of flexibility for multiple types of assessment and kids are in their own just right books."
Math	The excerpt is clearly referring to math instruction, or math instructional planning.	"Well the curriculum is pretty basic, we use Eureka Math so teachers have to add a lot to support those struggling students and reach the kids who got it yesterday and they're bored."

Not in practice	School team member(s) suggest that UDL principles are not implemented in instructional planning	"Um, I don't think we are doing that. We stick really closely to the curriculum so every classroom should look the same. There shouldn't be any variation in planning or instruction."
Some implicit implementation	School team member(s) describe that UDL principles are implemented unintentionally, sporadically, or is "just what good teachers do"	"Oh yeah, I think that what good teachers do naturally, they think about their students in planning and how they can help them. Not all teachers but the more seasoned, quality teachers are totally doing that."
Unclear explanation	School team member(s) describes practices in a way that they aren't clearly UDL, or not enough information is provided to make a determination	"Yeah, I think so but I would say its similar to SIPS so that is pretty exciting."
Conflation	School team member(s) describe UDL priniciples in such a way that they are clearly conflating the concept with something else (e.g. differentiation, MTSS, intervention)	"Yes, we have UDL stuff going on, we do small groups based on data in reading. So like if a student is struggling in a lesson, tomorrow they will get a reteach and extra support."
Primary Code 3: Barriers	**These segments give information about barriers to (1) UDL implementation or (2)Integration**	
Secondary Codes	**Operationalized Definition**	**Example**
Knowledge/Awareness	School team member(s) identified a lack of knowledge or awareness of the concepts as a barrier to implementation	"Well we really haven't had any training or anything on that so I don't know that my staff even could tell you what it is."
Shared Language/Terminology	School team member(s) identified a lack of shared or common language as a barrier to implementation	"I mean we do some of the things you were talking about definitely but we don't use that language, if you asked if teachers are doing UDL one teacher might be able to explain but the next would look at you sideways because they don't know that term."
Staff buy-in	School team member(s) identified a lack of staff buy-in as a barrier to implementation	"There isn't agreement amongst the staff about the best way to address the issue so I'd say staff buy-in is a barrier for sure."

Overwhelmed/Too many initiatives	School team member(s) identified being overwhelmed or having other focuses as a barrier to implementation	"Well we just have been focused on getting PBIS up and running and now we have this grant for mental health, so we just haven't had it on our radar. There is so much else going on, that isn't a focus right now."
Unneccesary	School team member(s) felt it unneccesary to implement, felt they were already meeting needs, or were generally unenthusiastic about impelmentation	"Maybe it would be good to consider but really my teachers are doing a great job so I don't really think it is a priority."
Other/School specific challenges	School team member(s) identified a barrier to implementation that was very specific to their school and doesn't otherwise fit into another code	"The school is involved in a grant and the principal is very against anything the interrupts or could impact fidelity of this reading curriculum we are using. There is not room to adjust in anyway, she really expects to hear the same lesson exactly from room to room in a grade level. So maybe once this reading study is over we could consider it but right now we don't have the option."
Primary Code 4: Differentiation	**These segments give information about what differentitation looks like in (1)reading and (2)math instruction**	
Secondary Codes	**Operationalized Definition**	**Example**
Reading	The excerpt is clearly referring to differentiation in reading instruction.	"So for reading, teachers are expected to do guided reading groups."
Math	The excerpt is clearly referring to differentiation in math instruction.	"Teachers meet with students during independent work time individually to help reteach whatever the concept was for the day like fractions or whatever."
Data-based	Differentiation is described as based on assessment data.	"They meet every week and make groups with their iready scores and target whatever skill it indicated or if their scores are just really low, they'll reteach the content."
Struggling Students	Differentiation is described as provided for struggling students.	"I mean if they aren't getting it, they can be pulled out for extra help. Luckily we have a para that meets with those kids during independent work time."

