The Effects of Progress Monitoring and Consultation on Emergent Literacy Performance as Measured by the Individual Growth and Development Indicators

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Abstract

An increased emphasis on data-based decision making has resulted in pressures on educational institutions to find new and innovative ways to reach and assess students at younger and younger ages. At the preschool level progress-monitoring tools are being utilized to inform instruction and intervention, and ideally, improving student outcomes. The purpose of the current study was to examine the effects of progress monitoring, both with and without the addition of a consultation model on student performance as measure by the Individual Growth and Development Indicators (IGDIs) with preschool aged students. Research questions, including: To what extent does the administration of the IGDIs measures as progress monitoring tools alone have an effect on student achievement both with and without consultation, and how does disability status moderate these findings are addressed. Additionally, this study intended to qualitatively assess teacher pedagogy as a function of progress-monitoring. Participants were 150 preschool students, ages 3-5, enrolled in either urban or suburban early childhood education programs including Early Childhood Special Education (ECSE), Early Childhood Family Education (ECFE), YMCA preschool, High Fives, YWCA preschool, school readiness or private preschool. ANOVA, Hierarchical Multivariate Linear Modeling (HMLM) and effect size analyses were used to examine the relationship between progress monitoring (both with and without consultation) and student performance. Results suggest progress monitoring as an intervention resulted in positive effects on student achievement compared to Control, while progress monitoring with the addition of a behavioral consultation model produced positive effects on student achievement compared to Control, but not above and beyond the effects of progress monitoring alone. When these results were further examined by disability status, results indicated mixed findings suggesting future studies investigating progress monitoring with students with disabilities is warranted. Implications for best practice, merits and limitations and directions for future research are also discussed.

Table of Contents

List of Tables

Table of Figures

CHAPTER ONE

Emergent literacy, a term indicative of the acquisition of those concepts concerning print, language, and the activities of reading and writing that provide the foundation for children to learn to read, has been stimulus for both debate and consensus. Specifically, debates have occurred regarding which elements of pre-reading behavior are representative of such development. Conversely, researchers have coalesced regarding the recent recognition of need for improved emergent literacy education (Stewart, 2004). Seminal research by Burns, Griffin and Snow (1999), Adams (1994), Whitehurst and Lonigan (1998), Senechal, Lefevre, Smith and Colton (2001), Juel (1988) and Teale and Sulzby (1986) have all contributed to a research literature that delineates the emergent literacy skills that shape the process of emergent literacy development before the formal act of reading occurs. Today, emergent literacy research continues to be recognized as an important facet within education due to pressure from current legislature, concerns for student outcomes related to the act of reading, and a renewed interest in the development of skills prerequisite for reading.

Legislation such as the No Child Left Behind Act (NCLB), which includes features such as school report cards (2001), has increased an emphasis on academic achievement by attaching performance grades (on an A through E and star quality scale) to both school-wide and individual subgroup performance against pre-determined criteria. These outcomes have resulted in both school-wide and individual performance pressures.

Schools, as a whole, are being held accountable based on Adequate Yearly Progress (AYP) status. Similarly, accountability has increased for the individual because progress is being monitored at the student level. That is, reports no longer assess performance across the school only as a whole, but instead break down the school into subgroups based on grade, disability status and demographic variables and expect all groups to meet a pre-determined criterion (NCLB, 2001). Specifically, concerns have increased in the domain of reading as early as the first grade (Pressley, Billman, Perry, Reffitt, Moorhead-Reynolds, 2007). Teachers and educational professionals are aware now more than ever of the difficulties associated with teaching reading skills and improving reading scores, and therefore are paying closer attention to the skills that precede the act of reading (Moats, 1999).

Related research suggests that nationally the number of students at-risk for reading problems is substantial. Existing literature indicates that students who are poor readers in the first grade are likely to continue to be poor readers in the fourth grade (Juel, 1988). These data illustrate the continued concerns for literacy development over time, as well as a lack of appropriate remediation for those students who are struggling readers. Stanovich (1986) also found that students who are not proficient readers in the third grade are not likely to achieve proficient reading levels in the secondary grades. Further, the Connecticut Longitudinal study (Shaywitz, 2003) found that approximately 1 in 5 school-age children have a reading disability. Overall, these alarming statistics indicate the concern for reading acquisition continues to be very real. Potentially, the most distressing result of this research is the knowledge that “most reading difficulties can be prevented” (Snow, Burns & Griffin., 1998, p. 13). To best address these issues, researchers have turned to prevention strategies in early childhood, beginning with emergent literacy strategies to improve skills and better prepare students for the actual act of learning to read.

A renewed interest in emergent literacy prerequisite skills has also recently propelled research in the areas of the “big five ideas in reading”: phonemic awareness, alphabetic principle, accuracy and fluency, vocabulary, and comprehension after a substantial period of research focusing on the whole language approach to literacy (National Reading Panel, 2000; King & Goodman, 1990). While both specific skill and whole language strategies feature potentially beneficial reading outcomes, current research regarding emergent literacy has shown a trend toward developing specific skill sets (i.e. phonics) as components of emergent literacy development.

These research findings and pressures from current legislature combined with renewed research interests in the development of skills prerequisite for reading, rather than attending to reading as an all-or-none phenomenon has lead to an influx of emergent literacy research.

Emergent Literacy Formative Assessment

At the preschool level, current research is exploring the role of formative assessment, such as progress monitoring, to support the improvement of emergent literacy achievement through data-based decision making. Parallel research findings in the elementary grades have shown positive outcomes of curriculum-based measures used for frequent progress monitoring of reading achievement (Deno, 1985b). The development and refinement of these types of assessment were necessary to meet the need to appropriately determine how students perform on reading tasks. Until recently, no parallel need had been established at the emergent literacy level, and therefore few such measures were developed.

However, in light of changing dynamics in accountability and emergent literacy theory, a substantial need has arisen to develop progress monitoring tools for the emergent literacy domain similar to those in the first through third grade. Indeed, a set of measures that may bridge the gap between emergent literacy development and basic literacy would benefit research and practice by offering a succinct progression of student achievement over an extended period of time. In turn, this information may open new doors in terms of improved intervention and prevention programs, as well increases in tailored instruction for students with specific literacy needs.

Currently, few such measures are available in the general research community. These global assessments of emergent literacy skills, frequently called General Outcome

Measures (GOMs) include the Individual Growth and Development Indicators (IGDIs; Early Childhood Research Institute on Measuring Growth and Development, ECRI-MGD, 1998a), which use three brief measures, one vocabulary and two phonemic awareness, as a proxy to measure overall emergent literacy development in preschool-aged students, and the Dynamic Indicators of Basic Early Literacy Skills (DIBELS), a series of brief measures tiered for assessment across the kindergarten, first and second grade spectrum that also measure specific emergent literacy skills as a proxy for overall emergent literacy development (Good, Gruba & Kaminski, 2002).

These GOMs may provide such benefits (e.g., improved intervention and prevention programs, tailored instruction and a succinct progression of student achievement over an extended period of time) in early childhood classrooms, as well as allow teachers to increase their awareness of students' emergent literacy performance as a whole. Using these types of measures on a frequent basis will likely introduce the power of GOMs as an intervention; teachers who are more aware of student performance as a result of using GOMs may be more likely to improve instruction to tailor to the needs of students within the classroom than those teachers who do not use GOM assessment models in the classroom. Because of these potential benefits the role of emergent literacy formative assessment as an intervention is one worth further exploring.

It is also possible that the role of emergent literacy formative assessment as an intervention could be further bolstered with the addition of consultation services. While no such research has been completed on the role of consultation in combination with emergent literacy assessment, it may be likely that positive outcomes could result through the process of consulting with teachers who use GOM emergent literacy assessment models. Parallel findings by Fuchs, Deno, and Mirkin (1984) indicate that consultation can improve instruction and intervention and can improve the utility of assessment results to inform classroom instruction. If teachers and educational professionals are provided an opportunity to consult with other professionals regarding GOM progress monitoring scores they may be better prepared to introduce and implement new instruction or intervention as a result of GOM data interpretation. The implementation of such as system may provide dramatic benefits within the classroom. However, current barriers common to the process of data collection and data-based decision making, such as skepticism and resistance to the process of progress monitoring, need to be overcome and rectified to best implement the system. It is possible that the results of this study may be used to overcome such barriers.

Purpose of this Study and Research Questions

In response to the growing need for progress monitoring tools at the preschool level, this study will investigate the effect of one such General Outcome Measure: Individual Growth and Development Indicators (IGDIs) as a progress monitoring tool. Both the effects of the IGDIs as a progress monitoring measure alone, as well as in combination with a consultation model will be investigated. In light of the research findings previously discussed, the following research questions will be addressed in this study:

1. To what extent does the administration of the IGDIs measures as progress monitoring tools alone have an effect on student achievement?
2. How does disability status moderate the findings presented in Question 1?
3. To what extent does the administration of the IGDIs measures as progress monitoring tools with additional consultation practices have an effect on student achievement?
4. How does disability status moderate the findings presented in Question 3?
5. After participating in this study, to what degree does teacher pedagogy change?

By supplementing research with the results of this study early childhood education teachers and professionals will be better equipped to understand the possible use of the IGDI tools as progress monitoring measures, the effects the IGDIs have on student performance, and the influence progress monitoring has on teacher pedagogy.

Summary

Data-based decision making and use of GOM progress monitoring tools will likely contribute in an important way to emergent literacy assessment as accountability standards receive more attention in early childhood education. The Individual Growth and Development Indicator measures offer easy to use progress monitoring tools for teachers to accurately assess student development of emergent literacy skills. The addition of consultation skills may further increase the utility of using such progress monitoring assessment tools (e.g. IGDIs) to inform instruction and intervention as well as to simply gauge student performance. Research is needed to ensure appropriate implementation of the IGDIs assessment system at the preschool level and further examination of the effects of the IGDIs as a progress monitoring system, both with and without consultation services on student achievement is warranted. Additionally, information regarding how IGDI score information is used to make data-based decisions is needed to forge robust connections between emergent literacy progress monitoring and the positive effects of progress monitoring systems.

CHAPTER TWO

A Review of the Literature

Assessing emergent literacy in children is often touted as a pivotal, yet highly debated topic in education. Conflicting perspectives on which aspects to measure, skill development, and assessment techniques have been debated for over half a century (Ramburg, 1998). Beyond the conceptual perspectives of emergent literacy assessment there are additional concerns about application and implementation. That is, the actual assessment of children is often riddled with barriers. Teachers and assessors are often resistant to change or assessment, resulting in inconsistencies in implementation, reduced efficacy and low frequencies of data-based decision making (Bailey, 2000). However, using General Outcome Measures (GOMs) of emergent literacy assessment may aid in promoting data-based decision making, improve efficacy and teacher pedagogy, and improve student achievement. For example, research indicates that the administration of some current measures of literacy, such as Curriculum-Based Measurement (CBM), show a substantial effect on student performance (Fuchs, Deno & Mirkin, 1984). Therefore, the purpose of this chapter is to review what is currently known about emergent literacy assessment and develop a bridge to further investigate the potential effects of emergent literacy assessment tools on academic achievement.

Emergent Literacy

The construct of emergent literacy (Teale & Sulzby, 1986; Clay 1985) suggests that children acquire reading skills through a continuous and developmental process. Teale and Sulzby (1986) state “It is not reasonable to point to a time in a child’s life when literacy begins. Rather we see children in the process of becoming literate, as the term emergent indicates” (p. xix). Based on this model, skills prerequisite for reading are continuously developing from birth to the time at which a child becomes functionally literate. Therefore the assessment and progress monitoring of emergent literacy skills to inform instruction and intervention is critically important to ensure students are prepared to be proficient readers when formal instruction occurs.

A substantial amount of research has been published supporting the theoretical underpinnings of emergent literacy (e.g. Wagner & Torgesen, 1987; Wagner, Torgesen, Laughon, Simmons & Rashotte, 1993; Whitehurst & Lonigan, 1998; Adams, 1994; Mason & Stewart, 1990) and current research demonstrates a sound scientific understanding of the "big ideas" in emergent literacy development and assessment (Adams, 1994; National Reading Panel, 2000; National Research Council, 2001, 1998; Whitehurst & Lonigan, 1998; National Early Literacy Panel, 2009). As children learn to read and access elements necessary to become proficient readers, they develop a repertoire for reading that begins with the development of oral language and is followed by a series of critical emergent literacy components categorized by Whitehurst and Lonigan (1998) into two domains, outside-in components and inside-out components. Outside-in components include a variety of context-based oral language skills such as narrative and conceptual knowledge (e.g. conventions about print, etc.). Inside-out components include function-based skills such as phonological awareness (i.e., the ability to hear and manipulate the individual sounds within spoken language), semantics and grammar, and an understanding of the alphabetic principle (i.e., understanding the relationship between letters and the sounds of spoken language, and using these relationships to read words; Whitehurst & Lonigan, 1998).

Further, research supporting the essential components of emergent literacy assessment suggests that critical skills representative of later reading include: phonemic awareness (e.g. rhyme, *Alliteration*, letter sounds; Wagner & Torgesen,1987; Wagner et al., 1993, Wagner et al., 1997; Goswami & East, 2000), the alphabetic principle, concepts and functions of print, emergent reading and writing, other cognitive factors (e.g. memory tasks), print motivation and oral language (Whitehurst & Lonigan, 1998; Adams, 1994; Senechal et al., 2001; Mason & Stewart, 1990; Hart & Risley, 1995). Overall, these foundational elements reflect those skills necessary to become a fluent reader in the formal academic setting.

Both outside-in and inside-out components are related to later reading development and are important aspects of children's emergent literacy experiences; however, there is strong evidence that inside-out components, or function-based skills, are especially important for children's early reading development in preschool and kindergarten (Storch &Whitehurst, 2002). Moreover, a large knowledge base suggests that individual differences in phonemic awareness and alphabetic knowledge in the early childhood period are strong predictors of success in acquiring beginning reading skills (Good, Simmons & Kame'enui, 2001; Torgesen, Wagner, Rashotte, Lindamood, Conway & Garvan, 1999; Coyne and Harn, 2006). Given Juel (1988) and Stanovich's (1986) analyses which together suggest a lack of foundational proficiency in reading leads to poor readers at both the primary and secondary levels, it is likely the case that phonemic awareness is of central importance as early as the preschool level to ensure later reading success.

Appropriate, sensitive assessment of emergent literacy skills is one of the most significant components for predicting future success as a reader (Adams, 1990;

Stanovich, 1986). In fact, reading assessment scores have been used as a universal benchmark in gauging academic success and can illustrate progress over time, aid in determining special education eligibility, and identify individual differences (Salvia, Ysseldyke & Bolt, 2007). Therefore, appropriately selecting assessment tools that accurately and sensitively measure emergent literacy skills is of paramount importance.

General Outcome Measures

Current research suggests the development of emergent literacy skills varies dramatically among young children (Senechal et al., 2001). Dramatic developmental differences within and between students creates difficultly in measuring skills that are prerequisites for reading. Historically, a mastery monitoring approach has been taken toward the assessment of early reading skills (Fuchs & Deno, 1991; Deno 1997; Fuchs, 2004). However, newer methods of assessment, such as General Outcome Measures (GOMs), may be better suited for determining the competency of preschool children's emergent reading skills.

GOMs are measures that monitor growth toward broad, achievement-based outcomes, and are characterized by repeated assessments of indicators that demonstrate concurrent and predictive validity with larger sets of skills (Deno, Mirkin & Chiang, 1982; Fuchs & Deno, 1991; Missall, 2004; Fewster & MacMillian, 2002; Fuchs, Fuchs & Compton, 2004; Allinder, Fuchs & Fuchs, 1998). These innovative assessment tools offer ease of use, instructional relevance, robustness, accuracy, longevity (i.e. can be used for at least a year) and cost efficiency (Fuchs & Deno, 1991; Deno, 1985a). Specifically, GOMs can be used for direct, frequent measurement of growth over long periods of time. Student progress is measured by developing standard tasks that can be used as indicators of student proficiency in a content area (Espin & Foegen, 1996). For example, in the area of reading, GOMs have been established as robust, valid measures of achievement (Deno 1985a; Deno et al., 1987; Deno & Fuchs, 1987, Fuchs & Deno, 1991; Deno et al., 1982; McMaster, Fuchs & Fuchs, 2002; Fuchs & Fuchs, 1992). Furthermore, oral reading GOMs, such as Curriculum Based Measurement-Oral Reading (CBM-OR) and Curriculum Based Assessment (CBA), at the first and second grade level are relatively well-researched and easy to administer (Fuchs & Fuchs, 1999; Deno, 1985a; Deno et al., 1982; Gikling & Rosenfield, 1995; Marsten, Deno, Dongil, Diment & Rogers, 1995). Currently, few comparable GOMs exist to assess emergent literacy. Examples include: DIBELS, a set of standardized, individually administered, one-minute measures designed to assess fluency and development of emergent literacy skills (Good & Kaminski, 2002), and IGDIs (ECRI-MGD 1998a), a set of brief, standardized measures that assess the development of expressive language, rhyme awareness, and *Alliteration* (www.getgotgo.net). IGDI *Picture Naming*, developed by McConnell and colleagues at the Early Childhood Research Institute (ECRI-MGD; 1998a), intends to measure vocabulary acquisition as a means of expressive language. (McConnell, Priest, Davis & McEvoy, 2002; ECRI-MGD, 1998a; Phaneuf & Silberglitt, 2003). IGDI *Rhyming*, also developed by McConnell and colleagues was developed to measure rhyme awareness, which has been shown to be a component of phonological awareness (ECRI-MGD, 1998b; Adams, 1990; Whitehurst & Lonigan, 1998; Lonigan, Burgess, Anthony & Barker, 1998; Deno, 2003a; Good & Kaminski, 2002; ECRI-MGD, 1998b). These measures gauge global outcomes representative of targeted academic areas as well as rely on "standardized, prescriptive measurement methodology that produces critical indicators of performance" (Fuchs & Deno, 1991).

General Outcome Measures in emergent literacy have been suggested as an innovative remedy to circumvent the flaws that both standardized and mastery monitoring type tests may include such as assuming that the tests used are valid and reliable, sensitive to growth and tied to a valid curriculum. Additionally, mastery monitoring demonstrates deficits in the areas of feasibility and logistics because the test must change with each unit of knowledge to appropriately assess each area for mastery (Shinn, 2005).

Additional features of GOMs supplement their robust ability as assessment measures in academia. First, GOMs do not require teachers or professionals to establish hierarchies before measurement can occur. Children between the ages of 3 and 5 make rapid developmental changes as well as radically differ in developmental rates of acquisition. Therefore, establishing instructional hierarchies may prove to be difficult for pre-literate children considering the dynamic and continuous transformations they make during this developmental period. Further, with GOMs, practitioners can assess students before a complex skill is completely developed. Practitioners identify the domain in which the student's proficiency will be measured and assess skill characteristics of the domain. For example, when using IGDIs the administrator must identify the theoretical underpinnings of emergent literacy, such as phonemic awareness, alphabetic principle or vocabulary (i.e. the domain) and then compare the results of the GOM assessment (i.e. assessment of those skills within the domain) with typical rates of acquisition of these theoretical concepts (Carroll, 1989). Fuchs and Deno (1991) reported a "general outcome measurement system focuses on the broader final task. Consequently, GOMs are more compatible with notions of learning that attend to teaching integrated outcomes in context." In emergent literacy this context reflects that of pre-literate behavior leading to reading, such as the acquisition of vocabulary and phonemic awareness skills.

Second, GOMs attend to long-term goals. A GOM must demonstrate utility. That is, the measure must be sensitive to student growth for at least one school year so that teachers and practitioners may be able to easily monitor progress across the course of the year without modifying the assessment system (Fuchs & Deno, 1991). This utility ensures that teachers will obtain data that can inform changes in curricula and planning, modifications of interventions, and show rates of progress for students. From an emergent literacy perspective long-term goals are particularly important for two reasons: first, long-term goals address the need for continuity across settings and topographies. Teachers, equipped with data across at least one academic year are more likely to view early literacy performance as a continuum of growth rather than examining specific sub-skills acquired over very brief periods of time. Second, because preschool-aged children experience dramatic differences from one child to the next in emergent literacy performance, it is important to examine student performance and growth over extended periods of time, such as an academic year to examine trends and evaluate performance. Across an entire academic year it is reasonable to have broad expectations of pre-literate children (e.g. acquisition of letter names, ability to rhyme etc.). However, expecting students to attain specific skills over very brief periods of time may be much more difficult to assess (e.g. mastery monitoring) and leaves the potential for examiners to overlook small increments of progress within students while experiencing a ceiling or floor effect with others. This lack of sensitivity may cause an under-representation of academic advancement in preschoolers. Any one student in a preschool classroom will likely develop emergent literacy skills at a different sequence than any other student in the same class.

GOMs in emergent literacy will address these issues by providing sensitive measures in which students can be continuously measured for at least a period of one academic year, if not longer. This will allow practitioners to view student progress over time as well as offer teachers extensive opportunities to modify and improve instruction as a result of interpretation of emergent literacy data. Emergent literacy professionals have only recently developed effective GOMs to measure emergent skills (ECRI-MGD 1998a, 1998b, Good & Kaminski, 2002). Three of these measures, IGDI *Picture Naming*, IGDI *Rhyming*, and IGDI *Alliteration* demonstrate sufficient research to evaluate their ability as progress monitoring tools and to further support their use as sensitive GOMs in pre-literate environments (ECRI-MGD 1998a, 1998b, McConnell et al., 2002). These measures were selected based on a sound theoretical foundation combined with current findings in CBM research, which suggests that the IGDI GOM measures will hold promising potential as progress monitoring measures.

Progress Monitoring and Data-Based Decision Making

Progress monitoring is a broad classification encompassing a variety of formative assessment measures designed to track student progress and assist in instructional decision making (Olinghouse, Lambert & Compton, 2006). However, like screening measures, progress monitoring assessment systems do not need to tell us everything about a student's emergent literacy achievement (Deno, 1992). They are similar to "vital signs" of health in that their purpose is to provide a reliable, quick indication of a student's literacy "well-being" (Deno, 1992, p.5). As in medicine, if a student's literacy "vital signs" are troublesome, teachers can then administer more thorough assessments. Similarly, if a student's vital signs are typical, teachers can feel confident that the student is making progress. Through progress monitoring we can quickly assess student progress and determine if further intervention and or instruction is warranted by making data-based decisions.

Progress monitoring assessments are unique in that they provide a quick, reliable indicator of actual performance. To be included in this realm of assessments, a tool must meet several requirements. First, the assessment must be authentic and have adequate reliability and validity (Deno, 1997; Fuchs & Fuchs, 1999). In addition, the material used for progress monitoring must be representative of the academic competence expected of students at the end of the school year. The measure must also be free of floor or ceiling effects, as well as demonstrate sensitivity to change over a short period of time as students gain more skills (Fuchs & Fuchs, 1999). Finally, the assessment must accurately predict gains on one or more standardized outcome measures (Good, Simmons, & Kame'enui, 2001). Progress monitoring instruments that meet these requirements allow teachers to have confidence that the instrument is providing valid and reliable data so that they can make educational decisions and improve instructional effectiveness. Progress monitoring assessments provide frequent data that teachers can use to make decisions about an individual student's instructional needs. For example, based on a student's progress, a teacher may decide to increase the amount of instruction, slow the pace of the instruction, or change the instructional method completely. Furthermore, the use of progress monitoring instruments in special education has been shown to improve student outcomes in academic areas (e.g. Fuchs & Fuchs, 1986a; Fuchs, Fuchs, & Hamlett, 1989).

Within the domain of early childhood, progress monitoring measures are beginning to surface in many different domains. Developers at the University of Kansas are continuing to research progress monitoring GOMs for early childhood indicators of social development and motor development (Greenwood, Luze, Cline, Kuntz & Leitschuh, 2002; Greenwood, Carta, Walker, Huges & Weathers, 2006, Greenwood, Luze & Carta, 2002). Similar research is also being conducted with progress monitoring tools on language and early numeracy skills (Luze et al., 2001; VanDerHeyden et al., 2004; Preschool Early Numeracy Indicators, Floyd, Hojnoski & Key, 2006). Specific to emergent literacy, progress monitoring tools, such as the IGDIs, are just coming to the forefront of both research and practice. A lack of data on how children are performing emergent literacy tasks during the early childhood years have challenged professionals to forge ahead with new and novel progress monitoring measures.

With a Response to Intervention (RTI) model becoming more and more prevalent in practice and a significant push for increases in accountability through the No Child Left Behind Act, teachers and researchers will find at least five ways to benefit from emergent literacy progress monitoring data. First, data could support efficient improvements in child outcomes through data-driven problem solving. Second, data could be used to determine if additional supports and services are necessary within the context of the early learning environment and third, progress monitoring data could demonstrate if additional supports and services are actually accelerating student growth in meaningful ways (VanDerHeyden & Snyder, 2006). Fourth, progress monitoring data increase the frequency of opportunities for data collection, which offers more occasions for teachers to recognize potential deficits in student performance, resulting in an increased likelihood of the teacher to adjust programming as necessary (Fuchs, Fuchs, Hamlett & Stecker, 1991). Fifth, increased teacher awareness through charts, graphs and other documentation may improve teacher awareness of adjustments, resulting in higher levels of achievement (Fuchs et al., 1991).

To enable early identification of students to prevent them from struggling with reading development, all students' emergent literacy and beginning reading progress should be monitored at least three times a year (Coyne & Harn, 2006). For students who successfully develop beginning reading skills, progress monitoring assessments ensure that they are making anticipated gains. The progress of students who are receiving targeted intervention should be monitored more frequently (e.g., weekly) so that changes in intervention or instruction can be made as soon as others are found to be ineffective. Through progress monitoring teachers can receive ongoing feedback about their students' progress to allow for changes necessary to maintain a positive trajectory of growth to close the gap between students' literacy skills and the skills of their peers who are not at risk. Analyzing progress monitoring data enable teachers to be more responsive to student learning and to know when an instructional adjustment is necessary so their instruction is more efficient and effective.

Progress monitoring assessment analyses can inform questions such as: “Are individual children on track for meeting end-of-year reading goals? Is intervention enabling children to make sufficient progress? Is instruction working? ”(Coyne & Harn, 2006). The answers to these questions allow teachers to intensify or change instruction and intervention strategies in a timely manner so children have the best chance of meeting reading goals (Coyne & Harn, 2006). Data obtained by the progress monitoring process also informs evaluation reports and individual education plan development by addressing diagnostic and placement issues (Lau et al. 2006). As these research findings and others indicate, research for early childhood progress monitoring measures is still in its infancy, however there is significant promise for the utility for such measures in practice and research applications.

Using progress monitoring data to inform instruction and intervention has also been well-researched in the literature (Fuchs, Fuchs & Hamlett, 1998; Codding, Skowron & Pace, 2005; Stecker, Fuchs & Fuchs, 2005). Evidence indicates that when used appropriately, progress monitoring can influence student scores through implementation. Simply by progress monitoring students teachers become more aware of the need for modification of intervention and instruction or changes made in curricula, resulting in improved student scores (Fuchs et al., 1998). In fact, data from some studies indicate that student scores are more likely to increase when progress monitoring tools, such as a CBM or IGDIs, as well as computerized progress monitoring systems, such as Accelerated Math, are used because of the intensity of monitoring, frequent adjustments in programming and overall awareness of achievement by both the student and the teacher (Fuchs, Deno, & Mirkin, 1984; Spicuzza & Ysseldyke, 1999). Indeed, a seminal article on the effects of simply administering a data-driven assessment model, such as CBM, showed positive effects on student outcomes (Fuchs, Deno & Mirkin, 1984). Similarly, the very same seminal study showed evidence of changes in teacher pedagogy; that is, after being trained to use progress monitoring measures and following administration guidelines, the teachers were more structured in their lesson plans, instruction and intervention (Fuchs, Deno & Mirkin, 1984). Another study demonstrated that the use of the Accelerated Math (AM) progress monitoring system yielded an average gain in student achievement of 5.75 Normal Curve Equivalents (NCEs) on the Northwest Achievement Level Test (NALT). Similar findings have been reported when using the AM program in urban schools and across low, middle and high performing students (Ysseldyke, Spicuzza, Kosciolek & Boys, 2003; Ysseldyke & Bolt, 2007). Additional studies, though dated, also show similar results indicating that students whose programs are monitored systematically show higher performance levels than students whose programs are not monitored systematically (Fuchs & Fuchs, 1986; Eubanks & Levine, 1983). Other supplemental studies on formative evaluation, such as progress monitoring, have found that student achievement may be improved when teachers monitor student responses or when they are provided with an analysis of student skills (Fuchs, Fuchs, Hamlett & Allinder, 1991; Fuchs, Fuchs, Hamlett & Stecker, 1990). One such study reported that teachers who received performance feedback on a daily basis and implemented interventions as a result of the feedback obtained a negative correlation with problem behavior in students, or stated another way, the more the teachers used the performance feedback in a proactive way to inform intervention, the better the students behaved (DiGennaro, Martens & Kleinmann, 2007). These findings and others suggest achievement may be related to the extent to which teachers administer measures of progress monitoring appropriately as well as to how teachers use formative data to modify programming and intervention and determine appropriate student goals (Fuchs, 1988; Deno, 2003b; Fuchs et al., 1991). Available research demonstrates that setting adequate and appropriate attainable goals improves teacher acceptance of progress monitoring and data-based decision making. By recognizing the limits of attainability teachers can avoid frustration related to inadequate student progress or achievement (Fuchs et al., 1989).

Nevertheless, these findings have not gone unchallenged. Findings by McCurdy and Shapiro (1992) indicate that students whose progress was monitored did not show significantly larger gains in oral reading over time than those students whose progress was not monitored. This finding suggests that the act of progress monitoring and feedback alone may not enough to influence student performance. Fuchs, Fuchs and Hamlett (1989) also found that the measurement component of CBM alone is not enough to lead to increased student achievement in reading. However this study and others have found that the act of progress monitoring in collaboration with consultation methods regarding data-based decision making and program modification show significant positive effects on student achievement (Fuchs et al., 1991). Additional findings in other domains, including math and social studies have found comparable conclusions. For example, in a study on the effect of CBM-math, results indicated that teachers who used CBM were more likely to make instructional adjustments than those who did not use progress monitoring measures. However, these results did not contribute to student achievement; instead findings indicated that only the combination of CBM and consultation resulted in higher levels of academic achievement compared to the Control Group, with effect sizes ranging from .84 to .94 (Fuchs et al., 1991).

The Role of the Consultation Model

Consultation, defined in the research literature as, "an indirect problem-solving process between a specialist and one or more persons to address concerns presented by a client," is an evidence- based methodology for building relationships and improving client and consultee (for the purposes of this study, referred to as student and teacher) outcomes in academic settings (pg. 341, Sheridan, Welch & Orme, 1996). Across research literature, consultation models have demonstrated utility and effectiveness when used to support data-based decisions (Wesson, 1990). Evidence suggests that consultation is a necessary component in successful service delivery because it allows experts, such as school psychologists to influence teacher and other third-party behavior. Erchul and Martens (2002) state, "influence is necessary in school consultation in order to increase the probability that teachers will function effectively as intervention agents, and engage in activities that potentially lead to the prevention of student academic failure and mental illness (pg. 20)." Additionally, consultation models show promise within an RTI framework in that consultation provides perhaps one of the most powerful tools to promote prevention in the academic setting (Gutkin, 1996). Furthermore, consultation can be used both as a universal mechanism to prevent problems during screening and system-wide intervention as well as within a tier-2 mechanism to remediate problems before they become significant (Gutkin, 1996). One such consultation model, the Behavioral Consultation model (BC), has demonstrated acceptance and effectiveness within the early childhood education domain and produced robust positive results across at least two comprehensive reviews (e.g. Sheridan, Kratochwill & Bergan, 1996, 1996; Kratochwill, Elliot & Busse, 1995; Sheridan, Clarke, Knoche, & Edwards, 2006). Sheridan and colleagues analyzed two meta-analyses published after 1985 utilizing the BC model and found that 95% of the studies examined demonstrated at least one positive result (1996). Similarly, research also indicates the BC model has also been frequently used to ramify academic concerns (Sheridan et al., 1996).

In conjunction, these findings suggest BC in collaboration with an emergent literacy progress monitoring system may offer a unique contribution to data-based decision making strategies and data interpretation. While little if any research is available specific to using GOMs as progress monitoring tools within a BC model, one study employed consultation-like strategies to improve teacher impressions about intervention implementation and student outcomes as a result of teacher knowledge about intervention implementation (Deno, 1985b).

Foundational elements of BC suggest that consultation may make a positive impact on data-based decisions. As a consultant, school psychologists assist teachers and educational professional by facilitating a problem-solving process through a series of interviews (Bergan & Kratochwill, 1990; Kratochwill, Elliot, Callan-Stoiber, 2002). Specifically BC (Bergen & Kratochwill, 1990) emphasizes a shared responsibility among school personnel, such as teachers, school psychologists and assessment specialists in discussing and making educational decisions. The BC model appears most frequently in research as an application in school-based consultation theory, which makes it an appropriate fit for addressing academic concerns in the preschool setting.

Bergen articulated seven key features that form the foundation of the BC model. First, the teacher must be an active participant in the process in terms of addressing the problem by designing an intervention plan, implementing the plan and evaluating its effectiveness. Second, when appropriate, the model can develop problem-solving skills in the student by allowing the teacher to incorporate the student's involvement in the intervention. Third, the model provides a link between the consultant and the teacher because consultants provide an avenue through which stakeholders can communicate information and knowledge. Fourth, BC attempts to link decision-making to empirical evidence. Fifth, the model defines the problem presented in consultation as residing outside the character of the student. Instead, the student's behavior is described and goals that might be attained are delineated. Sixth, the model stresses the role of environmental factors in controlling behavior. In regards to this, basic behavioral strategies, such as identifying and isolating antecedents, specific behaviors and consequences are often used in BC (Stages et al., 2008). Finally, BC focuses its evaluation on goal attainment and plan effectiveness rather than on within student characteristics (Bergan, 1977; Erchul & Martens, 2002).

The process of BC focuses on four steps and lends itself to data-based decisions by using core principles frequently found in problem solving models (Wilkinson, 2007). The first step, problem identification, is an interview which allows the teacher (consultee) and school psychologist (consultant) to identify the problem based on a description and operational definition of the behavior of concern (Kratochwill et al., 2002). This step defines when a student can be identified as in need of remediation or a change in instruction or intervention. In collaboration with the BC model, pre-existing criteria regarding progress monitoring evaluation will allow teachers to determine which students need an instructional change. For example, existing studies have used 4, 6, or 8 data points as criteria to make an instructional change; the BC model will allow teachers to more easily identify when these criteria are met through the interview process (Fuchs, Fuchs & Stecker; 1989; Fuchs, Fuchs & Hamlett, 1992; Fuchs & Fuchs, 1998). Research indicates the problem identification step is essential to producing improved student outcomes because it allows all parties involved to address the problem from the same point of reference (Fuchs & Fuchs, 1989).

The second step, problem analysis, focuses on the variables and factors that influence student problem behavior. During this step the school psychologist and teacher work together to determine the antecedents and consequences related to the behavior of concern (Kratochwill et al., 2002, Stage et al., 2008). In the context of an emergent literacy progress monitoring system this step allows teachers to determine what specific influences are factoring into a student's performance. As the teacher takes these factors into account he or she can make appropriate decisions about how to change instruction and if new intervention strategies should be considered. Research indicates the problem analysis step is another critical element within the BC model. Problem analysis allows all parties to determine the aspects of behavior that can be manipulated. One such study, by Fuchs and Fuchs (1989) revealed that both the first and second step of BC are important features to ensure improved student outcomes.

The third step, plan implementation, focuses on selecting and implementing an appropriate intervention. During this stage the interview process aids in discussing procedural aspects and assisting in securing appropriate resources to implement the intervention (Kratochwill et al., 2002). For the emergent literacy progress monitoring system, this step allows teachers to select evidence-based intervention practices when necessary and implement them with available resources. Research support for the plan implementation step of BC has been supported by Fuchs and Fuchs (1989) and Fuchs, Fuchs and Bahr (1990) which both indicate that the addition of the implementation step improves student outcomes more than those teachers who completed the BC model only using the problem identification and problem analysis steps. That is, for those consultees that implemented the determined intervention with fidelity, student outcomes improved over those who discussed interventions but did not implement them with fidelity as measured by fidelity checklists and observations. Because students received structured interventions, implemented with a high degree of fidelity, variability due to error was reduced. However, Fuchs, Fuchs and Bahr (1990) also found that interventions facilitated by students within the BC process, rather than teachers, through self-monitoring were found to be just as effectives as those interventions monitored continuously by teachers, suggesting greater efficiency in the BC process when interventions can be maintained by the client.

The fourth and final step of the BC model, plan evaluation, allows the school psychologist and teacher to assess and interpret student outcomes based on the intervention. If the student's academic concerns are reduced or eliminated the intervention was likely successful, however, when little or no changes in student performance are obtained the BC model becomes circular and the teacher and school psychologist should again identify the problem and continue through the model (Kratochwill et al., 2002). Research indicates plan evaluation is an important piece of the BC process because it improves treatment integrity by evaluating plan implementation and student outcomes. Studies by Wickstrom, Jones, LaFleur and Witt (1998) and Wilkinson (2007) suggest the plan evaluation step significantly improves future treatment integrity for those teachers consistently using the BC model.

The BC model also allows school psychologists and other educational professionals to cultivate relationships within collaborative problem solving. One definition of consultation is reported as, "emphasizing interpersonal process variables and procedural variables," here the term interpersonal process variables refer to the relationships between participants (Noell & Witt, 1999, p.30). The nature of this relationship is important in that research indicates those professionals who nurture positive, trusting relationships with consultees are more likely to deliver high-fidelity treatments and view collaborative interventions and ideas as meaningful (Rosenfield, 1991). Through this relationship participants are allowed to share knowledge and expertise toward a common goal, as well as build a sense of cohesiveness which supports both positive student outcomes for clients and consultees (Rosenfield, 1991; Gutkin, 1996). Furthermore, teachers in at least four studies (see Gutkin, 1980; Gutkin, 1996; Hughes, Grossman & Barker, 1990; and Erchul, Hughes, Meyers, Hickman & Braden, 1992) reported that they "look forward to consultation", and view it as a more effective methodology than traditional psychological assessment and believe it to be capable of enhancing their professional skills (Erchul & Martens, 2002).

Taken together, BC theory and studies suggesting consultation practices supplement progress monitoring indicate that teachers may be able to see improvements from the actual process of administering progress monitoring measures, however, it appears that with the addition of consultation and collaboration practices dramatic effects may be found, such as improved performance outcomes for students (e.g. CBM scores, Fuchs et al., 1991). Further, effects attributable to the process of ongoing progress monitoring assessment may include that the process assists teachers to engage in revision of instruction and intervention and teachers may benefit from additional support through collaboration and consultation to enhance the nature and quality of instruction and intervention, which in turn may promote higher achievement (Fuchs, Deno & Mirkin, 1984). Furthermore, information from objective on-going assessment systems can be used to determine when progress is falling behind and when instructional practices need to be modified as outlined in steps 2 and 3 in the BC model.

Bringing it all Together: Assessment as an Intervention

Taken together, studies that bridge GOMs of emergent literacy, such as the IGDIs, and data-based decision-making with progress monitoring show potential for developing promising pathways toward using assessment as an intervention. Indeed, parallel research in the medical and mental health professions also show evidence of assessment as an intervention. For example, research in psychotherapy has shown that the process of assessment alone often addresses therapeutic goals. That is, as assessment occurs clients become more aware of subsequent needs, and therapeutic changes occur (Finn & Tonsager, 1997). Similarly, dietary research has shown that individuals who participated in skin-fold assessment techniques were more aware of their dietary program and more likely to monitor their own dietary consumption, resulting in the outcomes such as significant weight loss and determining appropriately proportioned servings sizes (Hunt-Pellow, 1986). Finally, research on insulin management of individuals with Type-I diabetes mellitus indicated that individuals who appropriately self-monitored their insulin regiment were more likely to have reduced levels of blood-sugar prior to insulin injections (Stoller, 2002).

In the educational domain assessment as an intervention is frequently cited in research regarding reactivity. Reactivity is the "effect of measurement procedures on the objects of study" and is often manifested as a change in student behavior as a result of a measurement procedure. For example, during observational assessment students often modify behavior because their environment has been altered by the introduction of an observer (Harris & Lahey, 1982, p. 524). Just as students are often reactive to observations they may also be reactive to assessment protocols such as progress monitoring.

Overall, these studies, and those reviewed within the educational domain indicate that individuals who appropriately use monitoring strategies, such progress monitoring tools or self-monitoring tools, both individually and with their students may be more likely to see positive outcomes and potential increases in student performance based on increases in self-awareness of teaching techniques and vigilance of student progress. The potential effects of proper implementation and administration of the IGDIs as progress monitoring tools may show promise in informing data-based decisions regarding instruction, curriculum and interventions.

Implications

While the potential positive effects of using progress monitoring assessment may be substantial, significant barriers remain to improving current levels of administration in the classroom. First, current research illustrates that teachers are not using GOMs, such as IGDIs, as frequently as necessary to promote optimal outcomes (Stecker & Fuchs, 2000). Second, research regarding the effects of progress monitoring systems both with and without consultation practices is outdated. Over the past two decades a substantial amount of improvement has been made both in informing consumers about the standardized practices required of progress monitoring tools, as well as improved dissemination regarding the positive effects and utility of using progress monitoring measures. Overall, it may be generally presumed that progress monitoring is much more often recognized as a robust indicator of student performance than it was 20 years ago. Furthermore, new policies and laws, such as the No Child Left Behind Act and IDEIA have encouraged a marriage of assessment and instruction, pushing teachers and professionals to more completely integrate teaching and intervention strategies with assessment information. Finally, specific to emergent literacy, significant gaps within the research exist regarding the administration and application of progress monitoring and data-based decision making processes.

Similarly, unique variables that may be attributable to the early childhood environment may also play a role in the effects of progress monitoring both with and without the consultation model. For example, early childhood educators experience only a small proportion of the standardized testing procedures that K-12 teachers experience (i.e. CBM; Minnesota Comprehensive Assessment [MCA]). Therefore, initially, early childhood educators may show more resistance to assessment and data-based decision making processes because this type of information may be novel or cumbersome. Another reason may be that teachers do not find meaningful value in assessment results. For example, teachers may receive assessment data on students but not be able to relate it to instruction taking place in the classroom or have the skill necessary to extrapolate necessary information to use the data in meaningful ways. Another variable may be that within the early childhood domain teachers are often equipped with additional adults and/or para-professionals in their classrooms and have more time to attend to individual needs. These opportunities to assist students at a more intimate level may encourage preschool teachers to use assessment data in appropriate ways to attend to individual needs. A final variable to consider specific to early childhood education is that during early childhood student achievement varies dramatically over brief periods of time. This dramatic variance makes accurate, sensitive assessment of all students difficult to accomplish and may result in what would appear to be some students making progress while others do not (Senechal et al., 2001).

CHAPTER THREE

Methods

Participants and Setting

Teachers

Thirty teachers and students in their classrooms were randomly assigned to one of three groups. Participants included 30 preschool classroom teachers. A sample of 30 teachers was chosen after a power analysis revealed an adequate effect at an appropriate alpha level could be obtained (Appendix A). Teachers were recruited from one suburban and one urban district from the following programs: Early Childhood Special Education (ECSE), Early Childhood Family Education (ECFE), school readiness, and YMCA Preschools, Public Preschools, High Fives (urban only) and YWCA programs (suburban only). Four criteria were used in subject recruitment. First, teachers were required to voluntarily participate in the study. Second, teachers were required to attempt to aid in the collection of progress monitoring data. Third, teachers were required to be willing to attend trainings and learn data-based analyses of the data supplied by the progress monitoring sequences. Fourth, teachers were required to be currently teaching a class of students aged 3 years to 5 years. No limitations in participation were made based on teacher age, gender, years of experience, or ethnicity.

Teachers were recruited to participate in the study and offered compensation for their participation in the form of $30.00 gift card to a local teaching store. The recruiting process achieved a participant group with 15 teachers/classrooms of typically developing students such as school readiness, YMCA or ECFE program participants, and 15 teachers/classrooms of students receiving special education services. All teachers were women. Demographic information, including age, years of experience, and ethnicity were collected for teachers; results indicate teachers were all of Caucasian ethnicity, had a mean age of 49.7 years, and on average teachers had 23.6 years of experience teaching.

A blocked random assignment of classrooms occurred after all 30 teachers had signed consent forms indicating their voluntary participation and delineating the participant criteria of the study. The random assignment included 10 classrooms placed in the Control Group, 10 in the IGDI training group (referred to as *IGDIs Alone* from this point forward) and 10 in the IGDI training with consultation support group (referred to as *IGDIs + Consultation* from this point forward). Because the design was blocked, each group was randomly selected from two blocked pools: typically developing students (5 classrooms) and students with disabilities (5 classrooms) to ensure equivalent disability status in each group.

Students

A total of 161 students were recruited to participate in the study. Students were nested within teachers, therefore only those students who were within the classrooms of teacher participants were recruited. Limitations on student participation included the exclusion of non-native English speaking students. This exclusionary criterion was chosen because no current research has determined if IGDIs are valid assessment tools for those students who are not native speakers of English.

To determine student participants after classrooms were randomly assigned to each treatment group, progress monitoring data were collected on two occasions within 1 week for all eligible students who academically fell in the lower 50% of the class, as nominated by classroom teachers. Average scores for each student were summed on each IGDI measure, *Picture Naming*, *Rhyming* and *Alliteration* and converted to z-scores standardized by each classroom. Z-scores for each measure were then complied into an IGDI composite score and students in each class were ranked by score. Students who fell within the bottom 25% of student scores for each class were then included in the study. If the bottom 25% of the student scores resulted in choosing less than 5 students for study participation, the 5 lowest scoring individuals were instead included in the study. Therefore, at a minimum, 150 students between the ages of 3 and 5 were available for experimental participation in the study.

Student demographics were collected through data acquired by district-wide database systems regarding child age, gender, ethnicity, and race, parent age, highest level of education, relationship to the child, marital status and disability status. A demographic information form was given to all students who were not included in the district-wide database systems due to late enrollment, private school attendance or other factors. Data regarding total number of adults and children in the household and financial aid status was also collected. Results are presented in Table 1. See Appendix B for additional selected student demographics presented by classroom. A copy of the demographic information form can be found in Appendix C.

Table 1.

Student Demographics of Overall Group

Demographics	Mean	SD	Minimum	Maximum
Non-White	53.4	35.5	0.0	100.0
Receiving Financial Aid	47.8	34.9	0.0	100.0
Mean Age at Baseline	50.3	30.8	136.0	290.0
Mean Age at Wave 11	56.1	30.7	162.0	314.0

Note: Ages are presented in months, Mean and Standard Deviations are presented in percentages.

Measures

Three IGDI measures, *Picture Naming*, *Rhyming* and *Alliteration* assess emergent literacy skill development. These tasks have been supported in the research to be sufficient progress monitoring measures for assessing emergent literacy skills in preschool aged students (McConnell, McEvoy & Priest, 2002).