Enrichment	Differentiation is described as provided for students who require enrichment.	"All students receive differentiated guided reading instruction, we have some students who are really great readers so they are in books pulled from the next grade up."
Small groups	Differentitation is described as provided in a structure of pulling small groups or individuals for additional instruction.	"All classes are expected to have small groups after their whole group instruction."
Other structure	Differentiation may be provided in a structure other than small group instruction.	"We have a workshop model, so each individual student is reading independently in an authentic text appropriate to their reading level and the the teacher confers with students and then there are kind of stations that they also rotate through where they are working on different skills."
Primary Code 5: Autonomy	**These segments give information about how much autonomy (flexibility to adjust instruction vs adherence to the curriculum) is allowed in (1)reading and (2)math instruction**	
Secondary Codes	**Operationalized Definition**	**Example**
Reading	The excerpt is clearly referring to differentiation in reading instruction.	"So for reading, teachers are expected to follow the Benchmark guide."
Math	The excerpt is clearly referring to differentiation in math instruction.	"The district provides EveryDay Math but we have the flexibility to adjust or even use something else."
Curriculum expectations	The district or school has expectations about the use of specific curriculum materials.	"The district provides EveryDay Math and we are expected to use that but we have the flexibility to adjust the pacing and stuff."
Autonomy	The excerpt describes flexibility for teachers to adjust or change instruction based on teacher judgement or student need.	"The teachers have access to Benchmark reading but they really decide what that instruction looks like fo rtheir students."
Minimal autonomy	The excerpt describes limited flexibility for teachers to adjust or change instruction based on teacher judgement or student need.	"I mean we can adjust the small group instruction but really we are supposed to stick to the whole group lessons, there is some autonomy but not much."

Adherence	The expert describes either no flexibility for teachers to adjust or change instruction, an expectation of adhereing to the curriculum, or an intention to implement with fidelity.	"Every classroom should looks the same, we are really expected to use this curriculum with fidelity."
Primary Code 6: (MTSS)Integration	**These segments give information about 1) whether or not academic and behavior tiered systems are integrated and 2) what it looks like in practice**	
Secondary Codes	**Operationalized Definition**	**Example**
integrated	The school team indicates explicitly that the systems are integrated, or describes an integrated system.	"Oh yeah, our academic and behavior MTSS is integrated. We are thinkng of the whole cild in our planning and decision making."
not integrated	The school team indicates explicitly that the systems are not integrated, or describes siloed systems.	"No, I mean we are talking about moving that way but definitely not integrated yet."
not tier 1	The school team describes aspects of their MTSS that are not about tier 1 or universal instruction. *If not describing tier 1 at all, no need to code as integrated or not integrated, this helps esstentially remove the excerpt from analysis	"When our problem solving team meets they look at all data, academic and behavior."

Appendix H

Class Confirmation Vignettes

Which one sounds like your school?

- **School A**

"In our school, classroom teachers meet regularly to plan reading and math instruction and consider how to integrate behavior instruction as well. We use an evidence-based curriculum, but adjust the materials, activities and assessments to meet the needs of the individual students. For example, the reading lesson today provides multiple options of texts and an audiobook for students to access. And of course, we always set behavior expectations and supports in all classrooms."

- **School B**

"One of our key tenants is to implement our reading and math curriculums with fidelity, as well as our universal behavior expectations. If you looked in our 4th grade windows for example, teachers should be doing almost the same thing in each room and you would hear the same language about behavior. This way ALL students get the full benefit of the evidence-based curriculum."

- **School C**

"Our school is incorporating some pieces of MTSS, mostly academic or behavior but not both yet. Our curriculum focuses on the majority of the students. I'd say we teach "to the middle" in reading and math and then we follow up with extra help for struggling students. That might look like one-on-one instruction during independent work time or working with the special education teacher."

- **School D**

"Our school is incorporating some pieces of MTSS, but we aren't integrating academic and behavior yet. In our reading and math planning meetings, we try to predict what supports students might need and have them available for all students. For example, in 3rd grade math, students will be measuring rectangles but not all are familiar with or ready for formal measuring tools so we will plan to have manipulatives, white boards, and number lines available."

VITA

Elizabeth R. Thomas is originally from a small town outside of St. Louis, Missouri. She received her bachelor's degree in education from Stephens College (Columbia, MO) with certification in early childhood and elementary education in 2012 and her master's degree in teaching from Columbia College with certification in special reading in 2017. Elizabeth was a 5th grade classroom teacher specializing in literacy instruction and then a gifted instructor for grades 3-8. As an educator, Elizabeth found herself in leadership roles advocating for students with learning difficulties and supporting teachers in using data-based decision-making and interventions. These experiences sparked a desire to pursue a career accomplishing those same goals on a larger scale. In her free time, Elizabeth enjoys spending quality time with her husband, son and two dogs.