IGDI Picture Naming

IGDI *Picture Naming*, developed by McConnell, McEvoy and colleagues through the Early Childhood Research Institute (1998b), is a measure of expressive language for children 3 to 6 years of age. During *Picture Naming* the administrator presents the student with a series of index cards. On each card is a photograph or drawing of a common object (e.g. inanimate objects such as food, vehicles, and clothing, and animate objects such as people and animals) that can be recognized in most preschool-aged children's environments. Before the task begins the administrator demonstrates an appropriate response with four cards. If the child can repeat this task the examiner moves on to the administration and asks the student to name each pictures as fast as he or she can. *Picture Naming* is presented for 1 minute and correct responses are recorded as a measure of expressive vocabulary. IGDI protocols and administration guides are available at the *Get It, Got It, Go!* website (http://ggg.umn.edu). For this investigation, each child's performance was recorded as the total number of correct responses in 1 minute.

Reliability and validity. Reliability of *Picture Naming* was obtained through alternate forms and test- retest methods. One-month alternate form reliability correlation coefficients ranged from .44 to .78 (McConnell, McEvoy & Priest, 2002) and test-retest reliability across a three week period was .67, for a sample of 29 preschool children (ECRI-MGD, 2004). Similarly, a series of studies have established robust relationships to support the validity of *Picture Naming*. McConnell and colleagues (2002) demonstrated concurrent validity with two well established norm-referenced measures of preschool language skills: the Peabody Picture Vocabulary Test (3^{rd} Edition; PPVT-III; Dunn & Dunn, 1997) and the Preschool Language Scale 3 (PLS-3; Zimmerman, Steiner & Pond, 1992) with correlation coefficients ranging from .56 to .81 (Priest, Davis, McConnell, McEvoy, & Shinn, 1999; ECRI-MGD, 1998a). Missall and McConnell (ECRI-MCD, 2004) found that *Picture Naming* appears to be sensitive to growth of expressive language skills. Correlations between age and scores revealed coefficients of .41 in a longitudinal study (n=90), .60 in a cross-sectional study of learning disabled students (n= 39), .32 in a study of children enrolled in Head Start, and .48 in a study of children with disabilities receiving services in early childhood special education classrooms (McConnell et al., 2002; ECRI-MGD 1998b).

IGDI Rhyming

Administration of *Rhyming* requests students to point to or name illustrations of items that rhyme with a target illustration. Illustrations are arranged with a target picture at the top of the card and three choice pictures across the bottom. The examiner begins the *Rhyming* task by first demonstrating the conceptual format of the task with two example cards. The examiner introduces the task by stating the prompt, “we’re going to look at some pictures and find the ones that sound the same, they rhyme” (ECRI-MGD, 2004). The administrator then points to each illustration on the card and states the names of the objects; for example, “bees, pants, gate, cheese.” The prompt then includes a direct exhibition of an appropriate response by stating, “Now I will find two that rhyme, bees, cheese—these two sound the same, they rhyme. Bees, cheese, okay, let’s do another (ECRI-MGD, 2004; McConnell et al., 2002)”. Following the presentation of the first two demonstration cards, the student is asked to complete four more examples with and without corrective feedback. If the child completes at least two of the examples correctly the examiner may begin the assessment (ECRI-MGD, 2004). During the assessment the examiner presents the cards, points to and recites the name of each illustration, and then states, “point to the one that sounds the same as _______ (stimulus word)” The examiner times the assessment for 2 minutes. Correct responses are then recorded as a measure of rhyme awareness.

Reliability and validity. Reliability of *Rhyming* is presented in terms of test-retest methods. Results revealed *Rhyming* scores to be stable over a 3 week period with correlations ranging from .83 to .89, for a sample of 49 preschool children (ECRI-MGD, 2004). Correlations between the *Rhyming* and three criterion measures have been reported with the PPVT-3 (r = .56 to .62), Concepts about Print (CAP; Clay, 1985; r = .54 to .64), and the Test of Phonological Awareness (TOPA; Torgesen & Bryant, 1994; r = .44 to 62; (McConnell et al., 2002; Missall 2004, ECRI-MGD, 2004; & Priest, Silberglitt, Hall, & Estrem, 2000). Criterion validity of IGDI *Rhyming* has been obtained through correlations with letter naming at .49 and IGDI *Picture Naming* at .54

(McConnell, Nitisou, Weisser, Good & Stadler, 2000). Similarly, construct validity of the data were supported with correlations between IGDI *Rhyming* and the remaining early literacy IGDI tasks (*Picture Naming*, *Alliteration*) that ranged from .43 to .63 (Missal, 2004).

Finally, social validity evidence has also been established for IGDI *Rhyming*. Results revealed teachers and administrators 'strongly agreed' or 'agreed' that *Rhyming* was easy to administer and a useful way to assess the phonological awareness of children in their classrooms (Phaneuf & Silberglitt, 2003).

IGDI Alliteration

Administration of *Alliteration* identically mirrors that of the *Rhyming* with the exception of the verbal prompts given to the student. To introduce the student to the procedure the administrator begins *Alliteration* by stating, "We're going to look at some pictures and find the ones that *start with the same sound*. Now I will find the two that *start with the same sound*." The administrator then continues through the demonstration cards and identifies the correct response illustrations. Following the presentation of the first two demonstration cards, the student is asked to complete four more examples with and without corrective feedback. If the child completes at least two of these examples correctly the examiner may begin the assessment (ECRI-MGD, 2004). During the assessment the examiner presents the cards, points to and recites the name of each illustration, and then states, "point to the one that *starts with the same sound as* ______(stimulus word).” The examiner times the assessment for 2 minutes. Correct responses are then recorded as a measure of phonemic awareness.

Reliability and validity. The reliability of *Alliteration* has also been established through test-retest methods. Scores appear to be stable over time. For 42 preschool-aged children, test-retest reliability over 3 weeks resulted in coefficients of .46 to .80 (ECRI-MGD, 2004). Current research also demonstrates adequate validity; correlation coefficients with other standardized measures were obtained at .40 to .57 for the PPVT-3, .75 to .79 TOPA and .34 to .55 for the CAP. *Alliteration* has also been shown to be positively correlated (r = .61) with age (ECRI-MGD, 2004). Similarly a longitudinal study of 90 preschoolers found a mean *Alliteration* score of 5.23 for typically developing children (slope = .38 *Alliteration*s per month), 4.28 for low income children (slope = .25 *Alliteration*s per month) and 4.43 for children with identified disabilities (slope = .36 *Alliteration*s per month; Priest et al., 2000). Finally, concurrent validity with DIBELS Letter Naming Fluency was obtained at correlations ranging from .39 to .71 (McConnell et al., 2002; Missal, 2004).

Test of Preschool Early Literacy (TOPEL)

The TOPEL is a relatively new assessment device used to assess preschool emergent literacy skills. The test is comprised of three subtests: Print Knowledge, Definitional Vocabulary and Phonological Awareness. The Print Knowledge subtest measures early knowledge of written language conventions and forms as well as alphabet knowledge. Questions include items about the student's ability to identify letters, written words, and identify sounds associated with letters. Additional questions request that the student points to particular parts of text (e.g. print or letters). The Definitional Vocabulary subtest measures the student's single word oral vocabulary and definitional vocabulary. Students are shown pictures and asked to report what the picture is, they are also asked to describe attributes or features of items. The Phonological Awareness subtest measure elision and blending abilities. For some of the items the student is asked to say a word and then say what is left after dropping out a specific sound (elision). For the remaining items the student is asked to listen to separate sounds and blend them together to form a word (blending). The TOPEL also includes a composite score called the Early Literacy Index, described as a combination of the three subtests. Student scores on the Early Literacy Index composite were used within this study. The TOPEL was normed on a sample group of 842 children across 12 states. Normative scores were collected in the spring, fall and winter of 2004 (Lonigan, Wagner, Torgesen & Rashotte, 2007). The TOPEL can be used for children ages 3 to 5 and takes approximately 30 minutes to administer. For this investigation, each child's performance was recorded as the Early Literacy Index score.

Reliability and validity. Reliability coefficients were obtained for internal consistency, test-retest and inter-scorer differences on the TOPEL. Internal consistency values were obtained at .96 for the index score, with each subscale ranging between .87 and .95 respectively. Test-retest reliability was computed over a period of 2 weeks. Values obtained ranged from .81 to .89 on the subscales, and were obtained at 0.91 for the index score. Further reliability coefficients were computed using inter-scorer differences. Agreement for scorers ranged between .96 and .97 for the subscales and was obtained at .98 for the index score (Lonigan et al., 2007). Overall, these scores indicate that the TOPEL demonstrates a high degree of reliability across all three types of reliability measured.

Three types of validity were used in construction of the TOPEL test, construct validity, content validity and criterion validity. Both content and construct validity were determined through analysis of existing theoretical research on emergent literacy development (Snow, Burns & Griffin, 1998). A substantial research base developed by Lonigan and Burgess (e.g. Lonigan et al., 1998) over the past decade demonstrates that the TOPEL aligns with existing research on emergent literacy and accurately uses research findings to support scale formation. Additional methods of analysis, including item analysis and differential item functioning analysis were used to support content validity. Results indicate that the scales show relatively high homogeneity of items. Differential item analysis also revealed that the TOPEL does not show any bias in score based on gender, race or ethnicity. For criterion validity the TOPEL was used in a criterion-prediction model to determine its effectives in predicting individual performance on existing reading tests. Correlations were computed for the Test of Early Reading Ability (TERA-3), Expressive One Word Picture Vocabulary Test (EOWPVT), the Comprehensive Test of Phonological Processing (CTOPP) and the Get Ready to Read!(GRTR; Lonigan et al., 2007). Results indicate that the TOPEL showed positive relationships between sub-tests and index composites with all measures. Coefficients ranged from .59 (CTOPP Elision task) to .77 (TERA-3; Lonigan et al., 2007). Overall, results indicate that the TOPEL is a valid measure of emergent literacy abilities.

Excel Graphing Program

Because not all teachers had consistent access to the internet, an Excel graphing program was created to allow teachers in the *IGDIs Alone* and *IGDIs + Consultation* groups to frequently graph student data, in lieu of the *Get it Got it Go!* online graphing program (Microsoft Office Excel, 2002). The Excel program replicated the *Get it Got it Go!* online program and offered three key features. An example of the Excel program is presented in Appendix D. First teachers were provided three (one for *Picture Naming*, one for *Rhyming* and one for *Alliteration*) graphing tables that supplied normative information including visual representations of the mean, 1 SD above the mean, 2 SD above the mean, 1 SD below the mean, and 2 SD below the mean for each measure. Second, the program was created so that teachers could enter data in specified bi-weekly cells and the graph would automatically create a connected series of data points for aduration of 12 waves (approximately 24 weeks). Third, each student's file included a goal line specific to the child's performance level, created by using the formula: $y = ((\bar{x} + (n \times .5))$ for *Picture Naming*, and $y = ((\bar{x} + (n \times .25))$ for *Rhyming* and *Alliteration*, where *y* represents the goal score, $\bar{x}$ represents the student's baseline performance, and *n* represents the week of occurrence. These equations were derived after analyses of two previous studies of rates of growth indicated *Picture Naming* improved at a mean rate of 0.11 pictures per week, *Rhyming* improved at a mean rate of 0.10 rhymes per week, and *Alliteration* improved at a mean rate of 0.24 *Alliteration*s per week (ECRI-MGD, 2004; Priest et al., 2000). Because the sample for this study represented both typically developing and special education students, an average performance ratio was computed and improved by 0.40 for *Picture Naming* and 0.20 for *Rhyming* and *Alliteration* to obtain an ambitious but reasonable goal, indicating *Picture Naming* would increase at a rate of 0.50 per week, and *Rhyming* and *Alliteration* would increase at a rate of 0.25 per week (Fuchs, 2002). Because no research studies examining student progress both at the frequency and with the intervention presented here it is hypothesized that students will be able to improve their rates of growth to a substantially higher rate than those found in current research. Additional research completed through

Get It Got It Go! at the Center for Early Education and Development (CEED) after this study's data collection had been initiated revealed data supporting rates of growth at 0.12 per week for *Picture Naming*, 0.10 per week for *Rhyming* and for .05 per week for *Alliteration*. These findings may be more robust across students as the data was representative of 40,420 students, compared to sample sizes of 39, 60 and 90 students in other studies (Roseth & Missall, 2008

Teacher Survey

A Likert-type teacher survey was administered following the intervention implementation to report any apparent changes in teacher pedagogy as assessed by teacher reports of changes in opportunities for students to respond, curriculum and instruction modifications, intervention implementation and effectiveness as a result of using the progress monitoring measure, effectiveness and implementation of the computer-based monitoring program and, if applicable, the implementation and effectiveness of the BC interview process. While many semi-structured teacher interviews and surveys were reviewed for use in this study, none were applicable across the spectrum of desired features. Therefore a survey with two versions (one for those who were in the *IGDIs Alone* treatment group [26 items], and one for those who were in the *IGDIs + Consultation* treatment group [29 items]) was created by the author in an attempt to adequately assess all the variables of interest in this study. The survey targeted seven conceptual areas representative of this study: Progress monitoring (3 questions), teaching and pedagogy (6 questions), data-based decision making and the computer based program (8 questions), consultation process (3 questions), personal information (4 questions), and overall impressions (5 questions).

Because the survey was created for this study, no reliability or validity data were available. However, every effort was made to maintain robust survey design. A copy of both surveys can be found in Appendix E.

Inter-rater Reliability

To ensure proper implementation and fidelity of assessment, data collectors obtained an initial level of inter-rater reliability of 85% before adjusting with Cohen's Kappa. Initial results revealed a kappa value of .71. During the course of the study each data collector was required to audio-record data collection procedures on a daily basis. Additionally, data collectors were randomly observed on at least three occasions during the assessment procedures (on-site) to ensure they maintained a level of at least 85% reliability. The data collector administered the IGDI and the principal investigator both timed and scored the administration simultaneous to the data collector's administration. Inter-rater reliability was then computed. Each data collector's recordings were also checked for maintenance of appropriate IGDI administration procedures. If at any time inter-rater reliability estimates fell below the rate of 85%, the data collector was required to attend an additional training until a rate of 85% was again attained. Teachers who collected data independently were also asked to maintain treatment integrity by agreeing to allow random observation of their data collection procedures on at least two occasions during the course of the study. If teachers fell below a Cohen's Kappa value of 70% reliability during the observation a booster session was scheduled to retrain the IGDI administration procedure.

Procedures

Pre and Post Assessment

Dependent measures were collected independently for all participants before and after any intervention was provided. First, the TOPEL was administered by research staff during the baseline period and during Wave 11 (after intervention was completed for both treatment groups, each wave consisted of a two week period). Second, *Picture Naming, Alliteration,* and *Rhyming* were collected independently by research staff, again during baseline and after Wave 11.

Data Collection

All data collection for students occurred in or outside of the classroom by teachers, paraprofessionals or data collectors provided by the study. Data collection of the IGDIs generally took less than 9 minutes a student including transition time and testing. If any teacher was concerned that she or he would not be able to fulfill all requirements for independent data collection required for study participation, that teacher could request that a trained data collector assist with data collection in their classroom. Teachers could make this request any time during the study. Data collectors who completed this task were trained graduate research assistants with experience in preschool settings. These data collectors only provided data on the students' performance to the teachers in the form of a score sheet and were not allowed to discuss scores or interpretation of scores in any form with the teachers or para-professionals. Data collectors used the *Get it Got it Go!* IGDI recording data sheet to record student performance, date, measure and any relevant notes and a separate weekly recording form to report scores to the teachers (see Appendix F). All student data sheets were kept in weekly files accessible to the data collectors.

Control Group

Teachers in the Control Group were not required to attend any training and were informed that trained graduate students would assess students within the classroom with the IGDIs. Neither IGDI scores nor TOPEL scores were reported to the teacher. The teacher was informed that the study staff would return in approximately 24 weeks to retest the same students. Teachers were not provided with any additional student information and were not contacted until a week before exit testing. During both pre and post-intervention testing periods, students were tested using IGDI measures and the TOPEL. Scores were not reported to the teachers; however teachers were informed that after the results of the study had been compiled they would receive information regarding their students' performance.

IGDIs Alone

Teachers in the *IGDIs Alone* treatment group were initially trained in September of 2007 on how to use IGDIs and how to collect and document data for students. Initially, teachers were trained 1 week before intervention implementation began to allow time for practice and improve treatment fidelity. Teacher data collection and analyses occurred during the academic school day when students were available in their classroom every other week. Trainings on IGDI administration were waived if an IGDI training had been administered by a trainer from the Center for Early Education and Development (CEED) within 1 month of the study start date.

All teachers were expected to obtain at least 85% reliability in the administration of the IGDI measures to begin monitoring students who were placed in the study. A booster session was planned for all teachers participating in a treatment group of the study at 6 weeks.

Individuals in the *IGDIs Alone* treatment group received training only on the IGDI progress monitoring protocols. Teachers were instructed to use the measures to progress monitor students listed on their class roster selected for the study. Teachers were asked to monitor students for 9 bi-weekly waves. Two additional waves (the initial baseline session and the conclusive last session) were collected by trained data collectors. All teachers in the *IGDIs Alone* treatment group requested data collection assistance, and therefore all data were collected by trained data collectors. Data reports were given to the teacher with each student's score immediately following data collection (Appendix F). Teachers were instructed to enter these data into the Excel graphing program. A total of 11 data points were provided to the teachers from October 2007 to April 2008.

Teachers in the *IGDIs Alone* treatment group were trained to use the EXCEL graphing program with minimal guidance. Teachers were instructed on how to download and use the basic functions of the program (e.g. entering data, examining graphs), but were not supplied with any criteria regarding educational changes.

IGDIs + Consultation

The *IGDIs + Consultation* teachers were requested to complete student monitoring with the exact same protocol and data collection process as the *IGDIs Alone* treatment group. For the *IGDIs + Consultation* treatment group 9 teachers requested assistance with data collection, while 1 teacher agreed to collect data herself.

In addition to training in data collection and graphing, teachers in *IGDIs + Consultation* received additional Excel training and consultation. Teachers placed in the *IGDIs + Consultation* treatment group were required to receive additional training on the Excel graphing program. Beyond learning how to download the Excel graphing program and how to enter data on a biweekly basis, the training described how to evaluate if a change in the goal line for each student was needed. A decision rule was put in place which stated that each student's scores should be evaluated against two criteria. First, if a student's score fell above or below the goal line on three consecutive data points, an educational change, such as modifying instruction, was made. Second, if a student's scores fell above or below the goal line on four consecutive data points a change in the goal was made to more accurately reflect an ambitious but reasonable goal (Fuchs, 2002). Changes in the goal line were completed by trained data collectors within the Excel program (see Appendix D). Teachers were informed to request assistance if a change in a goal line was needed.

Data collectors used the following formula to compute new goal lines: All collected scores were averaged. This average score was then considered the new baseline score for the new goal line. The new goal was established to begin at the most recent wave and was projected using the same formulas presented at the initiation of the study: $y = ((\bar{x} + (n \times .5))$ for *Picture Naming*, and $y = ((\bar{x} + (n \times .25))$ for *Rhyming* and *Alliteration*, where $\bar{x}$ is the new mean baseline and n is the remaining number of weeks in the study. Upon entering a second goal line the EXCEL program automatically established a second column for data entry entitled "Goal Line 2." Teachers were instructed to use this column to enter all data collected following the implementation of the new goal line.

Teachers in the *IGDIs + Consultation* treatment group also met with a consultant (for the purposes of this study the consultant was the principal investigator) during the study to discuss when scores suggested a change should be made to student instruction or intervention. However, no information on what types of intervention or instructional changes needed was suggested. Instead consultants simply assisted the teacher in determining if a change was needed. Consultation was scheduled for each teacher in the *IGDIs + Consultation* group on the ‘off’ week of data collection. Individual teachers were consulted by phone or email regarding specific consultation dates and times. Consultation sessions followed the Behavioral Consultation model and lasted approximately 25-30 minutes per teacher. A time period of 25-30 minutes was chosen because this period appeared most frequently in the research as an effective time frame for school related meetings, including consultation (Erchul & Martens, 2002).

Consultation sessions began after the third data collection session, so that teachers would have a minimum of three data points to evaluate for each student. After the first three consultation sessions, teachers in the *IGDIs + Consultation* requested to meet every other consultation session, and reported that meeting every other week did not offer enough time to evaluate discussed changes in intervention or instruction. Therefore, following the sixth data collection consultation was only offered once a month or after every two data points. At the end of the study a total of six consultation sessions were completed for each teacher. Consultation services were provided during the academic day, during a preparation hour or before or after school.

Analyses

For the purposes of this study, multiple methods of analysis were used to address the proposed research questions. To answer research questions regarding effectiveness of both *IGDIs Alone* treatment and *IGDIs + Consultation* treatment group in comparison to the Control Group, descriptive analyses, Analysis of Variance (ANOVA) comparing both slopes and scores, Hierarchical Linear Models (HLMs) and Effect Sizes were used. To answer the research question regarding the changes in pedagogy survey analyses and qualitative reports are reported.

Hierarchical Linear Modeling (HLM)

HLM is a set of statistical analyses that allows users to assess effects of differing levels of independent variables. HLM offers substantial benefits over traditional pre-test post-test models. HLM can detect individual growth as well as detect the degree to which individual differences can be reliably detected (Burchinal, Bailey & Snyder, 1994). Additionally, HLM has generally more flexible data requirements because repeated measurements are considered nested within the person, and finally HLM is flexible in accommodating missing data. From an analytical view point, HLM offers additional benefits. First, it is not necessary to assume that repeated observations of the same individual are independent. Second HLM allows time-varying covariates to be included as predictors. Finally, case-wise deletion is not performed with incomplete or inconsistently timed data (Burchinal et al. 1994).

A specific type of Hierarchical Linear Modeling (Bryk & Raudenbush, 1987) was used to examine emergent literacy performance on the IGDIs across the 12 waves of data collection over the course of the academic year. Hierarchical Multivariate Linear

Modeling (HMLM), a multilevel model, using longitudinal data was chosen for this study because the model can explain the individual change of each student's performance as a function of time, intervention and disability status. Individual change can be represented through a 2-level hierarchical model. At level-1, each student's performance is represented by an individual growth trajectory that depends on a unique set of parameters. These individual growth parameters become the outcome variables in a level-2 model. In other words, the multiple observations on each student are nested within the level-2 predictor (e.g. time; Raudenbush & Bryk, 2002). One important benefit of using HMLM is that it allows examination of multiple observations as nested variables and allows the investigator to proceed without difficulty when the number of waves varies across cases (Raudenbush & Bryk, 2002).

Important to this study was the expectation that individual performance changed over time; thus, a central focus of this study was modeling change with time as an independent variable. Given the repeated measures nature of the data, there were likely to be heterogeneous errors across time as well as correlated errors between times. Thus, standard regression procedures were inadequate and inappropriate for these data. For these reasons, multilevel growth modeling offered a preferred approach. Because of non-balanced and missing data the particular growth modeling technique selected was HMLM. HMLM allows for the estimation of more complex Level-1 error structures than does traditional HLM.

HMLM uses level-1 models to examine within-child variables and level-2 models to measure between-child variables. In the current study, the level-1 model represents each individual's growth trajectory in IGDI scores as a function of the person-specific parameters plus random error. The level-2 model describes the variation in observed growth and student scores for children as a function of time (wave).

Preliminary procedures. To initially examine data, a model fitting procedure was completed to determine if variability was present both within and across students. Singer and Willet (2003) suggest first fitting the model with the unconditional means model (UMM) followed by an unconditional growth model (UGM). The UMM model first fits the data without regard to time. UMM results reveal if the there is systematic variation in the model that may be better described by the addition of predictors (Singer & Willet, 2003).

The UMM was first fit using the equations:

Level 1 Model

$$Y_{ij} = \pi_{0i} + \varepsilon_{ij}$$

Level 2 Model

$$\pi_{0i} = \gamma_{00} + \zeta_{0i}$$

Where, for the level-1 sub-model: Y_{ij} is the outcome for individual *i* on *j* occasion; π_{0j} is the person-specific mean, or stated another way, the mean initial status for individual *i*;

and ε_{ij} is the error for individual *i* on occasion *j*. For the level-2 sub-model: π_{0i} was the true mean initial status for individual *i*; γ_{00} was the average intercept across all individuals on all occasions; and ζ_{0i} was the true error for individual *i*.

The UMM does not include predictors, instead it simply determines if the performance variable for individuals (in this case the IGDIs) is significantly different from a specified elevation, π_{0i}, and partitions any variance present at that level into two levels, within-person and between-person. Stated another way, the UMM assumes that each individual has a flat rate of growth, sitting at an elevation π_{0i}. The level-2 model stipulates that while individuals may differ in elevation, their average elevation across the entire population is γ_{00}. Therefore, a null hypothesis of the UMM states that individuals may vary in elevation but the average initial status of all individuals is γ_{00}. Thus, rejecting the null hypothesis suggests that average students' scores show some variability in both growth a Level 1 and across individuals at Level 2(Singer & Willet, 2003).

Following the fitting of the UMM, and UGM was then applied. The UGM introduces the predictor of time using the equations:

Level 1 Model

$$Y_{ij} = \pi_{0i} + \pi_{1i} TIME_{ij} + \varepsilon_{ij}$$

Level 2 Model

$$\pi_{0i} = \gamma_{00} + \zeta_{0i}$$

$$\pi_{1i} = \gamma_{10} + \zeta_{1i}$$

Where, for level-1 TIME was the assessment cycle (waves 0-11); Y_{ij} was the outcome for individual, *i*, on occasion, *j*; π_{0i} was individual *i's* true intercept at baseline (when TIME= 0); π_{1i}(TIME) was individual *i's* true rate of growth in the outcome; ε_{ij} was the scatter, or residual variance, of each individual's outcome around his or her change trajectory. For level-2: π_{0i} was individual *i's* true intercept at baseline (when TIME = 0); Υ_{00} was the average true initial status for all individuals (when TIME= 0); ζ_{0i} was between person variability in true initial status across all individuals; π_{1i} was individual *i's* true rate of growth in the outcome; Υ_{10} was the average true rate of growth for all individuals; and ζ_{1i} was the between person variability in true rate of change across all individuals. For the UGM the level-2 sub-model that depicts inter-individual variation in rates of change, where π_{1i} represents inter-individual variation as the sum of an intercept (γ_{00} or γ_{10}) and level-2 residual (ζ_{0i} or ζ_{1i}). For the UGM the level-1 residual variance summarizes the scatter of each individual's data around his or her own linear change trajectory (rather than his or her mean as specified in the UMM).

The UGM was used to determine if differences between individual scores on the IGDIs were due to differences between children or if they may be attributed to growth over time. Further, results of the UGM allowed analyses to suggest what accounts for differences in individual growth rates, initial status, or slope. Finally, the UGM also provides a baseline to determine if additional predictors are valuable in a model by providing the amount of variance accounted for.

UGM output offers valuable information regarding fixed effects and variance components to best fit an HMLM model. The fixed effects, Υ_{00}, which represents the average true initial status for all individuals at wave 0, and Υ_{10}, representing the average true rate of growth for all individuals were initially tested to determine whether they were significantly different from zero. Therefore null hypotheses of the UGM state that individuals may vary in both elevation and rate of change. By rejecting null hypotheses for each effect (intercept and slope) we can determine that the IGDI scores have variable intercepts across subjects and non-zero slopes. Then, variance components were examined to assist in determining the origin of variation as well as in comparison to the UMM. Thus, if the within-person variation had significantly decreased from the UMM, the addition of TIME in the model provides important and valuable predictive power. Singer and Willet (2003) report that slope is often used to represent growth and can be interpreted as a relative treatment effect. Therefore for the purposes of this study slope will be examined to determine treatment effect. To determine if the *IGDIs Alone* and the *IGDIs + Consultation* treatment groups had an effect I used the model:

Level-1 Model

$$Y_{ti} = \pi_{0i} + \pi_{1i}\text{ (WAVE)} + e_{ti}$$

Level-2 Model

$$\pi_{0i} = \beta_{00} + r_{0i}$$

$$\pi_{1i} = \beta_{10} + r_{1i}$$

This model provides information to determine if students improved over time (within-person), and whether individual student's scores showed variance over time (between-person).

At level 1, a model for each student was created using the 12 waves of IGDI data collected. This model was used to predict individual student's IGDI scores at a specified status. Therefore, level 1 represents an individual's data at different waves. Dependent variable (Y_{ti}) is individual *i*'s IGDI score at the observed status time *t*. Y_{ti} is a function of a systematic growth trajectory plus random error (e_{ti}). The measure of time (WAVE) is a predictor variable in this model. At level 2, each student's observed scores across time are nested in each person. The intercept, π_{0i} is the expected outcome when WAVE= 0. π_{0i} is defined as a predicted value of *Y* at the beginning status of student's IGDI scores (baseline).

HMLM results presentation. An HMLM analysis was completed to supplement Research Questions 1 through 4. Separate multivariate (HMLM) analyses were completed by each treatment group (*IGDIs Alone* and *IGDIs + Consultation*) for each IGDI measure (*Picture Naming, Rhyming* and *Alliteration*) considering disability status (typically developing and special education) using time (wave) as the predictor (a UGM). This analysis was used to determine slope and intercept for each treatment group. Therefore the HMLM analyses will results in 18 sets of results, where Research Questions 1 and 3 are represented by the six sets of results including all students within the two treatment groups (Question 1 representing three sets of results from *IGDIs Alone* treatment group and Question 3 representing three sets of results from the *IGDIs + Consultation* treatment group) and Research Questions 2 and 4 are represented by six sets of results with special education students and six set of results with typically developing students. See Appendix G for a summary of intended results.

HMLM results are presented for each measure and treatment group in three ways and are listed here for parsimony in the presentation of the results section.

First statistics are presented to determine model fit by testing the UMM and UGM. For each measure, three sets of HMLM result are reported based on the conditions of covariance matrix Δ; unrestricted (UMM) ($\tau_{00} = \tau_{11} = \tau_{01} = 0$), variance homogeneous (UGM) ($\sigma_t^2 = \sigma^2$), and variance heterogeneous ($\sigma_t^2 \neq \sigma^2$). Where the deviance computed represents a measure of variance accounted for within the model. If the variance accounted is a statistically significant addition to the UGM model (using a Chi Square test between models) the null hypothesis was rejected and a model was chosen. A statistically significant difference in models indicates the selected model is a more appropriate fit than the other available models considering parsimony and fit.

Second, HMLM Random effects models were computed to illustrate growth analyses of slope and intercept. Results are presented in terms of intercept, or baseline entry (β_{00}), significance of the baseline score and rate of growth/slope (β_{10}) and significance of the rate of growth or slope. Significant baseline entry scores suggest individual initial scores were significantly different from each other at entry; or stated another way, individual initial baseline score varied significantly at $p<.05$. Rate of growth/slope results suggest on average, student scores increased linearly a given rate of measurement units per wave (2 week period). A significant slope can be interpreted to mean students improved in average growth on a given measure across time.

Third, deviance comparisons of two heterogeneous variance models were completed to determine if there were inter-individual differences in growth (via linear slope (β_{10})) for occasion. In Model 1, the slope variance is constrained to zero (with given deviance and degrees of freedom), and in Model 2, the slope variance is unequal (with given deviance and degrees of freedom). The difference of deviance ($D_2 - D_1$) was tested for significance using a Chi-Square analysis at $\alpha = .05$. Significant deviance comparisons were interpreted as the linear slopes for occasion were statistically unequal (slopes varied) between students. Thus, individual student scores on a give measure improved across students.

CHAPTER FOUR

Results

Preliminary Analyses

To examine normality of data, growth and dispersion, initial descriptive statistics were calculated for the total sample across time by averaging values (both pre and post assessments). A summary of basic descriptives for the IGDI measures and the TOPEL is presented in Table 2. For further analysis, including basic descriptives by treatment group and wave, including mean, SD, minimums and maximums regarding the IGDIs and raw scores for the TOPEL see Tables 42-46 in Appendix H.

To further examine the data, a binomial Chi Square test was completed to ensure students were not disproportionately placed in treatment groups based on financial aid. Results indicated students were not disproportionately placed in treatment groups with 76 students receiving free and reduced-prices lunches and 77 not receiving free and reduced-price lunches (n = 153). The relation between these variables was not significant, X^2 = .007, p =.94 (2, N = 153).

Additionally, tests of normality were completed on the IGDI measures both as a function of treatment group and as a function of disability status. *Picture Naming* scores were distributed normally regardless of treatment group or disability status; however distributions for both *Rhyming* and *Alliteration* were non-normal in all groups ($p<.05$). *Rhyming* and *Alliteration* were significantly negatively skewed for all groups.

Table 2.

Summary of Descriptive by Treatment Group and Measure

Measure By Treatment Group	Min.	Max.	Mean	SD
Picture Naming				
Control	0.00	29.00	14.00	7.58
IGDIs Alone	6.33	36.08	22.07	6.66
IGDIs + Consultation	0.67	37.21	21.62	7.15
Rhyming				
Control	0.00	16.00	1.19	2.94
IGDIs Alone	0.00	23.08	5.31	6.62
IGDIs + Consultation	0.00	21.75	4.39	6.02
Alliteration				
Control	0.00	4.50	0.44	1.04
IGDIs Alone	0.00	15.17	2.44	3.76
IGDIs + Consultation	0.00	16.96	2.29	4.08
TOPEL- Early Literacy Index				
Control	47.50	107.50	75.92	17.17
IGDIs Alone	51.00	119.50	84.57	18.04
IGDIs + Consultation	46.50	119.50	82.93	17.76

Additionally, *Rhyming* and *Alliteration* were also significantly leptokurtic for all groups. Skew and kurtosis statistics were evaluated before analyses were completed. Previous research using the IGDIs, combined with the robust nature of HMLM analyses suggested further analyses could be completed without compromising results; therefore no further adjustments were made. For further exploration of normality see test of normality output in Appendix I.

Table 3.

Tukey's Post-Hoc Analysis of TOPEL Time 2 Index Scores

Treatment Comparisons		Mean Differences	Standard Error	Sig.
IGDIs + Consultation	Control	10.32*	3.66	.02
	IGDIs Alone	-0.04	3.37	1.0
Control	*IGDIs + Consultation*	-10.32*	3.66	.02
	IGDIs Alone	-10.35*	3.77	.02
IGDIs Alone	*IGDIs + Consultation*	0.04	3.37	1.0
	Control	10.35*	3.77	.02

* The mean difference is significant at a $p<.05$ level

To determine if differences in performance on the TOPEL were accounted for by treatment groups an ANOVA and Tukey's post-hoc analysis was completed for Wave 11 TOPEL *Index* scores. Results revealed student performance on the TOPEL varied significantly across groups (F = 4.879, p=.009*).* Table 3, a Tukey's post-hoc analysis, illustrates specific treatment group comparisons. Results indicate statistically significant comparisons included Control vs. *IGDIs + Consultation,* and Control vs. *IGDIs Alone*. Results were also analyzed using ANOVA and Tukey's post-hoc analyses for each subtest, however results were parallel to those represented by the *Index* scores and therefore are not reported here.

Results indicated significant differences could be detected between treatments. An omnibus ANOVA resulted in the identification of significant differences between groups for each measure (see Table 4). Table 5 displays a Tukey's post-hoc comparison that was used to further examine the effects present in the omnibus ANOVA. For Research Questions 1 and 3, relevant portions of Table 5 will be specifically addressed.

Finally, to determine if significant changes in growth occurred over the course of the study slopes were compared for IGDIs using pre and post scores in an ANOVA model with Tukey's post-hoc analyses. ANOVA results indicated all measures demonstrated growth over the course of the study at p <.05. Tukey's post-hoc analyses of these differences are presented in Table 5.

Table 4.

Omnibus Analysis of Variance of Slopes by Treatment Group

		Sum of Squares	df	Mean Square	f	Sig.
Picture Naming						
	Between Groups	4.03	2	2.02	6.60	.00*
	Within Groups	38.49	126	0.31		
	Total	42.51	128			
Rhyming						
	Between Groups	4.63	2	2.32	7.22	.00*
	Within Groups	40.45	126	0.32		
	Total	45.08	128			
Alliteration						
	Between Groups	0.92	2	0.46	3.25	.04*
	Within Groups	17.80	126	0.14		
	Total	18.72	128			

*p<.017

Table 5.

Tukey's Post-hoc Comparisons of Slope by Treatment Group by Measure

Measure	Treatment Group	Comparison	Mean Difference	Standard Error	Sig.
Picture Naming	*IGDIs + Consultation*	Control	0.37	0.12	.00*
		IGDIs Alone	-0.05	0.11	0.89
	Control	*IGDIs + Consultation*	-0.37	0.12	0.00*
		IGDIs Alone	-0.42	0.12	0.00*
Rhyming	*IGDIs + Consultation*	Control	0.36	0.12	0.01*
		IGDIs Alone	-0.10	0.13	0.65
	Control	*IGDIs + Consultation*	-0.36	0.12	0.01*
		IGDIs Alone	-0.47	0.13	0.00*
Alliteration	*IGDIs + Consultation*	Control	0.16	0.08	0.04*
		IGDIs Alone	-0.05	0.08	0.83
	Control	*IGDIs + Consultation*	-0.16	0.08	0.04*
		IGDIs Alone	-0.21	0.08	0.04*

*p <.05

Research Question 1

To answer the first research question, "To what extent does the administration of the IGDIs as progress monitoring tools alone (*IGDIs Alone)* have an effect on students achievement?" multiple analyses were completed. As suggested in the initial descriptive findings, ANOVA results indicated the IGDI measures differed significantly from the Control Group. To further examine the strength and direction of these effects, both HMLM growth curve and effect size analyses were completed.

Picture Naming

ANOVA. Tukey's Post Hoc analysis results indicate *IGDIs Alone, Picture Naming* demonstrated significantly different scores than the Control Group (mean difference 0.42, α=.00) as presented in Table 5.

Table 6.

IGDIs Alone Summary of HMLM Model Fit (*Picture Naming*)

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	1193.42
Homogenous sigma squared (UGM)	4	1343.35*
Heterogeneous sigma squared	15	1314.43

*p < 0.00

HMLM. Table 6 presents the model fit results of variance comparisons of UMM and UGM models for *Picture Naming.* Results indicate the homogeneous level 1 variance (Model 2) is best give parsimony and fit. Table 7 presents Model 2 growth analyses.

Table 7.

IGDIs Alone Summary of Random Effects Model (HMLM)

with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	Df	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	15.30	1.12	13.70	18	0.00*
For occasion slope, π_{1i} Intercept 2, β_{10}	1.17	0.08	13.86	226	0.00*

*p<.05

For deviance comparisons the Model 1 slope variance (deviance = 1343.35, *df* = 4) compared to the Model 2 slope variance (deviance = 1337.77, *df* = 6) resulted in significant difference of deviance (D_2 - D_1 = 5.58, *df* = 2; α =.05). Individual student *Picture Naming* scores improved during the course of intervention both within (as determined by intercept and slope) and across students (as determined by deviance comparisons).

Taken together, *IGDIs Alone* students' scores on *Picture Naming* were significantly larger than student scores on Control Group, *Picture Naming.* Therefore, offering teachers student progress monitoring data did have an effect on student achievement for *Picture Naming.*

Rhyming

ANOVA. Tukey's Post Hoc analysis results indicate *IGDIs Alone, Rhyming* demonstrated significantly different scores than the Control Group (mean difference 0.47, α=.00) as presented in Table 5.

HMLM. Table 8 presents the model fit results of variance comparisons of UMM and UGM models for *Rhyming.* Results indicate the homogeneous level 1 variance (Model 2) is best given parsimony and fit. Table 9 presents Model 2 growth analyses.

Table 8.

IGDIs Alone Summary of HMLM Model Fit (*Rhyming*)

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	2214.20
Homogenous sigma squared (UGM)	4	2629.75**
Heterogeneous sigma squared	15	2548.64

**p < 0.00

For deviance comparisons the Model 1 slope variance (deviance = 2629.75, *df* = 4) compared to the Model 2 slope variance (deviance = 2395.69, *df* = 6) resulted in a significant difference of deviance ($D_2 - D_1 = 234.06$, *df* = 2; α =.05). Individual student *Rhyming* scores improved during the course of intervention both within and across students.

Table 9.

IGDIs Alone Summary of Random Effects Model (HMLM)

with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	2.41	0.94	2.56	45	0.01*
For occasion slope, π_{1i} Intercept 2, β_{10}	0.52	0.04	12.20	471	0.00*

*p<.05

Taken together, *IGDIs Alone* students' scores on *Rhyming* were significantly larger than student scores on Control Group, *Rhyming.* Therefore, offering teachers student progress monitoring data did have an effect on student achievement for *Rhyming*.

Alliteration

ANOVA. Tukey's Post Hoc analysis results indicate student scores on *IGDIs Alone*, *Alliteration* were significantly different from student scores on Control Group (mean difference 0.21, α=.04) as presented in Table 5.

HMLM. Table 10 presents the model fit results of variance comparisons of UMM and UGM models for *Alliteration.* Results indicate the homogeneous level 1 variance (Model 2) is best given parsimony and fit. Table 11 presents Model 2 growth analyses.

Table 10.

IGDIs Alone Summary of HMLM Model Fit (*Alliteration*)

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	2140.10
Homogenous sigma squared (UGM)	4	2468.16**
Heterogeneous sigma squared	15	2391.04

**$p < 0.00$

For deviance comparisons the Model 1 slope variance (deviance = 2468.16, df = 4) compared to the Model 2 slope variance (deviance = 2320.10, df = 6) resulted in a significant difference of deviance (D_2 - D_1 = 148.06, df = 2; α =.05). Results indicated linear slope for occasion varies both within and across students for *Alliteration*.

Table 11.

IGDIs Alone Summary of Random Effects Model (HMLM)

with Homogeneous Level-1 Variance for *Alliteration*

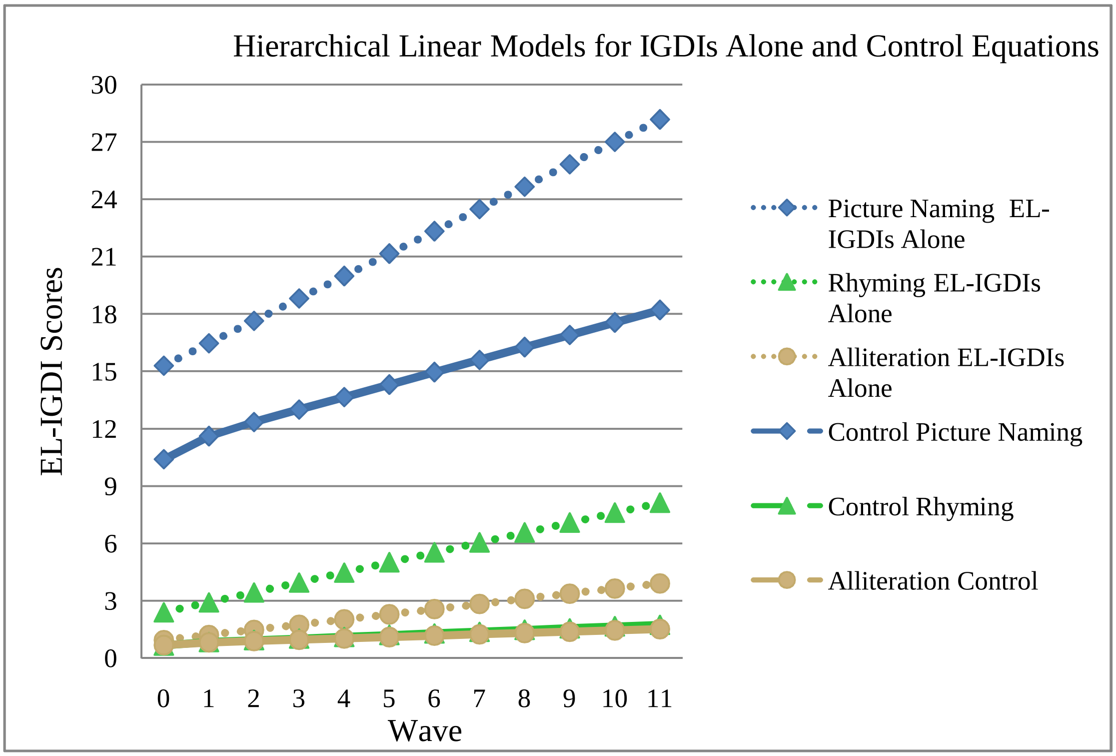
Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	0.94	0.49	1.94	45	0.05*
For occasion slope, π_{1i} Intercept 2, β_{10}	0.27	0.04	7.59	483	0.00*

*p<.05

Taken together, *IGDIs Alone* students' scores on *Alliteration* were significantly larger than student scores on Control Group, *Alliteration.* Therefore, offering teachers student progress monitoring data did have an effect on student achievement for *Alliteration.*

Figure 1.

HMLM Linear Models for IGDIs Alone and Control by Measure



HMLM results for *IGDIs Alone* compared to the Control Group are illustrated in Figure 1. Raw scores used to calculate HMLM analyses were also graphed, this figure can be found in Appendix J.

Effect Sizes

To supplement the analyses provided, effect sizes were computed using Cohen's *d* (1988). Absolute effect sizes were first computed for each IGDI measure between the end of treatment performance (Wave 11) and baseline performance (Wave 0). The Control

Group effect size, representative of growth which occurred as a result of non-intervention related methods and experience, was then subtracted from *IGDIs Alone* effect size to describe relative effects produced by the treatment intervention.

Table 12.

Effect Sizes for Progress Monitoring Measures by Treatment Group

Treatment Group by Measure	Effect Sizes	
	Absolute Effect Size	Relative Effect Size
Picture Naming		
IGDIs Alone	4.84	2.22
Control	2.62	--
Rhyming		
IGDIs Alone	2.57	1.70
Control	0.87	--
Alliteration		
IGDIs Alone	1.46	0.92
Control	.54	--

Note: All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

Because of the longitudinal nature of this study relative effect sizes were used to account for maturational effects attributable to aging and the preschool environment. Results are presented in Table 12. According to Cohen's definitions of effect sizes, all *IGDIs Alone* relative effects were considered large.

Research Question 2

To answer the second research question, "To what extent does disability status moderate treatment effects of the comparison of Control and *IGDI Alone*?" multiple analyses were completed including HMLM, ANOVA and effect sizes. The ANOVA findings from Research Question 1, which indicated student scores in the *IGDIs Alone* treatment groups differed significantly from the Control Group, were further examined using HMLM to consider the strength of effects within specific subgroups. Results are presented by disability status, typically developing students first, followed by students with disabilities. Sample sizes for the *IGDIs Alone* treatment group by disability are n=22 for typically developing, n=29 special education.

Picture Naming, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs Alone* treatment group vs. Control for *Picture Naming,* typically developing, followed by relevant Tukey's post-hoc analyses. Results are presented in Tables 13 and 15.

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 574.70, p <.05). Table 14 presents Model 2 growth analyses.

Table 13.

ANOVA of Individual Slopes for each IGDI Measure

Measure of Slope		Sum of Squares	df	Mean Square	f	Sig.
Picture Naming	Between	5.43	5	1.09	3.60	.04
	Within	37.08	123	0.30		
	Total	42.51	128			
Rhyming	Between	12.72	5	2.55	9.67	.00*
	Within	32.36	123	0.56		
	Total	45.08	128			
Alliteration	Between	3.48	5	0.70	5.62	.00*
	Within	15.24	123	0.12		
	Total	18.72	128			

*$p<.017$

For deviance comparisons the Model 1 slope variance (deviance = 574.70, *df* = 4) compared to the Model 2 slope variance (deviance = 574.55, *df* = 6) resulted in a non-significant difference of deviance ($D_2 - D_1 = .15$, *df* = 2). Therefore, linear slopes are not statistically different between students, or stated another way linear slopes are statistically equal between students. Thus, typically developing students in the *IGDIs Alone* treatment group achieved scores that improved during the course of intervention within students, but not between students on the *Picture Naming* measure.

Table 14.

IGDIs Alone, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	17.82	1.27	14.01	7	0.00*
For occasion slope, π_{1i} Intercept 2, β_{10}	1.17	0.13	8.79	94	0.00*

*p<.05

Picture Naming, Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs Alone* treatment group for *Picture Naming,* special education, followed by relevant Tukey's post-hoc analyses. Results are presented in Tables 13 and 15.

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 759.25, p <.05). Table 16 presents Model 2 growth analyses.

Table 15.

Post-Hoc Tukey's Analysis of *Picture Naming* for *IGDIs Alone* by Disability Status

IGDIs Alone by Disability Status (a)	Treatment Group by Disability Status (b)	Mean Difference (a-b)	SE	Sig.
IGDIs Alone Typically Developing	Control Typically Developing	0.41	0.19	0.05*
	Control Special Education	0.59	0.17	0.01*
	IGDIs Alone Special Education	-0.01	0.16	1.00
IGDIs + Alone Special Education	Control Typically Developing	0.42	0.18	0.05*
	Control Special Education	0.60	0.16	0.01*

**p*<.05

Table 16.

IGDIs Alone, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	13.46	1.46	9.18	10	0.00*
For occasion slope, π_{1i} Intercept 2, β_{10}	1.18	0.09	12.24	130	0.00*

*p<.05

For deviance comparisons the Model 1 slope variance (deviance = 759.25, *df* = 4) compared to the Model 2 slope variance (deviance = 750.68, *df* = 6, α =.05) resulted in a significant difference of deviance (D_2 - D_1 = .15, *df* = 2). Therefore, for special education students in the *IGDIs Alone* treatment group, *Picture Naming* scores improved during the course of intervention both within and across students.

In summary, *IGDI Alone* typically developing students' scores on *Picture Naming* were significantly larger than student scores in both the typically developing and special education Control Group. Similarly, *IGDIs Alone* special education students' scores on *Picture Naming* were significantly larger than student scores in both the typically developing and special education Control Group.

Rhyming, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs Alone* treatment group for typically developing students given *Rhyming* followed by Tukey's post-hoc analyses. Results are presented in Tables 13 and 17.

Table 17.

Post-Hoc Tukey's Analysis of *Rhyming*, *IGDIs Alone* by Disability Status

IGDIs Alone by Disability Status (a)	Treatment Group by Disability Status (b)	Mean Difference (a-b)	SE	Sig.
IGDIs Alone Typically Developing	Control Typically Developing	0.27	0.18	0.25
	Control Special Education	0.91	0.16	0.00*
	IGDIs Alone Special Education	0.75	0.15	0.00*
IGDIs Alone Special Education	Control Typically Developing	0.01	0.17	0.99
	Control Special Education	0.08	0.15	0.91

*p<.05

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 330.80, p <.05). Table 18 presents Model 2 growth analyses. For this model, the intercept was not significant, indicating students' scores did not vary significantly at baseline. For deviance comparisons, Model 1 slope variance (deviance = 330.80, df = 4) compared to Model 2 slope variance (deviance = 310.62, df = 6) resulted in a significant difference of deviance (D_2 - D_1 = 20.18, df = 2, α =.05).

Table 18.

IGDIs Alone, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	4.37	3.24	1.35	4	0.25
For occasion slope, π_{1i}					
Intercept 2, β_{10}	0.43	0.12	3.64	58	0.00*

*p<.05

Therefore, for students in the *IGDIs Alone* treatment group, *Rhyming* scores improved during the course of intervention between students; however students did not vary significantly within performance at baseline, but did indicate significantly improved performance over time.

Rhyming Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs Alone* treatment group. Tables 13 and 17 (Tukey's post-hoc analyses) illustrate differences in special education students' scores on *Rhyming* by treatment group.

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 442.08 p <.05). Table 19 presents Model 2 growth analyses. The intercept was not significant, indicating students' scores were statistically equal at baseline (Wave 0).

Table 19.

IGDIs Alone, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	0.64	0.50	1.30	8	0.23
For occasion slope, π_{1i} Intercept 2, β_{10}	0.15	0.04	3.20	106	0.00*

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 442.07*, df* = 4) compared to Model 2 slope (deviance = 433.07, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 9.00, *df* = 2, α =.05).

Therefore, for special education students in the *IGDIs Alone* treatment group, *Rhyming* scores improved during the course of intervention between students, however scores were statistically equal within students at baseline. Additionally, slopes indicated average growth across the intervention was significant.

In summary, *IGDIs Alone* typically developing student scores on *Rhyming* were not significantly larger than student scores in the typically developing Control Group, but were significantly larger than student scores in the special education Control Group. Similarly, *IGDIs Alone* typically developing student scores on *Rhyming* were significantly different from special education student *Rhyming* scores. *IGDIs Alone* special education student scores on *Rhyming* were not significantly larger than student scores on neither the typically developing nor special education Control Group.

Alliteration, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for *IGDIs Alone* typically developing students given *Alliteration* followed by Tukey's post-hoc analyses. Differences in typically developing student scores are presented in Tables 13 and 20 using Tukey's post-hoc methods.

Table 20.

Post-Hoc Tukey's Analysis of *Alliteration*, *IGDIs Alone* by Disability Status

IGDIs Alone by Disability Status (a)	Treatment Group by Disability Status (b)	Mean Difference (a-b)	SE	Sig.
IGDIs Alone Typically Developing	Control Typically Developing	0.40	0.12	0.01*
	Control Special Education	0.47	0.11	0.00**
	IGDIs Alone Special Education	0.43	0.10	0.00**
IGDIs Alone Special Education	Control Typically Developing	0.03	0.12	1.00
	Control Special Education	0.10	0.10	0.69

*p<.05

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 529.03, p = .01). Table 21 presents Model 2 growth analyses. For this model, the intercept was not significant, indicating students' scores did not vary significantly at baseline.

Table 21.

IGDIs Alone, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Alliteration*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	0.94	1.20	0.78	7	0.46
For occasion slope, π_{1i} Intercept 2, β_{10}	0.42	0.10	4.15	94	0.00*

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 529.03, *df* = 4) compared to Model 2 slope variance (deviance = 500.02, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 29.01, *df* = 2, α =.05). Therefore, for typically developing students in the *IGDIs Alone* treatment group, *Alliteration* scores improved during the course of intervention between students and within students as a result of slope, however students obtained statistically equal scores at baseline.

Alliteration, Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for *IGDIs Alone*, *Alliteration*. Results were further explored for special education student scores using Tukey's post-hoc analyses. Results are presented in Tables 13 and 20.

HMLM. Model fitting comparisons indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 605.44, p = .00). Table 22 presents Model 2 growth analyses.

Table 22.

IGDIs Alone, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Alliteration*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	0.87	0.60	1.46	10	0.18
For occasion slope, π_{1i} Intercept 2, β_{10}	0.12	0.06	2.13	130	0.03*

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 605.44, *df* = 4) compared to Model 2 slope variance (deviance = 584.54, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 20.90, *df* = 2, α =.05). Therefore, for special education students in the *IGDIs Alone* treatment group, *Alliteration* scores improved during the course of intervention between students and as a result of slope, however student performance did not vary significantly within baseline scores.

In summary, *IGDIs Alone* typically developing student scores on *Alliteration* were significantly larger than student scores in both the typically developing and special education Control Group. Similarly, *IGDIs Alone* typically developing student scores on *Alliteration* were significantly larger than *IGDIs Alone* special education student scores on *Alliteration.* However, *IGDIs Alone* special education student scores on *Alliteration* were not significantly larger than student scores in both the typically developing and special education Control Group.

Effect Size

Effect sizes were also computed by disability status for each treatment group. Absolute effect sizes were first computed for each IGDI measure between the end of treatment performance (Wave 11) and baseline performance (Wave 0).

The Control Group effect size, representative of growth which occurred as a result of non-intervention related methods and experience, was then subtracted from each treatment group's effect size to describe relative effects produced by the treatment intervention. Results are presented in Table 23.

According to Cohen's interpretation values, relative effects sizes for *Picture Naming* were large, for *Rhyming*, relative effects were large in typically developing students and medium in special education students. For *Alliteration*, relative effects were large for typically developing students and small for special education students.

Table 23.

Effect Sizes for *IGDIs Alone* by Measure and Disability Status

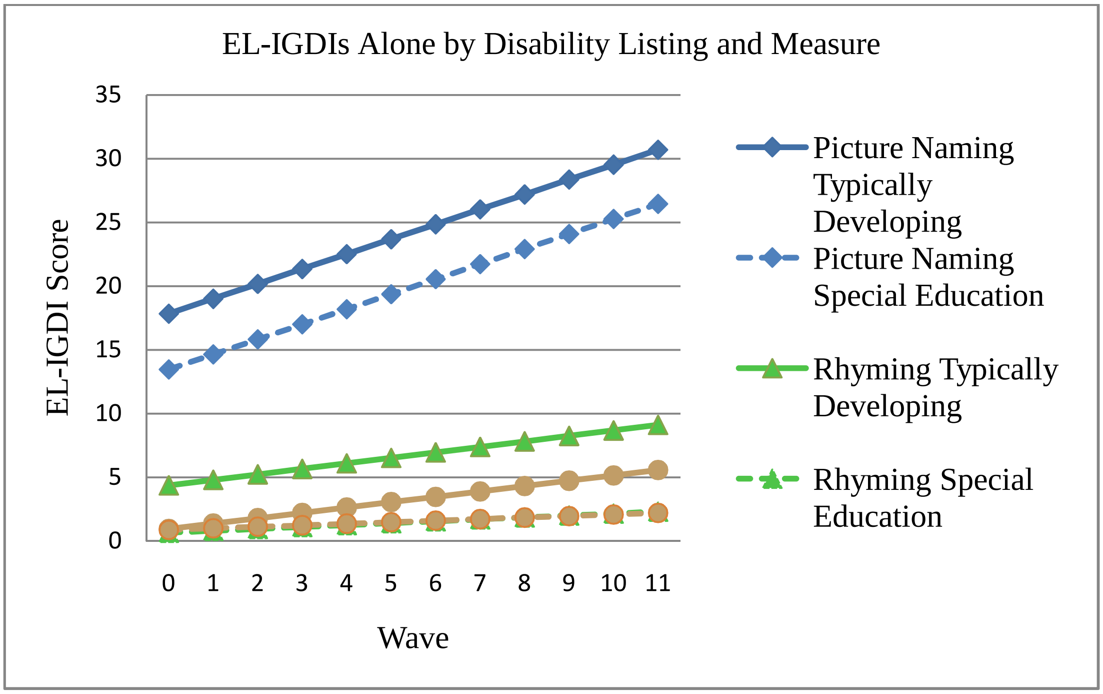
Treatment Group	Disability Status	Effect Sizes	
		Absolute Effect Size	Relative Effect Size
Picture Naming			
IGDIs Alone	Typically Developing	6.00	2.90
	Special Education	4.43	1.50
Control	Typically Developing	3.10	--
	Special Education	2.93	--
Rhyming			
IGDIs Alone	Typically Developing	4.26	2.23
	Special Education	1.18	0.58
Control	Typically Developing	2.03	--
	Special Education	0.60	--
Alliteration			
IGDIs Alone	Typically Developing	2.61	1.67
	Special Education	0.43	0.17
Control	Typically Developing	0.94	--
	Special Education	0.26	--

Note: All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

A graphical representation of HMLM results presented in Tables 14-22 is presented in Figure 2; raw scores are presented in graph format in Appendix J.

Figure 2.

IGDIs Alone Treatment Group by Disability Status, Measure and Wave



Research Question 3

To answer the third research question, "To what extent does the administration of the IGDI measures as progress monitoring tools with additional consultation practices (*IGDIs + Consultation)* have an effect on student achievement?," multiple analyses were completed. To specifically answer this research question I contrasted *IGDIs + Consultation* vs. *IGDIs Alone* as well as *IGDIs + Consultation* vs. Control Group. As suggested in the initial descriptive findings, results indicate *IGDIs + Consultation* differed significantly from the Control Group, but not from *IGDIs Alone*. ANOVA analyses were completed to test this hypothesis and to further examine the strength and direction of these effects, both HMLM growth curve and effect size analyses were completed.

Picture Naming

ANOVA. Tukey's Post Hoc analysis results indicate *IGDIs + Consultation, Picture Naming* demonstrated significantly different scores than the Control Group (mean difference 0.37, α=.00), but not from *IGDIs Alone* (-0.05, α=.89) as presented in Table 5.

Table 24.

IGDIs + Consultation Summary of HMLM Model Fit (*Picture Naming*)

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	1032.34
Homogenous sigma squared (UGM)	4	1178.01**
Heterogeneous sigma squared	15	1161.14

$^{**}p<.00$

HMLM. Based on the model fit result (Table 24), homogeneous level 1 variance (Model 2) is best give parsimony and fit. Table 25 presents Model 2 growth analyses.

For deviance comparisons, Model 1 slope variance (deviance = 1178.01, *df* = 4) compared to Model 2 slope variance (deviance =1160.27, *df* = 6) resulted in a significant difference of deviance ($D_2 - D_1 = 17.74$, *df* = 2, α =.05). Therefore, individual student *Picture Naming* scores improved during the course of intervention both within and across students.

Taken together, *IGDIs + Consultation* students' scores on *Picture Naming* were significantly larger than student scores on Control Group, *Picture Naming.* However, *IGDIs + Consultation*, *Picture Naming* were not significantly larger than students scores on *IGDIs Alone*, *Picture Naming.* Therefore, for *Picture Naming,* providing teachers with consultative services did not have an effect on student achievement above and beyond that of the *IGDIs Alone*.

Table 25.

IGDIs + Consultation Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	Df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	16.82	1.44	11.70	15	0.00**
For occasion slope, π_{1i} Intercept 2, β_{10}	1.15	0.10	11.92	190	0.00**

*p<.05

Rhyming

ANOVA. Tukey's Post Hoc analysis results indicate *IGDIs + Consultation, Rhyming* demonstrated significantly different scores than the Control Group (mean difference 0.36, α=.01), but not from *IGDIs Alone* (-0.10, α=.65) as presented in Table 5.

Table 26.

IGDIs + Consultation Summary of HMLM Model Fit (*Rhyming*)

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	2381.16
Homogenous sigma squared (UGM)	4	2781.86**
Heterogeneous sigma squared	15	227.52

**p<.00

HMLM. Based on the model fit result (Table 26), homogeneous level 1 variance (Model 2) is best give parsimony and fit. Table 27 presents Model 2 growth analyses.

Table 27.

IGDIs + Consultation Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	0.89	0.64	1.39	47	0.17
For occasion slope, π_{1i} Intercept 2, β_{10}	0.46	0.04	11.48	512	0.00**

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 2752.98, *df* = 4) compared to Model 2 slope variance (deviance = 2583.24, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 169.74, *df* = 2, α =.05). Inter-individual *IGDIs + Consultation*, *Rhyming* scores improved during the course of intervention; however baseline performance (intercept) did not vary significantly within individuals.

In summary, *IGDIs + Consultation* student scores on *Rhyming* were significantly larger than student scores on Control Group, *Rhyming.* However, *IGDIs + Consultation*, *Rhyming* were not significantly larger than students scores on *IGDIs Alone, Rhyming.*

Therefore, for *Rhyming,* providing teachers with consultative services did not have an effect on student achievement above and beyond that of the *IGDIs Alone*.

Alliteration

ANOVA. Tukey's Post Hoc analysis results indicate *IGDIs + Consultation, Alliteration* demonstrated significantly different scores than the Control Group (mean difference 0.16, α=.04), but did not demonstrate significantly different scores from *IGDIs Alone* (-0.05, α=.83) as presented in Table 5.

HMLM. Based on the model fit result (Table 28), homogeneous level 1 variance (Model 2) is best give parsimony and fit. Table 29 presents Model 2 growth analyses.

Table 28.

IGDIs + Consultation Summary of HMLM Model Fit (*Alliteration)*

Model	Number of Parameters	Deviance
Unrestricted (UMM)	80	2114.25
Homogenous sigma squared (UGM)	4	2425.70**
Heterogeneous sigma squared	15	2393.36

***p*<.00

For deviance comparisons, Model 1 slope variance (deviance = 2425.70, *df* = 4) compared to Model 2 slope variance (deviance = 2337.18, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 88.52, *df* = 2, α =.05). Individual student *Alliteration* scores improved during the course of intervention across students; however baseline performance (intercept) did not vary significantly within individuals.

Table 29.

IGDIs + Consultation Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Alliteration*

Fixed Effects	Coefficient	Error	T-ratio	*df*	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	0.65	0.42	1.57	47	0.12
For occasion slope, π_{1i} Intercept 2, β_{10}	0.20	0.03	7.10	512	0.00*

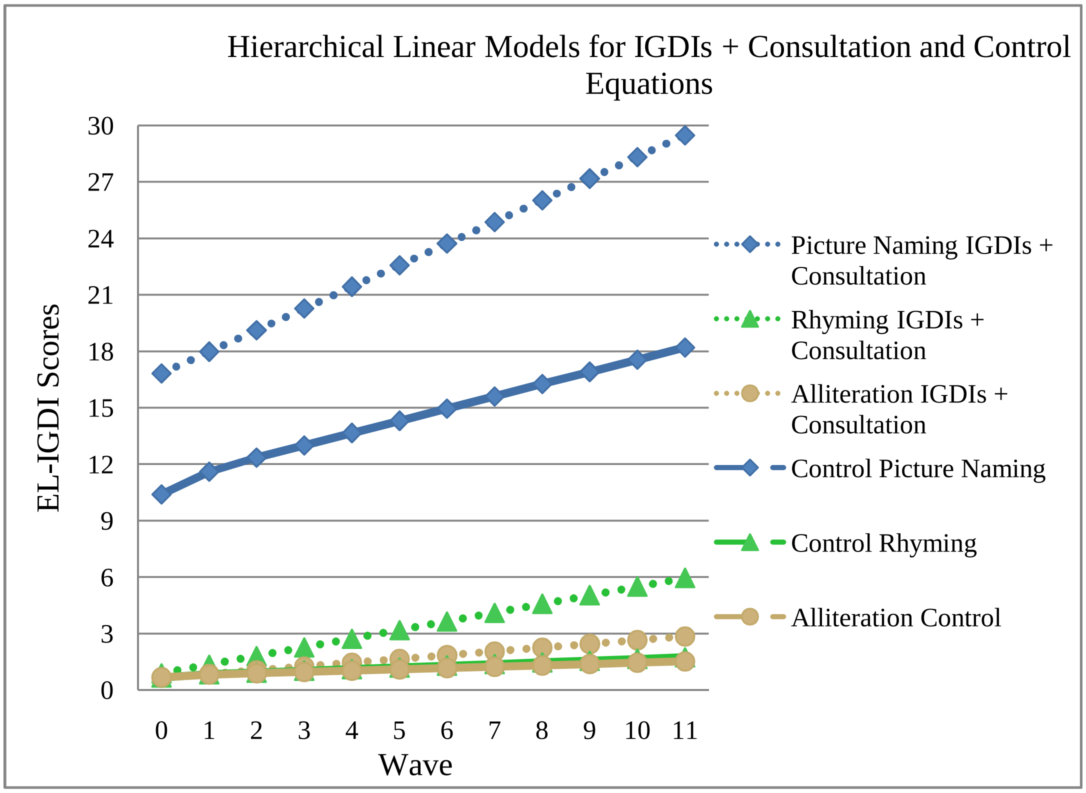
*p<.05

Taken together, *IGDIs + Consultation* students' scores on *Alliteration* were not significantly larger than students' scores on *IGDIs Alone*, *Alliteration.* Therefore, providing teachers with consultative services did not have an effect on student achievement above and beyond that attributable to *IGDIs Alone.*

A graphical representation of the HMLM results presented in Tables 25-29 is presented in Figure 3. Similarly, actual mean scores by wave are presented in Figures 6 and 8 for comparison purposes and can be found in Appendix J.

Figure 3.

Hierarchical Linear Models for *IGDIs + Consultation* and Control Equations



Effect Sizes

Effect sizes were computed using Cohen's *d* (1988) between the end of treatment performance (Wave 11) and baseline performance (Wave 0) for each treatment group using the procedures described in Research Question 1. Because the intervention within this study was progress-monitoring (both with and without consultation) effect size was computed from a beginning baseline value of "no treatment" at Wave 0, to "completed treatment" at Wave 11. This provided a gauge of treatment across the study using effect size analyses. Results are presented in Table 30. According to Cohen's definitions of effect sizes, all relative effects, with the exception of *Alliteration* were considered large. For comparison purposes an expanded effect size table, including all treatment groups is presented in Appendix K.

Table 30.

Effect Sizes for Progress Monitoring Measures for *IGDIs + Consultation*

Treatment Group by Measure	Effect Sizes	
	Absolute Effect Size	Relative Effect Size
Picture Naming		
IGDIs + Consultation	4.53	1.91
Control	2.62	--
Rhyming		
IGDIs + Consultation	2.04	1.17
Control	0.87	--
Alliteration		
IGDIs + Consultation	1.05	0.51
Control	.54	--

Note: All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

Considering both the HMLM and ANOVA slope analyses, results indicate when comparing each measure by treatment groups (*IGDIs Alone* vs. *IGDIs + Consultation)* none of the measures *Picture Naming*, *Rhyming* or *Alliteration*, obtained significantly different slopes (p = .89 for *Picture Naming*, p = .65 for *Rhyming*, p = .83 for *Alliteration*).

Research Question 4

To answer the fourth research question, "To what extent does disability status moderate treatment effects of *IGDIs + Consultation*?" multiple analyses were completed including HMLM, ANOVA and effect sizes. The ANOVA findings from Research Question 3, which indicated student scores in the *IGDIs + Consultation* treatment group differed significantly from the Control Group, were further examined using HMLM to consider the strength of effects within specific subgroups.

Sample sizes for *IGDIs + Consultation* treatment group by disability are n = 34 for typically developing, n = 29 special education. Results are presented by disability status, typically developing students first, followed by students with disabilities.

Picture Naming, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Typically developing student scores for *Picture Naming* were further explored using a Tukey's post-hoc analyses. Results are presented in Tables 13 and 31 (see Research Question 2).

Table 31.

Post-Hoc Tukey's Analysis of *Picture Naming* by Treatment Group and Disability Status

Treatment Group by Disability Status (a)	Treatment Group by Disability Status (b)	Mean Difference (a-b)	SE	Sig.
IGDIs + Consultation Typically Developing	*IGDIs + Consultation* Special Education	-0.49	0.16	0.02*
	Control Typically Developing	0.23	0.18	0.82
	Control Special Education	0.30	0.16	0.47
	IGDIs Alone Typically Developing	-0.30	0.16	0.44
	IGDIs Alone Special Education	-0.30	0.16	0.44
IGDIs + Consultation Special Education	Control Typically Developing	0.70	0.19	0.00*
	Control Special Education	0.79	0.17	0.00*
	IGDIs Alone Typically Developing	0.29	0.17	0.49
	IGDIs Alone Special Education	0.28	0.16	0.51

* $p<.05$

HMLM. Based on the model fit result, (number of parameters = 4, deviance, 1223.91, p = .05) homogeneous level 1 variance (UGM-Model 2) is best give parsimony and fit. Table 32 presents Model 2 growth analyses.

For deviance comparisons, Model 1 slope variance (deviance = 1223.91, df = 4) compared to Model 2 slope variance (deviance = 1221.81, df = 6) resulted in a non-significant difference of deviance (D_2 - D_1 = 2.10, df = 2). Therefore, linear slopes are

Table 32.

IGDIs + Consultation, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	Df	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	19.75	0.97	20.26	17	0.00*
For occasion slope, π_{1i}					
Intercept 2, β_{10}	0.97	0.08	10.83	202	0.00*

*p<.05

not statistically different between students, or stated another way linear slopes are statistically equal between students. Thus, typically developing students in the *IGDIs + Consultation* treatment group achieved scores that improved during the course of intervention within students, but not across students on the *Picture Naming* measure.

Picture Naming, Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Special education student scores on *Picture Naming* were further explored using Tukey's post-hoc analyses. Results were presented in Tables 13 and 31 (see Research Question 2).

HMLM. Based on the model fit results, homogeneous model (UGM- Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 1179.24, p = .05). Table 33 presents Model 2 growth analyses.

Table 33.

IGDIs + Consultation, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Picture Naming*

Fixed Effects	Coefficient	Error	T-ratio	*Df*	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	12.47	1.57	7.92	17	0.00**
For occasion slope, π_{1i} Intercept 2, β_{10}	1.16	0.08	13.72	195	0.00**

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 1179.24, *df* = 4) compared to Model 2 slope variance (deviance = 1155.59, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 23.65, *df* = 2, α =.05). Therefore, for special education students in the *IGDIs + Consultation* treatment group, *Picture Naming* scores improved during the course of intervention both within and across students.

In summary, *IGDIs + Consultation* typically developing student scores on *Picture Naming,* were *not* significantly larger than student scores in neither the typically developing nor special education Control Group. However, a significant difference was detected between *IGDIs + Consultation* typically developing students in *Picture Naming* and *IGDIs + Consultation,* special education students in *Picture Naming.* Similarly, *IGDIs+ Consultation* special education student scores on *Picture Naming* were significantly larger than student scores in both the typically developing and special education Control Group.

When *IGDIs + Consultation, Picture Naming* was compared to *IGDIs Alone* none of the suggested contrasts (i.e. special education or typically developing) resulted in significant differences. Therefore, for neither typically developing nor special education students in *IGDIs + Consultation, Picture Naming,* offering teachers consultative services in combination with student data for data-based decision making did not result in improved early literacy scores above and beyond those effects attributable to *IGDIs Alone*.

Rhyming, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Typically developing student score for

Rhyming were explored using Tukey's post-hoc analyses. Results are presented in Tables 13 and 35 (see Research Question 2).

HMLM. Model fit procedures indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 1139.19 p>.00). Table 34 presents Model 2 growth analyses.

Table 34.

IGDIs + Consultation, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	*Df*	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	1.00	1.11	0.90	17	0.38
For occasion slope, π_{1i} Intercept 2, β_{10}	0.72	0.07	10.31	202	0.00*

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 1139.19, df = 4) compared to Model 2 slope variance (deviance = 1063.08, df = 6) resulted in a significant difference of deviance (D_2 - D_1 = 76.11, df = 2, α =.05). Therefore, for typically developing students in the *IGDIs + Consultation* treatment group, *Rhyming* scores improved during the course of intervention between students as well as for slope,

Table 35.

Post-Hoc Tukey’s Analysis of *Rhyming*, *IGDIs Alone*, by Disability Status

Treatment Group by Disability Status (a)	Treatment Group by Disability Status (b)	Mean Difference (a-b)	Std. Error	Sig.
IGDIs + Consultation Typically Developing	*IGDIs + Consultation* Special Education	0.53	0.15	0.02*
	Control Typically Developing	0.56	0.17	0.01*
	Control Special Education	0.65	0.15	0.00**
	IGDIs Alone Typically Developing	0.29	0.15	0.49
	IGDIs Alone Special Education	0.57	0.15	0.01*
IGDIs + Consultation Special Education	Control Typically Developing	0.13	0.17	0.98
	Control Special Education	0.21	0.15	0.76
	IGDIs Alone Typically Developing	-0.25	0.15	0.22
	IGDIs Alone Special Education	0.05	0.15	0.99

*p<.05

however, intercept scores revealed students were not significantly different within baseline performance.

Rhyming, Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Special education student score for *Rhyming* were explored using Tukey's post-hoc analyses. Results are presented in Tables 13 and 35 (see Research Question 2).

HMLM. Model fit procedures indicated the homogeneous model (UGM- Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 873.43 p <.05). Table 36 presents Model 2 growth analyses.

Table 36.

IGDIs + Consultation, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Rhyming*

Fixed Effects	Coefficient	Error	T-ratio	*Df*	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	01.18	0.90	1.31	15	0.21
For occasion slope, π_{1i} Intercept 2, β_{10}	0.19	0.05	3.61	174	0.00*

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 873.43, *df* = 4) compared to Model 2 slope variance (deviance = 864.28 *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 9.14, *df* = 2, α =.05). Therefore, for special education students in the *IGDIs + Consultation* treatment group, *Rhyming* scores improved during the course of intervention both within and across students.

In summary, *IGDIs + Consultation* typically developing student scores for *Rhyming* were significantly larger than student scores in both the typically developing and special education Control Group. Similarly, a significant difference was detected between *IGDIs + Consultation* typically developing students on *Rhyming* and *IGDIs + Consultation* special education students on *Rhyming.* In contrast, *IGDIs+ Consultation* special education student scores on *Rhyming* were not significantly larger than student scores in neither the typically developing nor special education Control Group.

When *IGDIs + Consultation, Rhyming* was compared to *IGDIs Alone* none of the suggested contrasts (i.e. special education or typically developing) resulted in significant differences with the exception of *IGDIs + Consultation*, typically developing vs. *IGDIs Alone*, special education. Therefore, for neither typically developing nor special education students in *IGDIs + Consultation, Rhyming*, offering teachers consultative services did not result in improved early literacy scores.

Table 37.

Post-Hoc Tukey's Analysis of *Alliteration* by Treatment Group and Disability Status

Treatment Group by Disability Status (a)	Treatment Group by Disability Status(b)	Mean Difference (a-b)	Std. Error	Sig.
IGDIs + Consultation Typically Developing	*IGDIs + Consultation* Special Education	0.20	0.10	0.50
	Control Typically Developing	0.26	0.12	0.12
	Control Special Education	0.27	0.10	0.10
	IGDIs Alone Typically Developing	-0.09	0.10	0.73
	IGDIs Alone Special Education	0.24	0.10	0.17
IGDIs + Consultation Special Education	Control Typically Developing	0.03	0.12	1.00
	Control Special Education	0.09	0.11	0.95
	IGDIs Alone Typically Developing	-0.37	0.11	0.01*
	IGDIs Alone Special Education	0.03	0.10	0.99

*$p<.05$

Alliteration, Typically Developing

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Typically developing student scores for *Alliteration* were explored using Tukey's post-hoc analyses. Results are presented in Tables 13 and 37 (see Research Question 2). *HMLM.* Model fit procedures indicated the homogeneous model (UGM-Model 2) was the most parsimonious fit (number of parameters = 4, deviance, 1059.94, p>.00). Table 38 presents Model 2 growth analyses.

Table 38.

IGDIs + Consultation, Typically Developing Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Alliteration*

Fixed Effects	Coefficient	Error	T-ratio	*Df*	*p*-value
For Intercept 1, π_{0i} Intercept 2, β_{00}	0.97	0.81	1.19	18	0.25
For occasion slope, π_{1i} Intercept 2, β_{10}	0.35	0.05	7.10	212	0.00*

*p<.05

For deviance comparisons, Model 1 the slope variance (deviance = 1059.94, df = 4) compared to Model 2 slope variance (deviance = 1009.86, df = 6) resulted in a significant difference of deviance (D_2 - D_1 = 50.08, df = 2, α =.05). Therefore, for typically developing students in the *IGDIs + Consultation* treatment group, *Alliteration* scores improved during the course of intervention between students. Similarly, average growth, as measured by slope statistically improved over the course of intervention, however significant differences within baseline performance were not obtained.

Alliteration, Special Education

ANOVA. A One-Way ANOVA model was completed to explore effects by disability status for the *IGDIs + Consultation*. Special education student scores for *Alliteration* were explored using Tukey's post-hoc analyses. Results are presented in Tables 13 and 37 (see Research Question 2).

HMLM. Model fit indicated the homogeneous model (UGM- Model 2) was again the most parsimonious fit (number of parameters = 4, deviance, 840.85, p <.00). Table 39 presents Model 2 growth analyses.

Table 39.

IGDIs + Consultation, Special Education Students Summary of Random Effects Model (HMLM) with Homogeneous Level-1 Variance for *Alliteration*

Fixed Effects	Coefficient	Error	T-ratio	*Df*	*p*-value
For Intercept 1, π_{0i}					
Intercept 2, β_{00}	0.41	0.50	0.83	18	0.42
For occasion slope, π_{1i}	0.11	0.04	3.04	196	0.00**
Intercept 2, β_{10}					

*p<.05

For deviance comparisons, Model 1 slope variance (deviance = 840.85, *df* = 4) compared to Model 2 slope variance (deviance = 825.28, *df* = 6) resulted in a significant difference of deviance (D_2 - D_1 = 15.57, *df* = 2, α =.05). Therefore, for special education students in the *IGDIs + Consultation* treatment group, *Alliteration* scores improved during the course of intervention between students and within student performance across time (slope), however students score did not differ significantly within baseline performance.

In summary, *IGDIs + Consultation*, typically developing student scores on *Alliteration* were not significantly larger than student scores in both the typically developing and special education Control Group. Similarly, *IGDIs+ Consultation* special education student scores for *Alliteration* were also *not* significantly larger than student scores in neither the typically developing nor special education Control Group.

When *IGDIs + Consultation, Rhyming* was compared to *IGDIs Alone* none of the suggested contrasts (i.e. special education or typically developing) resulted in significant differences with the exception of *IGDIs + Consultation*, typically developing vs. *IGDIs Alone*, special education. Therefore, for neither typically developing nor special education students in *IGDIs + Consultation, Alliteration*, offering teachers an additional consultation service did not result in improved early literacy scores.

Effect Size

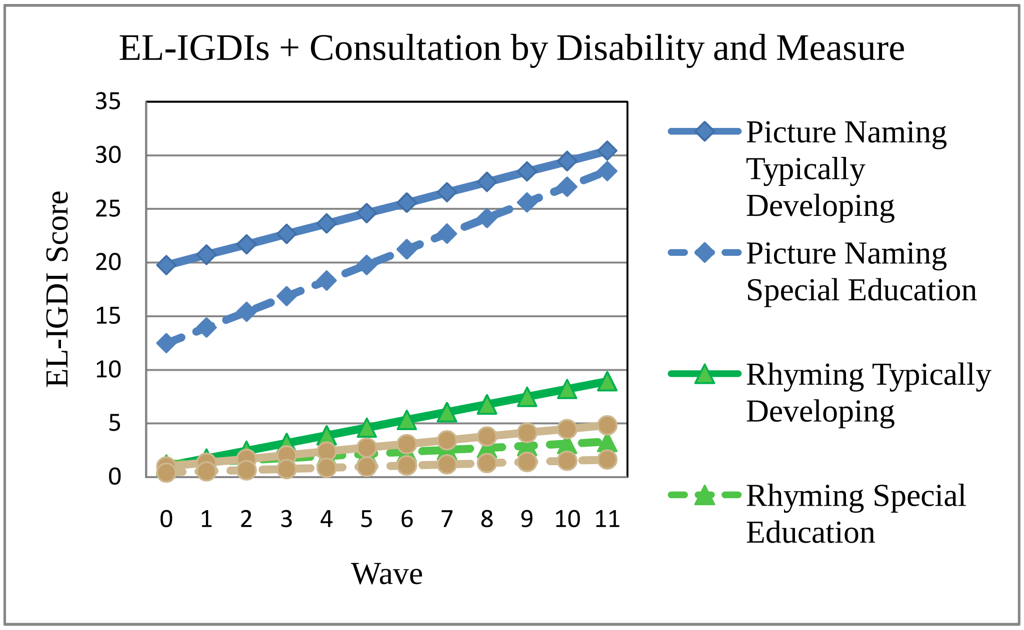
Effect sizes were also computed by disability status for each treatment group using the methodology described in Research Question 2. Results are presented in Table 40.

According to Cohen's definitions of effect sizes, all effects for *Picture Naming* were large, for *Rhyming* effects were medium for typically developing students and a small effect was present for special education students. Finally, for *Alliteration*, effects were medium for both typically developing and special education students.

A graphical representation of the HMLM results presented in Tables 30-39 is presented in Figure 4 and a summary of all HMLM statistics are available in Appendix L. Additionally, actual mean scores by wave are presented in graph format in Appendix H for comparison purposes. When considering the ANOVA and HMLM analyses, results indicate for both the *IGDIs Alone* treatment group and the *IGDIs + Consultation* treatment group, slopes were significantly different from zero on all three measures in both typically developing and special education groups.

Figure 4.

IGDIs + Consultation Treatment Group by Disability Status, Measure and Wave



Similarly, when considering slopes in the context of disability status (special education vs. typically developing), slopes were all significantly different from zero for all measures and disabilities. However, when specific comparisons were considered results reflected differences attributable to disability status.

Table 40.

Effect Sizes for IGDIs by Treatment Group and Disability Status

Treatment Group by Measure	Disability Status	Effect Sizes	
		Absolute Effect Size	Relative Effect Size
Picture Naming			
IGDIs + Consultation	Typically Developing	5.02	1.92
	Special Education	4.76	1.83
Control	Typically Developing	3.10	--
	Special Education	2.93	--
Rhyming			
IGDIs + Consultation	Typically Developing	2.73	0.70
	Special Education	0.70	0.10
Control	Typically Developing	2.03	--
	Special Education	0.60	--
Alliteration			
IGDIs + Consultation	Typically Developing	1.45	0.51
	Special Education	0.62	0.36
Control	Typically Developing	0.94	--
	Special Education	0.26	--

Note: All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

To examine further effects attributed to disability status, TOPEL scores were also considered. An ANCOVA model was selected to compare student performance while accounting for disability on the *El-Index* scores. Results indicate disability status played a significant role in the effectiveness of each treatment group at wave 11 (Time 2; f = 88.84, p = .01), however the interaction of disability status and treatment group was not significant (f =.426, p= .65), results are presented in Figure 5.

Figure 5.

Estimated Means of the TOPEL by Treatment Group

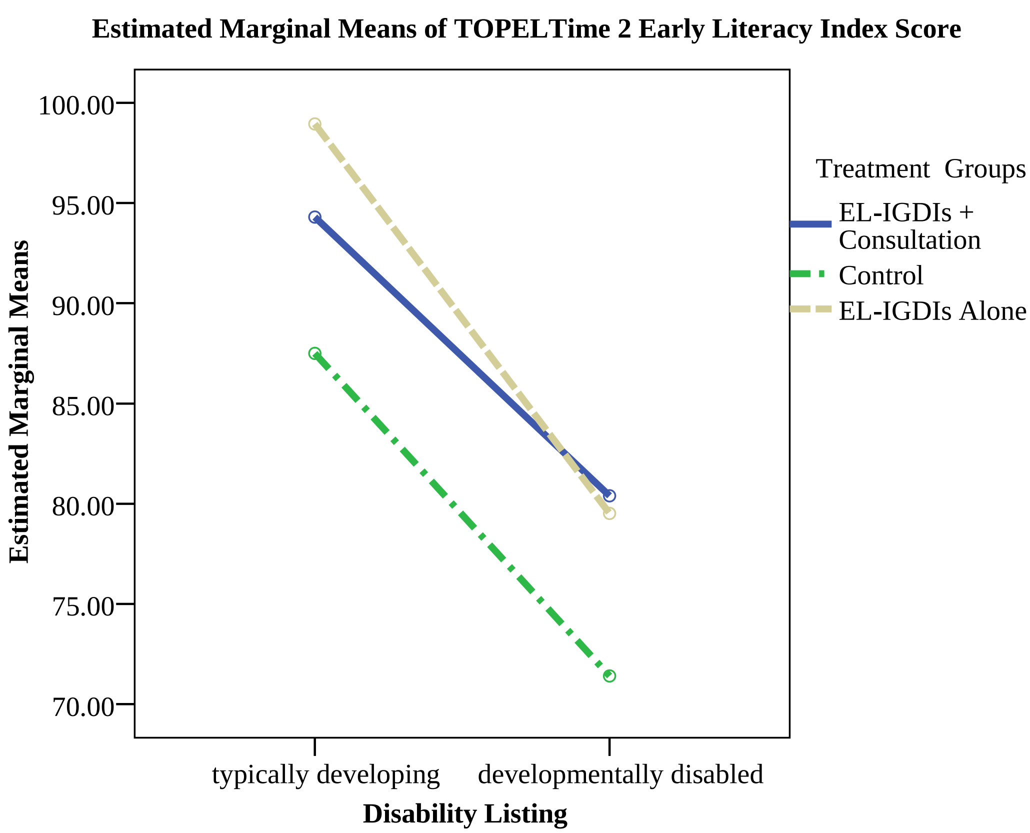


Table 41.

Summary Statistics for the Control Group Line Equations

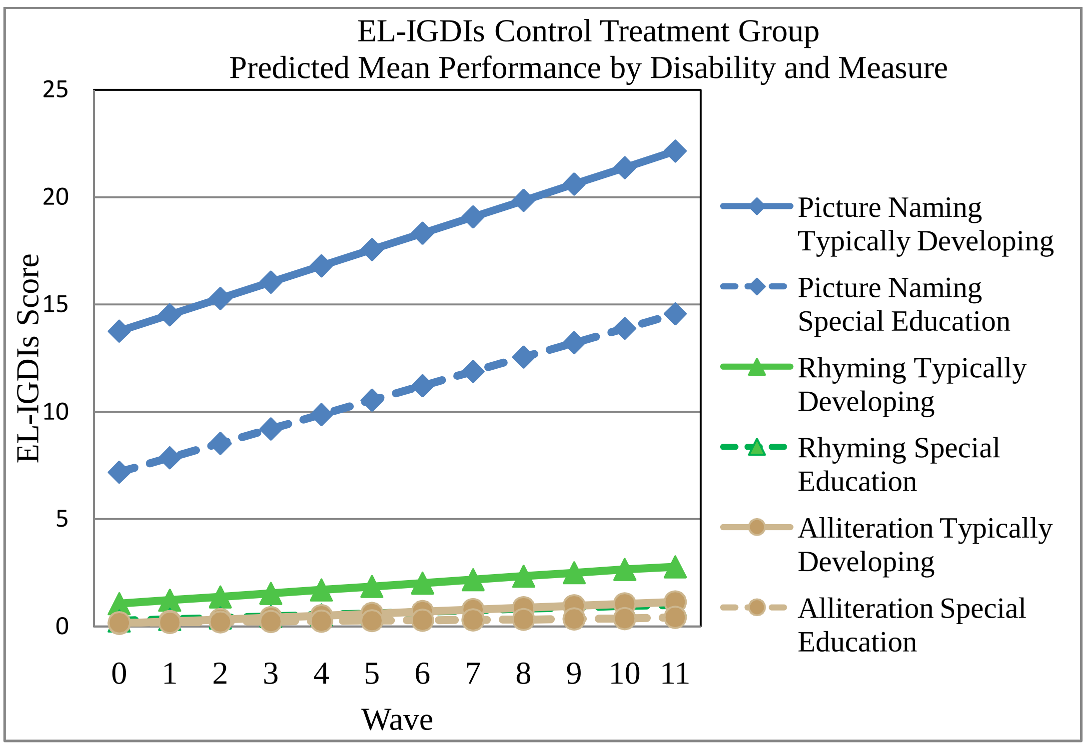
Treatment Group	Disability Status	IGDI Measure	Intercept β_{00}	Slope β_{10}
Control	NA	*Picture Naming*	10.4	0.65
Control	NA	*Rhyming*	0.66	0.09
Control	NA	*Alliteration*	0.68	0.07
Control	Typically Developing	*Picture Naming*	13.76	0.76
Control	Typically Developing	*Rhyming*	1.07	0.16
Control	Typically Developing	*Alliteration*	0.15	0.09
Control	Special Education	*Picture Naming*	7.19	0.67
Control	Special Education	*Rhyming*	0.27	0.07
Control	Special Education	*Alliteration*	0.17	0.02

Control Group

Control Group IGDI measure line equations were computed using basic least-squares regression formulas. Regression line statistics are presented in Table 41. Control line equations were used to determine if significant differences were obtained when compared to HMLM growth analyses. Graphical representations of the Control lines by treatment group and disability status are presented in Figure 6.

Figure 6.

IGDI Control Treatment Group by Disability Status, Measure and Wave



Research Question 5

To answer the research question, “After participating in this study, to what degree does teacher pedagogy change?” basic survey analysis methods were completed. Results are presented in Table 42. Additional survey questions included on the survey but not reported in the table include: “How often during this study did you spend time reviewing student data?” Results indicate 5% of individuals reported reviewing the data twice a week, 75% of the individuals reported reviewing the data once every other week and 20% reported reviewing the data less than once every other week. Open-ended anecdotal questions, including, “Was your experience in this study worth the time you invested in the study? If so, what value did you receive? If not, please explain,” and “Please describe any suggestions or concerns you have had during your experience in this study.” Open-ended results included statements such as, “This experience gave me a quantitative picture of student growth,” “This experience was a positive because it aided in maintaining and collecting data for my students, as well as demonstrated that an increased frequency and exposure to elements of an emergent literacy environment improved growth of student performance on the IGDIs,” “This was a useful study, however I won’t have the time in future to commit to data collection; every other week seems like too frequent, and my time is better spent in other areas,” and “My only concerns are that I wish the graphing program was available online and more user-friendly, I would also like to be able to use this with all of my students.

Table 42.

Teacher Pedagogy Survey Results

Survey Question		*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
1.	Bi-weekly progress-monitoring of emergent literacy skills (with the Individual Growth and Development Indicators) was a valuable addition to current assessment methods which occur in my classroom.	20	55	40	5	0
2.	Progress-monitoring data helped me be better informed to make instructional decisions for my students.	20	50	50	0	0
3.	Progress-monitoring is a useful method for assessing student performance on a frequent basis.	20	60	30	10	0

Survey Question		*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
4.	I feel that my ability to evaluate student ***emergent literacy performance*** has improved because of my participation in this study.	20	25	70	5	0
5.	I feel that I am better able to evaluate ***student data*** as a result of my participation in this study.	20	25	60	5	10
6.	I feel that I am better able to use ***student data*** to make educational decisions as a result of my participation in this study.	20	20	60	10	10

Survey Question		*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
7.	In the future, I am likely to continue using a progress-monitoring measure like the one used in this study in the assessments I complete with my students.	19	30	40	25	0
8.	After participating in this study I feel that I use research to inform my teaching more than I did before participating in the study.	20	20	40	40	0
9.	After participating in this study I feel that my students were offered more opportunities to respond during classroom instruction.	20	25	40	35	0

Survey Question		*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
10.	Assessment is an integral part of my planning and teaching.	20	40	55	5	0
11.	Assessment ***does not*** inform my instruction.	20	0	5	60	35
12.	The EXCEL graphing program improved my ability to evaluate my student's progress.	20	30	65	5	0
13.	The EXCEL graphing allowed me to use my student's data to inform instructional changes.	20	0	95	5	0
14.	I feel comfortable using the EXCEL graphing program on my own after participating in this study.	20	30	35	35	0
15.	I am likely to continue using the EXCEL graphing program.	19	5	45	45	0
16.	The EXCEL graphing program was easy to navigate.	20	20	70	10	0

	Survey Questions	*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
17.	When I had questions about the EXCEL program they were quickly resolved.**	20	40	50	10	0
19	The consultation meetings allowed me to gain a better knowledge of student performance.	10	10	35	5	0
20.	I feel the consultation experience was a critical component in this study.	10	10	30	10	0
21.	In the future, I would participate in consultative services similar to those provided in this study.	10	35	10	5	0
26.	I feel that participating in this study was a ***negative*** experience.	20	0	0	20	80

Survey Questions		*n*	Percent Agreement			
			Strongly Agree	Agree	Disagree	Strongly Disagree
27.	I would be willing to implement the strategies in this study in the future.	20	35	60	5	0
28.	I believe my students' (who participated in this study) ***emergent literacy achievement improved*** as a result of participating in this study.	20	35	60	5	0

** For Question 17, 10% of individuals (2 people) reported "Not applicable"

CHAPTER FIVE

Discussion

Purpose of Study

The purpose of this study was to investigate the effects of progress monitoring using the Individual Growth and Development Indicators (IGDIs) on student achievement both with and without additional consultation services. Specifically, results of this study may supplement ongoing Response to Intervention and consultation research by providing teachers and professionals with information on the effectiveness, efficiency and sensitivity of IGDIs. The IGDIs were selected as assessment tools to be used as intervention because of at least four factors: 1) a renewed interest in emergent literacy development in research; 2) accessibility, low cost and ease of use of the IGDI measures; 3) the psychometric and practical promise of using a GOM in intervention and assessment; and 4) existing research supporting the use of progress-monitoring measures as an intervention (Fuchs et al., 1991; Fuchs et al., 1990). In addition, a Behavioral Consultation (BC) model was used to supplement the IGDI interventions because of robust research regarding effectiveness, as well as to improve teacher-professional interactions concerning student performance in an effort to support Response to Intervention procedures (e.g. pre-referral discussion; Bergen & Kratochwill, 1990).

Ideally, the results of this study will inform professional practice by illustrating the effectiveness of IGDIs as an intervention in multiple populations (e.g. typically developing and special education) as well as provide information regarding the effectiveness of an additional BC model in collaboration with a progress monitoring model. Results for this study are reviewed sequentially.

Summary of Findings

Preliminary Findings

Initial descriptive results revealed student scores improved significantly over time for measures and treatment groups; that is, students, as a group (regardless of treatment) made growth over time. Additionally, ANOVA results indicated significant differences existed between treatment groups. Scores on the second dependent measure, the TOPEL, also differed by treatment group in improvement over time ($p < .05$). These findings suggested further analyses were warranted.

Initial test of normality illustrated inflated rates of skew and kurtosis for the IGDI measures as reported in additional studies (McConnell & Wackerle-Hollman, in preperation, McConnell et al., 2002; ECRI-MGD 1998b), but overall, were acceptable. Variance in skew and kurtosis may be supported theoretically because of the exceptionally brief period of time in development in which *Rhyming* and *Alliteration* appear to represent a normal distribution, making it difficult to measure emergent literacy development without experiencing floor and ceiling effects (Paris, 2005). Indeed, there is a brief period of time in development in which *Rhyming* and *Alliteration* appear to come 'online' and maintain a normal distribution (Paris, 2005). This finding replicates results found in additional studies of *Rhyming* and *Alliteration* (McConnell & Wackerle-Hollman, in preparation).

Research Question One

The first research question addressed the extent to which administration of IGDIs, as progress monitoring tools, had an effect on students' achievement. I hypothesized that using IGDI progress monitoring tools to provide teachers with access to student data would produce a significant change in student achievement (*IGDIs Alone*) when compared to the Control Group. Presenting teachers with progress monitoring IGDI data were associated with improved student achievement. Measuring each student's emergent literacy performance in *IGDIs Alone* had a positive effect on both the intercept and slope of the IGDI measures compared to controls. This analysis considered the sample as one homogenous group, rather than separating students by disability status.

Surprisingly, growth rates obtained were considerably larger than those found in similar studies (McConnell et al., 2002; ECRI-MGD 1998b, Roseth & Missall, 2008). It possible that the high frequency of progress-monitoring, teacher exposure to data, and use of data for decision-making resulted in improved slopes. As a result the IGDIs may have captured participant's skills more appropriately, illustrating an increased rate of growth over time compared to other studies. Indeed, compared to slopes computed for Control, treatment group students made relatively large gains on emergent literacy achievement. Results indicate that individuals grew in early literacy skills across time as measured by the IGDI measures. *Picture Naming* was the measure with the largest bi-weekly growth (1.17 pictures per 2 wk wave), followed by *Rhyming* (0.52 per 2 wk wave) and *Alliteration* (0.27 per 2 wk wave), compared to Control group slopes of 0.65 (pictures per 2 wk wave) for *Picture Naming,* .09 (rhymes per 2 wk wave) for *Rhyming* and .07 (*Alliteration*s per 2 wk wave) for *Alliteration.*

Effect size analyses also supported this conclusion; relative effect sizes for comparisons between Control and *IGDIs Alone* were all large varying from 0.92 (for *Alliteration)* to 2.2 (for *Picture Naming).*

This finding is surprising because no other study has detected such robust effects for an "assessment as intervention" application. Comparisons between HMLM results and actual mean scores obtained suggest, overall, the process of progress-monitoring alone has a significant effect on student achievement when completed on a bi-weekly basis.

These particular findings support existing research (Fuchs, Deno, & Mirkin, 1984; Spicuzza & Ysseldyke, 1999) and extend our current knowledge by offering effect sizes for progress-monitoring applications. For example, results here indicate teachers may be able to use regular assessment of child progress as one part of an overall effort to make significant modifications to instruction and intervention, potentially resulting in significantly improved student outcomes. This finding may be substantiated by directly assessing teacher behaviors. That is, by observing how teachers use student data directly we may be able to determine why the results found here emerged, as well as investigate behaviors that support data-based decision making. Therefore it is important to consider teacher behavior as a potential factor when using assessment as an intervention.

Findings obtained for this research question may be attributed to a series of factors. First, it is possible that frequency of progress-monitoring may have informed teachers about current student status on a regular basis, and in turn, influenced curriculum and intervention planning to suit specific student needs. Second, the high frequency of data collection (every other week) may have encouraged teachers to improve literacy instruction as a result of reactivity. Because teachers witnessed data collection procedures every other week they may have been more reactive to their own accountability in teaching style, instruction and intervention. Third, even though random assignment occurred, it is possible students may have improved their emergent literacy achievement because of practice effects. Because students were being tested on the IGDIs every other week, there is a chance practice effects may have inflated student scores, however, every attempt to randomly present IGDI cards was made (see data collection procedures) and therefore it is unlikely this was the case.

It should also be noted that while the intended results of this study were to determine if using the IGDIs as a progress monitoring measure improved student performance, results actually reflected the opportunity to receive data representative of using the IGDIs because all but one teacher requested a trained data collector to collect the progress monitoring data. Therefore, because teachers were not actually completing the data collection themselves and were simply given the data, the results more accurately reflect offering teachers progress-monitoring data rather than the act of progress-monitoring itself.

Research Question Two

The second research question addressed the extent to which growth due to progress monitoring only (as represented by the *IGDI Alone* group) is moderated by disability status. That is, do effects attributable to the intervention package in the larger sample change when considered in for children with and without disabilities? I hypothesized students receiving special education services would obtain smaller slopes (i.e. grow slower) than students who were typically developing, but still outperform students in the Control Group.

Results suggest, when examining the effectiveness of the *IGDIs* as an intervention by disability status, *Picture Naming* and *Alliteration*, when given to typically developing students demonstrate the most robust effects. Additionally, some surprising results were also demonstrated. For example, *IGDIs Alone Picture Naming* special education slopes were larger than typically developing peers, albeit marginally (special education =1.18 pictures/2-week period, typically developing = 1.17/2-week period). Table 43 summarizes my findings on how disability status moderated results for *IGDIs Alone* students. Results indicate *Rhyming* and *Alliteration* may be less robust measures when used as an intervention than *Picture Naming* in specific disability status groups. Results also suggest the Control group students performed just as well as those students with disabilities receiving intervention for *Rhyming* and *Alliteration*.

Additionally, analyses indicate typically developing and special education students grew in early literacy skills across time as measured by the IGDIs. *Picture Naming* with special education students was the measure with the largest bi-weekly growth (1.18), followed by *Picture Naming,* typically developing,(1.17), *Rhyming,* typically developing (0.43), *Alliteration,* typically developing (0.42), *Rhyming,* special education (0.15) and *Alliteration,* special education (0.27).

These results should also be considered within the context of slopes. While statistically significant differences were not detected for many of *Rhyming* and *Alliteration* comparisons, differences in actual slopes were considerable. For example, the *IGDIs Alone* slope for special education students in *Rhyming* was 0.15, while control students' slope was 0.07 - or intervention students were growing at a slope over twice that of control children. Similarly, *IGDIs Alone* special education slope for *Alliteration* was 0.27, while the control slope was 0.02 a difference representative of over ten times the Control.

These findings may supply valuable information regarding the sensitivity of *Rhyming* and *Alliteration,* suggesting the measures may not be sensitive enough to measure growth with some student populations, or conversely, student growth on in the early literacy domains of *Rhyming* and *Alliteration* may be limited during the ages of 3 to 5. Additionally, these findings may be due to teacher impressions. For example, for typically developing students, teachers may not have focused as much attention on changes in instruction, attributing failing scores to lack of maturation or external factors compared to special education students.

When considered with the findings from the first research question, results here suggest student response to the intervention was moderated by disability status. Therefore, my hypothesis was only partially supported; students receiving special education services did obtain smaller slopes (i.e. grew slower) than students who were typically developing for *Rhyming* and *Alliteration*, and all three IGDIs outperformed the Control Group, however differences were only statically significant for *Picture Naming* group comparisons.

Findings suggest for *IGDIs Alone*, typically developing and special education students measured with *Picture Naming* produce significant effects above and beyond those attributable to both the typically developing and special education students in the Control Group, suggesting progress monitoring with *Picture Naming* is a promising intervention. For *Rhyming* and *Alliteration* results were inconsistent, however *Alliteration*, when used with typically developing students shows some credibility as a promising intervention when compared to students in the Control Group.

Table 43.

Performance comparisons for *IGDIs Alone* by Disability Status and Measure

Comparison			*IGDIs Alone* outperformed the comparison?		
			Picture Naming	*Rhyming*	*Alliteration*
**IGDIs Alone*, typically developing	vs.	*IGDIs Alone*, special education	Yes**	Yes**	Yes**
IGDIs Alone, typically developing	vs.	Control, typically developing	Yes**	No	Yes**
IGDIs Alone, typically developing	vs.	Control, special education	Yes**	Yes**	Yes**
IGDIs Alone, typically developing	vs.	*IGDIs + Consultation*, typically developing	No	No	No
IGDIs Alone, typically developing	vs.	*IGDIs + Consultation*, special education	Yes**	Yes**	Yes**
IGDIs Alone, special education	vs.	Control, typically developing	Yes**	No	No
IGDIs Alone, special education	vs.	Control, special education	Yes**	No	No

Comparison			*IGDIs Alone* outperformed the comparison?		
			Picture Naming	*Rhyming*	*Alliteration*
IGDIs Alone, special education	vs.	*IGDIs + Consultation*, typically developing	No	No	No
IGDIs Alone, special education	vs.	*IGDIs + Consultation*, special education	No	No	No

*The first comparison answers the question, "Did *IGDIs Alone*, typically developing outperform *IGDIs Alone* special education?" All other comparisons refer to column 1 *IGDIs Alone* groups. **Comparisons were significant at p >.05

When considering the result of this research question additional factors should be considered. First, data collectors may have unknowingly increased intervention intensity with students with disabilities as a result of environmental cues suggesting students needed additional support, and as a result interfered with procedural fidelity.

For example, data collectors may have been more patient or considered environmental distractions more thoroughly when working with students with disabilities, possibly resulting in additional support to influence scores compared to typically developing students. Second, special education classrooms often provide students with a decreased student to teacher ratio (7:1) compared to typically developing classroom ratios (24:1; Krueger, 2003). Because teachers have more time for individualized intervention in special education, students may have benefited from one-on-one support of emergent literacy development, and in turn an increased frequency of exposure to emergent literacy curricula and environment may have influenced IGDI scores. Finally, because sample sizes within each disability status group were relatively small ($n < 25$), there may have been insufficient power to detect a difference in intervention effects for both *Rhyming* and *Alliteration.* Therefore, future studies should examine the effects of *IGDIs Alone* with a larger sample of special education students.

Research Question Three

The third research question addresses the extent to which the *IGDIs + Consultation* intervention package had an effect on student achievement. I hypothesized the *IGDIs + Consultation* treatment group would produce a significant increase in student achievement, and additionally *IGDIs + Consultation* students would outperform students in Control and *IGDIs Alone* groups. These hypotheses were founded in research supporting the efficacy and effectiveness of BC in conjunction with research supporting the use of progress monitoring measures as an intervention (Fuchs, Deno & Mirkin, 1984; Bergan 1977, Bergan & Kratochwill, 1990). It was hypothesized that together; these features would create a more robust intervention package that would offer larger effect sizes over the effects of either the *IGDIs Alone* or Control treatment groups. This hypothesis was not supported, as students whose teachers received Behavioral Consultation did not make significant gains above and beyond those attributable to the *IGDIs Alone* treatment group; however, students in the *IGDIs + Consultation* did make significant gains on student achievement compared to the Control Group.

Results revealed student growth in early literacy skills across time as measured by each IGDI. *Picture Naming* demonstrated the most growth (1.15 pictures/2 weeks), followed by *Rhyming* (.46/2 weeks) and *Alliteration* (.20/2 weeks). Similar to the findings in Research Question 1, growth rates obtained were considerably larger than those found in similar studies (McConnell et al., 2002; ECRI-MGD 1998b, Roseth & Missall, 2008). When compared to slopes computed for the Control group (*Picture Naming*: 0.65/2 weeks, *Rhyming*: 0.09/ 2 weeks, *Alliteration*: 0.07/ 2 weeks) students in the *IGDIs + Consultation* group made relatively large gains on emergent literacy achievement.

Furthermore, effect size analyses supported these findings; relative effect sizes for students in *IGDI + Consultation* were large for *Picture Naming* and *Rhyming* and medium for *Alliteration*. These findings suggest overall, the process of bi-weekly progress-monitoring with the addition of the BC model has a significant effect on student achievement when compared to the Control Group. However, adding a consultation model to an existing progress-monitoring program did not significantly improve student performance.

These findings do not support existing research demonstrating additional positive effects of a consultation model (Fuchs et al., 1991, Rosenfield, 1991; Gutkin, 1996). Current research literature offers both supporting and contrasting findings. Some studies indicate the BC model may offer additional benefits above and beyond the effects present attributable to measurement such as progress monitoring (Gutkin, 1996). For example, Gutkin (1996) found that implementing a consultation model improved student outcomes, similarly DiGennaro and colleagues (2007) found that performance feedback through a BC model used in a proactive way to inform intervention improved student behavior. However, other studies, such as Teelucksingh (2002), found the addition of a consultation model did not improve student achievement on the CBM math progress-monitoring tools above and beyond those results attributable to the progress monitoring measure alone.

The lack of effectiveness of the BC model may be attributed to a series of factors. First, it is possible frequency of consultation sessions may not have been enough to produce robust effects on student achievement. Because teachers met with study personnel only once a month (a total of six sessions) they may not have had enough time to build robust relationships with the consultant in such a way that would result in positive student outcomes. Rosenfield (1991) suggested positive, trusting relationships are a necessary component to successful BC implementation. Because BC interactions were not performed by in-school staff (e.g. School Psychologists, intervention specialist) teachers may have perceived the consultant with less trust and confidence than if the consultant had established a relationship prior to the commencement of the study. Second, it is possible BC interactions may have been appropriate, however teachers may have had limited time and resources to make changes in intervention discussed and hypothesized in the BC interaction. Third, it is possible the BC model may not have been an appropriate fit for early-childhood education teachers. While extensive research reviews were considered no existing data on the effect of a BC model in early childhood in combination with progress monitoring were available.

In general, by improving the application of the BC model, through improving and increasing the frequency of interaction, facilitating further development of intervention strategies and providing additional guidance in intervention implementation the integrity of the BC intervention may be improved, potentially resulting in improved student performance, and as a result, increased treatment effects.

Finally, it is possible the BC model did not include enough specified content regarding how to use student data through intervention and instruction. Because teachers were not provided with specific interventions it may have been difficult for them to apply the progress monitoring data to concrete methods of intervention or instruction, resulting in limited intervention as a result of the consultation.

Research Question Four

The fourth research question addressed the extent to which consultation effects were moderated by disability status. That is, do effects attributable in the larger sample to the intervention package change when considered in specific disability groups? I hypothesized students receiving special education services would obtain smaller slopes (i.e. grow slower) than students who were typically developing, but still outperform students in the Control Group as well as students in the *IGDIs Alone* group.

Results were mixed. When disability status was compared among the *IGDIs + Consultation* treatment group for both special education and typically developing students, results indicated only some relevant effects. Results suggest, when examining the effectiveness of *IGDIs+ Consultation* as an intervention by disability status, *Rhyming* demonstrated a difference in a performance between special education and typically developing students. *Picture Naming* also demonstrated some positive treatment effects, however in isolated specific subgroups, while *Alliteration* demonstrated no additional treatment effects. Additionally, some surprising results were also demonstrated. For example and in some cases, such as *Picture Naming*, slopes were significantly larger than typically developing peers (special education =1.46, typically developing = .97 $p<.05$). Table 44 presents a summary of *IGDIs + Consultation* when moderated by disability status results.

Results also indicated children's early literacy performance on each IGDI significantly improved across time ($p < .00$). *Picture Naming* with special education students was the IGDI measure with the largest biweekly growth (1.46/2 weeks), followed by *Picture Naming* with typically developing students (0.97/2 weeks), *Rhyming* with typically developing students (0.72/2 weeks), *Alliteration* with typically developing students (0.35/2 weeks), *Rhyming* with special education students (0.19/2 weeks) and finally *Alliteration* with special education students (0.11/2 weeks).

While statically significant differences were not detected for many of *Picture Naming* and *Alliteration* comparisons, differences in actual slopes were considerable in some cases. For example, typically developing students in *IGDIs + Consultation* had an *Alliteration* slope of 0.35/2 weeks, while typically developing children in the Control Group demonstrated a slope of 0.09/2 weeks – a difference where the treatment group grew four times that of controls.

One comparisons of particular interest within *IGDIs + Consultation* is the *Picture Naming* comparison between *IGDIs + Consultation* special education and *IGDIs + Consultation* for typically developing children. For this particular contrast special education students significantly outperformed typically developing peers. Because *Picture Naming* is a GOM representative of early language development, which is one of the first skills children develop, it may have been more sensitive to growth in special education students, allowing the special education slope to achieve a rate similar to typically developing peers as a result of more intensive intervention with special education students, an increased emphasis on early language development or a combination of both. This finding was unexpected and may suggest further investigation particularly for the use of *Picture Naming* in combination with consultation for special education students.

Additionally, results suggest for *IGDIs + Consultation, Alliteration,* there were no significant differences in slope for disability status. These comparisons indicated progress monitoring treatment was equally successful with typically developing and special education students. Because *Alliteration* research suggests it is the most difficult task of the three measures, it is possible both typically developing and special education received low scores, resulting in floor effects and a lack of sensitivity in detecting performance differences among groups. These results may also be due to small sub-samples sizes. Because samples sizes were reduced to $n < 30$ for most sub-samples statistics may not have had sufficient power to produce significant effects.

Another finding that warrants further investigation is the comparison of *IGDI + Consultation* typically developing students' slopes for *Picture Naming* and *Alliteration* to slopes computed for the Control group (both for typically developing and special

Table 44.

Performance Comparisons for *IGDIs + Consultation* by Disability Status and Measure

Comparison			*IGDIs + Consultation* outperformed the comparison?		
			Picture Naming	*Rhyming*	*Alliteration*
**IGDIs + Consultation*, typically developing	vs.	*IGDIs + Consultation*, special education	No**	Yes**	No
IGDIs + Consultation, typically developing	vs.	Control, typically developing	No	Yes**	No
IGDIs + Consultation, typically developing	vs.	Control, special education	No	Yes**	No
IGDIs + Consultation, typically developing	vs.	*IGDIs Alone,* typically developing	No	No	No

Comparison			*IGDIs + Consultation* outperformed the comparison?		
			Picture Naming	*Rhyming*	*Alliteration*
IGDIs + Consultation, typically developing	vs.	*IGDIs Alone*, special education	No	Yes**	No
IGDIs + Consultation, special education	vs.	Control, typically developing	Yes**	No	No
IGDIs + Consultation, special education	vs.	Control, special education	Yes**	No	No
IGDIs + Consultation, special education	vs.	*IGDIs Alone*, typically developing	No	No	No
IGDIs + Consultation, special education	vs.	*IGDIs Alone*, special education	No	No	No

*The first comparison answers the question, All other comparisons refer to column 1 *IGDIs Alone* groups.

education students). For example, *Picture Naming,* when used to measure typically developing students did not obtain significantly larger scores than typically developing Control students or special education Control students ($p < .05$). Similar results were obtained for *Alliteration.* This finding indicates the *IGDIs + Consultation* treatment was not effective specifically for typically developing students when using *Picture Naming* and *Alliteration*.

Within *IGDIs + Consultation,* special education students grew at statistically equivalent rates as special education and typically developing Control Group students for *Rhyming* and *Alliteration.* These results are particularly interesting because when considered in terms of disability status, students' raw scores all outperformed Control student scores, but slopes did not all outperform Control slopes, potentially as a result of classroom intervention or lack of effectiveness of the *IGDIs + Consultation* intervention.

Finally, and potentially the most influential of comparisons were those between *IGDIs + Consultation* and *IGDIs Alone.* Results indicate none of the comparisons involving direct comparisons of disability status (e.g. *IGDIs + Consultation* special education vs. *IGDIs Alone* special education) resulted in statistically significant gains attributable to the addition of the BC model. This finding is surprising in that the BC model added no detectable effects for students with disabilities. This finding may be due to the nature of special education intervention, in that teachers with students with IEPs may be accustomed to consulting about student progress frequently as a result of interventions applied through the IEP. Additionally, this finding may be due to the lack of specified intervention as previously mentioned. This may translate to a limited effect for *IGDIs + Consultation* because teachers may have already been functioning in a consultative model.

These findings, in addition to those presented in Research Question 3 suggest student response to the intervention was moderated by disability status. My hypothesis was only partially supported, in that students receiving special education services did obtain smaller slopes (i.e. grow slower) than students who were typically developing for *Rhyming* and *Alliteration*, and all three IGDI measures outperformed the Control Group, however differences were not statistically significant for all comparison groups. Furthermore, only typically developing students measured with *Rhyming* and typically developing and special education students measured with *Picture Naming*, when receiving the *IGDIs + Consultation* treatment produce significant effects above and beyond those effects attributable to the Control Group.

Taken together, *IGDIs + Consultation* students' scores on *Rhyming* for typically developing students show evidence of being a robust intervention above and beyond the effects of the Control Group. However, when considering effects specific to special education students, *IGDIs + Consultation* provides no additional positive outcomes above and beyond those obtained by progress monitoring alone using any of the IGDIs.

Together, these findings indicate *Rhyming* may feature significant intervention elements related to positive student emergent literacy outcomes.

The results detected here may be attributable to some of the same factors suggested in Research Question 2. For example, teachers who are working with special education students may already be attuned to differentiating instruction and may have been able to use constructive information produced in the consultation process in meaningful ways. Just as with the results presented in Research Question 2, selective intervention emphasis and special education class size may have had an impact on student outcomes. Another potential influence may have been the intensity of the BC intervention package as well as the lack of specified intervention may have attributed to lack of effect. Finally, because sample sizes within each disability status group were relatively small ($n < 25$), there may have been insufficient power to detect a difference in intervention effects for both *Picture Naming* and *Alliteration*, and in some cases for *Rhyming*. Therefore, future studies should examine the effects of *IGDIs + Consultation* with a larger sample.

Research Question Five

The fifth research question addressed the extent to which teacher pedagogy changed as a result of participating in this study. At the end of the study teachers filled out a Likert questionnaire (see Appendix E) based on their treatment group. I hypothesized after participating in the study teachers would feel better equipped to teach and their pedagogies would change as a result. Findings for this hypothesis were supported, and on average, teachers impressions about their pedagogy improved (as determined by ‘strongly agree’ or ‘agree’ for positively worded questions, as ‘strong disagree’ or ‘disagree’ for negatively worded questions) in the areas of progress-monitoring (47.5%), teaching and pedagogy (39.1%), data-based decision making and computer-based graphing (42.2%). However, teachers’ impressions about the consultation process were not generally supportive of the BC model (21.6%). Some particular results of specific survey questions were of interest. For example, Question 8, “After participating in this study I feel that I use research to inform my teaching more than I did before participating in the study” resulted in 40% of teachers disagreeing. This suggests teachers participating in the study, even when supplied with robust research, reviewing procedures presented in the study, theoretical support and similar intervention findings, did not find the information helpful to inform instruction. This may be because the information was not readily accessible, possibly due to resistance to change, literary jargon presented in journal article findings or a disconnect between research and practice. Additionally, teachers may have not benefited from the BC interaction because specific intervention in instructional guidelines were not provided. Because the model simply used a problem solving approach to use progress monitoring data to inform teacher response, teachers may have felt they did not have the resources to choose specific interventions. Similarly, Question 15, “I am likely to continue using the EXCEL graphing program,” resulted in 40% of teachers’ disagreement. This finding was particularly interesting, because across the remaining research questions regarding the EXCEL graphing program teachers expressed satisfaction (Questions 12, 95%; 13, 95%; 14, 65%, 16, 90% and 17, 90% respectively). These results indicate while teachers felt comfortable with the EXCEL program, and found it beneficial to evaluating student progress, informing instructional changes and were easy to navigate; they were not willing to continue implementing it after the study completed. This indicates that another factor, such as time, resources (staff to enter and evaluate data) or confidence in the program without assistance on a bi-weekly basis may have attributed to an invested interested in continuing to use the program.

Teachers generally responded to study implementation with positive responses. All teachers reported that time invested was worth the experience and many highlighted benefits of the experience including improving familiarity with the IGDI cards, improvement in instructional changes as a result of progress-monitoring data, improved recognition of the importance of emergent literacy skills, improved knowledge base on the uses of graphing progress-monitoring scores and improved recognition of student trends in emergent literacy performance. Teacher feedback also included concerns such as, time constraints, limited resources, a request for more consistent wording on graphing forms, concerns about students being over-tested, concerns about dramatic variance in student performance from one wave to the next, and concerns about significant student truancy affecting student performance. These findings are promising because they offer information to improve intervention packages in future studies.

Limitations

Normality of Scores

The normality of both *Rhyming* and *Alliteration* is one limitation of this study. Neither *Rhyming* nor *Alliteration* demonstrated a statistically normal distribution of scores during preliminary analyses. Non-normal distributions can suggest significant analytical challenges and risks such as possibilities of floor or ceiling effects within the data or undetected covariates. However, existing research demonstrates emergent literacy data are often presented with such limitations (Paris, 2005). Current literature suggests emergent literacy development is dynamic in that students can be observed to represent a normal distribution for extremely brief periods of time (Senechal et al., 2001). For example, Paris (2005) suggests emergent literacy contains both "*constrained*" and "*unconstrained*" skills, where constrained skills represent those that are "necessarily skewed during initial acquisition and later mastery with variance that ranges from nil to large to nil during mastery" (p.187). Constrained skills include specific tasks such as those characteristic of alphabetic principle and phonemic awareness. In contrast, unconstrained skills develop continuously, and may vary in proficiency across people. Paris also notes, "Unconstrained skills may also appear to reach asymptote if learning is not continued, or at least rapid skill growth may slow down after childhood or educational experiences. However, the course and duration of learning are potentially endless for unconstrained skills" (p. 194). Examples of unconstrained skills include vocabulary development and comprehension.

For the purposes of this study, HMLM was chosen for analyses because it is a robust method that allows for the contribution of both individual and group characteristics however, HMLM does request that the parameters included in analyses represent a normal distribution. Byrk and Raudenbush (1987) note, "When violations of normality of assumptions are made, the estimated reliability of the growth parameters should be regarded as tentative" (p. 156). Therefore it is important to consider the HMLM results within the parameters of IGDI normality.

Level of Analysis

The levels of analysis for this study were also a limitation in that while treatment groups were randomly assigned by teacher/class, analysis was completed with students in each class. Because performance was assessed longitudinally, an HMLM model was chosen to best describe the data as a function of individual scores (level 1) and person over time (wave; level 2). To consider teacher/class as a level of analysis a sample size of at least 60 is suggested for HLM procedures. Because only 30 teachers were included in this study a HLM analysis could not be completed. Analysis at the teacher level would have allowed for further interpretation of the effects of both *IGDIs Alone* and *IGDIs + Consultation*. By restricting analysis to the student level findings cannot be attributed to classroom variables such as teacher characteristics, teacher investment in the intervention or intervention integrity variance among teachers. Future studies should consider this level of analysis for further applications.

Data Collection Protocols

During the course of this study teachers were trained on IGDI measures, data collection and data analysis. To improve teacher implementation, teachers were offered assistance with data collection if needed. This feature of the study resulted in teachers in all but two classroom requesting assistance with data collection. Because only two teachers actually participated in the data collection procedures for more than 1 week it is likely that teacher buy-in was reduced and teacher commitment to intervention was compromised. Conversely, as a result of the provided data collector's inter-rater agreement, it was more likely that treatment integrity was maintained in those classrooms that did request assistance. As a result data collection protocols may have compromised face validity, but improved treatment integrity. This finding stimulates discussion for future studies regarding teacher protocol implementation that will be discussed in directions for future research.

Future Implications

The current study has both merits and limitations that should stimulate future investigation of the link between assessment as an intervention and student performance on emergent literacy measures both with and without an additional consultation model.

The current study provides important information about growth of emergent literacy skills for students in both suburban and urban environments as well as within both typically developing and special education populations. The surprising size of the effect of progress monitoring alone (*IGDIs Alone)* on emergent literacy performance serves as evidence of the power of data-based decision making when used to inform instruction. These data support the notion that assessment can be used as an intervention and the process of data-based decision making informs instruction in meaningful ways.

Moreover, these findings highlight the need to further investigate the effects of emergent literacy progress monitoring. Indeed, because progress monitoring is used frequently in schools across the nation, the implications for these results are promising. By informing teachers of the link between progress monitoring and improved achievement practitioners can highlight the link between awareness of student performance and improved student outcomes as a result tailored instruction and intervention.

Directions for Future Research

The results of the current study were mixed. Overall, results regarding progress monitoring as an intervention were consistent with past research that supported a link between progress monitoring and student performance as a result of data-based decision making. Indeed, findings suggest that the process of progress monitoring alone can offer valuable information to teachers to differentiate instruction in meaningful ways for students. However, results regarding progress monitoring with the addition of the BC model were not supportive of existing research literature on BC. In fact, research demonstrates that the BC model shows positive results on student achievement (Gutkin, 1996). Nevertheless, in this study, the BC model did not have a significant additional effect on student achievement above and beyond that of progress monitoring alone. This finding replicates at least one study which also indicated no additional effects attributable to the BC model (Teelucksingh, 2002). Furthermore, these findings suggest that using progress monitoring alone is a robust intervention to improve student achievement on emergent literacy measures. Considering these findings, continued investigation of both the link between progress monitoring and student achievement and the role of BC is an important research effort for future studies.

Future research should focus on determining evidence-based interventions applicable within the BC model when evaluating student progress monitoring data. By successfully identifying interventions that complement the BC model and result in improved outcomes professionals and students could benefit in significant ways, such as improved student achievement scores, improved collegial relationships and improved problem solving proficiency. Research should also focus on identifying particular intervention characteristics that allow teachers and professionals to be successful with progress monitoring on a biweekly basis through task analyses. By determining what resources are disposable and what resources are critical, future applications may be more likely to be accepted in classroom settings. For example, if data collection reminders or data-based decision making frameworks are critical features of data-based decision making, additional research should be conducted to reinforce efficacy and integrity of each feature.

Additionally, future research should consider applications in which teachers are required to collect student data to facilitate improved ownership, teacher buy-in and face validity. By facilitating teacher ownership of the data collection process research may explore or result in features that improve the effects or student outcomes as a result of progress monitoring. Similarly, direct assessment of teacher behavior during implementation to consider effects of personal bias, differential treatment based on disability status, integrity of intervention implementation for typically developing students compared to special education students and effects of reactivity should be explored to determine if intervention effectiveness can be improved as a result of changes in teacher behavior.

Further investigation of measures that performed poorly with specific demographic groups (special education students, typically developing students) should also be explored, specifically with larger sample sizes. Continued exploration of the relationship between disability status and progress-monitoring as an intervention may result in valuable research regarding how to improve student outcomes.

Finally, future research should investigate the parameters of the BC model that support progress monitoring data-based decision making. For this study, a time period of 25-30 minutes was chosen for consulting because this period appeared most frequently in the research as an effective time frame for school related meetings (Erchul & Martens, 2002). Future research should determine if this is time period is appropriate and how consultants can best use the time to result in meaningful outcomes for both teachers and students.

In conclusion, this study revealed progress monitoring as an intervention resulted in positive effects on student achievement compared to the Control Group, while progress monitoring with the addition of a BC model produced positive effects on student achievement compared to the Control Group, but not above and beyond the effects of progress monitoring alone. When these results were further examined by disability status, results indicated mixed findings suggesting future studies investigating progress monitoring with students with disabilities is warranted.

Appendix A. Power Analysis

Table A-1.

Power Analysis, Using an ANOVA Model, Repeated Measures, Between Factors

Sample Size	Effect Size	Alpha level	Correlation Among Measures	Power
30	.5	.05	.80	.684
30	.6	.05	.80	.842
30	.7	.05	.80	.937
45	.5	.05	.80	.872
45	.4	.05	.80	.684

Appendix B. Student Demographics by Teacher and Classroom

Table B-1.

Student Demographics by Teacher and Classroom

Teacher/Class	*n*	Percentage Non-white	Percentage Receiving Financial Aid	Mean Age Baseline	Mean Age Wave 11
1	7	100	83.3	222 (51.2)	248 (57.2)
2	3	0	33.3	235 (54.2)	260 (60.0)
3	8	37.5	0	216 (49.8)	242 (55.8)
4	7	60	50	241 (55.6)	269 (62.1)
5	9	100	87.5	238 (54.9)	261 (60.2)
6	10	80	70	256 (59.1)	281 (64.8)
7	3	0	0	204 (47.1)	207 (47.8)
8	5	60	40	193 (44.5)	219 (50.5)
9	7	60	71.4	205 (47.3)	229 (52.8)
10	4	0	0	228 (52.6)	256 (59.1)
11	6	50	0	232 (53.5)	260 (60.0)
12	5	20	60	211 (48.7)	239 (55.1)
13	5	60	60	226 (52.2)	251 (57.9)

Teacher/Class	*n*	Percentage Non-white	Percentage Receiving Financial Aid	Mean Age Baseline	Mean Age Wave 11
14	6	100	83.3	241 (48.5)	264 (60.9)
15	9	33.3	28.6	204 (47.1)	230 (53.1)
16	4	25	50	232 (53.5)	259 (59.8)
17	5	40	20	227 (52.4)	255 (58.8)
18	5	0	0	229 (52.8)	256 (59.1)
19	6	16.7	33.3	230 (53.1)	257(59.3)
20	4	75	100	204 (47.1)	231 (53.3)
21	4	75	100	241 (55.6)	266 (61.4)
22	1	0	0	232 (53.5)	256 (59.1)
23	11	93.9	72.7	189 (43.6)	214 (49.4)
24	6	83.3	66.7	205 (47.3)	230 (53.1)
25	8	75	62.5	192 (44.3)	219 (50.5)
26	2	50	0	176 (40.6)	202 (46.6)
27	6	100	66.7	172 (39.7)	198 (45.7)
28	5	100	100	231 (53.3)	257 (59.3)
29**	*NA*	*NA*	*NA*	*NA*	*NA*
30**	*NA*	*NA*	*NA*	*NA*	*NA*

*Age presented in weeks, with age in months presented in parentheses.

** Two classrooms withdrew from the study before initial demographic information was collected.

Appendix C. Early Literacy Study Progress-Monitoring with the Individual Growth and Development Indicators Demographic Survey

Date:________________________

Thank you again for allowing your child to participate in our project. To help us learn more about your child, we have some questions to ask you. It will take about 5 minutes to complete these questions. **You are free to skip any question you do not wish to answer**. All of the information you provide will be kept strictly confidential, viewed only by members of our research team and kept in locked files in our office. If you have any questions at any time, please contact Alisha Wackerle at wacke020@umn.edu.

Respondent

1. What is ***your*** name?

   First________________________________

   Last ________________________________

2. What is your relationship with the student? Please circle the best answer

   a. mother
   b. father
   c. grandparent
   d. other

Child Information

3. What is your child's name?

   First _________________

   Last _________________

4. What is your child's date of birth?

Month _____________,Date_____________Year_____

5. Is your child a *BOY or a GIRL*? (please circle the right answer)

6. What is ***your child's*** ethnic background? *(Circle all that apply.)*

a. American Indian or Alaska Native
b. Asian
c. Black or African American
d. Hispanic or Latino
e. Native Hawaiian or Other Pacific Islander
f. White
g. Other ___________________________

Language

7. What is the main language *you* speak at home?

a. English
b. Spanish
c. Other________________

8. What is the main language *your child* speaks at home? Circle the best answer

d. English
e. Spanish
f. Other________________

Socio-Economic Information

9. Is your family currently receiving some form of public financial assistance (for example, WIC, Food Stamps, Minnesota Family Investment Program, Free or Reduced School Lunches)? Please circle the best answer.

a. Yes
b. No
c. Don't know

10. How many ***adults*** are currently living in your household? Please circle the best answer.

a. 1
b. 2
c. 3
d. 4
e. more than 4 (How many?________)

11. How many ***children*** are currently living in your household?

a. 1
b. 2
c. 3
d. 4
e. More than 4 (How many?________)

Caregiver's Information

12. Tell us about your education. Please circle the best answer.

a. I did not attend high school
b. I attended some high school, but didn't graduate
c. I graduated from high school, but didn't go to college
d. I attended some college
e. I graduated from college
f. I went to graduate school

13. For how many years have you lived in the United States?
____________________ years

14. For how many years did you attend schools in the United States?
____________________ years

Appendix D. Excel Graphing Program

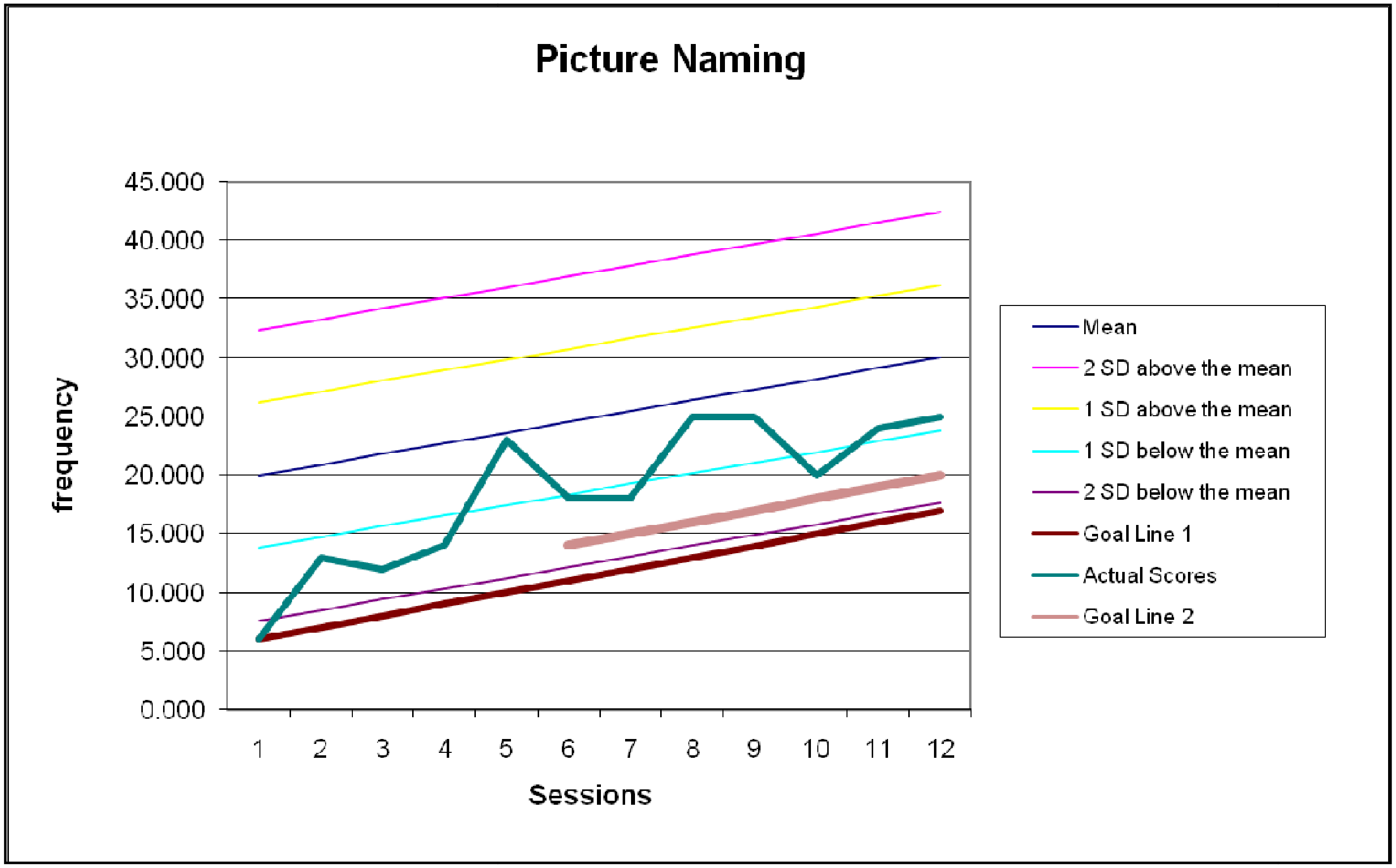
Picture Naming

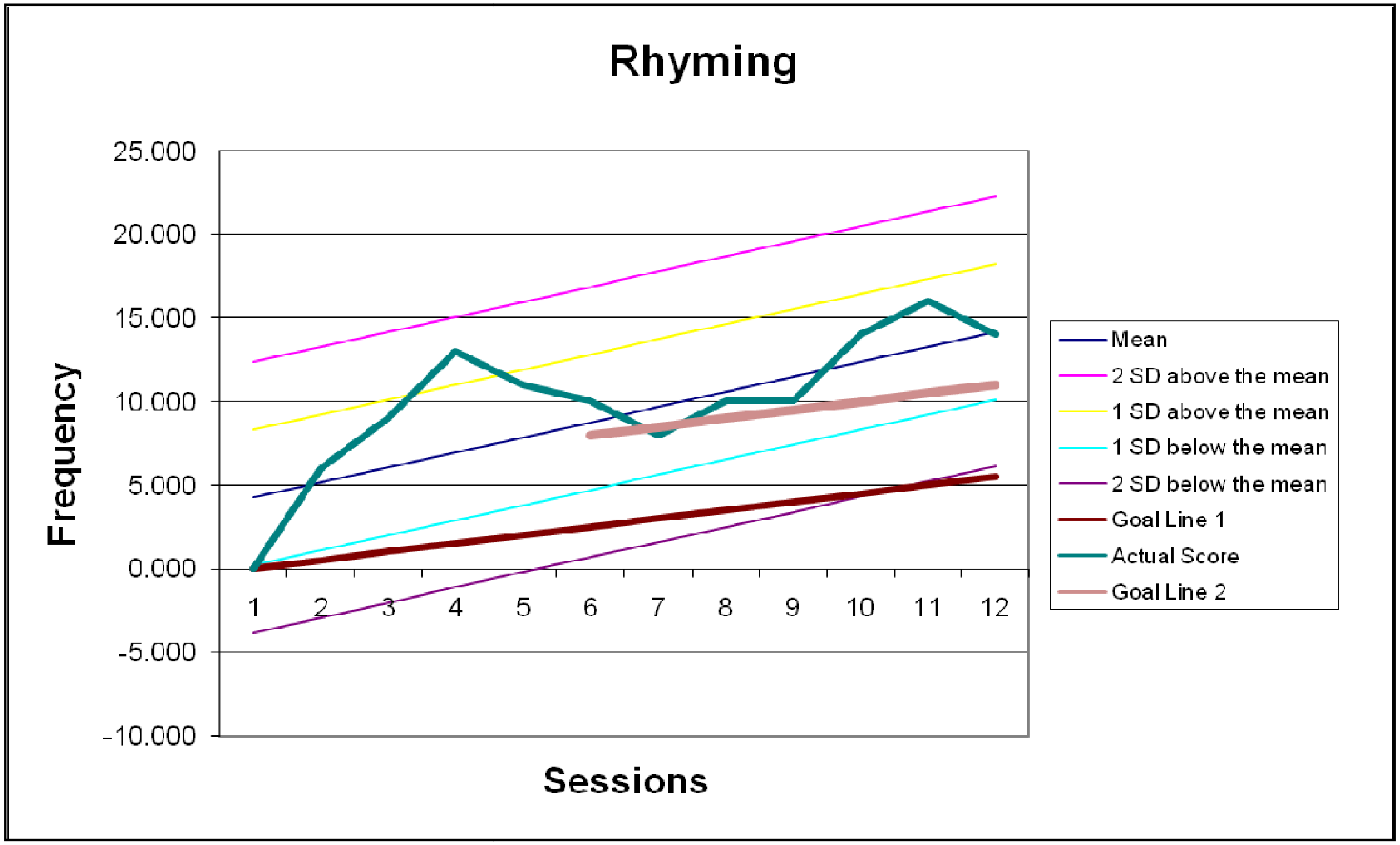
Wave	Norm	+2 SD	+1 SD	-1 SD	-2 SD	Goal Line	Data Entry	Goal Line 2
0	20.025	32.429	26.227	13.823	7.621	6	6	
1	20.933	33.337	27.135	14.731	8.529	7	13	
2	21.841	34.245	28.043	15.639	9.437	8	12	
3	22.749	35.153	28.951	16.547	10.345	9	14	
4	23.657	36.061	29.859	17.455	11.253	10	23	
5	24.565	36.969	30.767	18.363	12.161	11	18	14
6	25.473	37.877	31.675	19.271	13.069	12	18	15
7	26.381	38.785	32.583	20.179	13.977	13	25	16
8	27.289	39.693	33.491	21.087	14.885	14	25	17
9	28.197	40.601	34.399	21.995	15.793	15	20	18
10	29.105	41.509	35.307	22.903	16.701	16	24	19
11	30.013	42.417	36.215	23.811	17.609	17	25	20

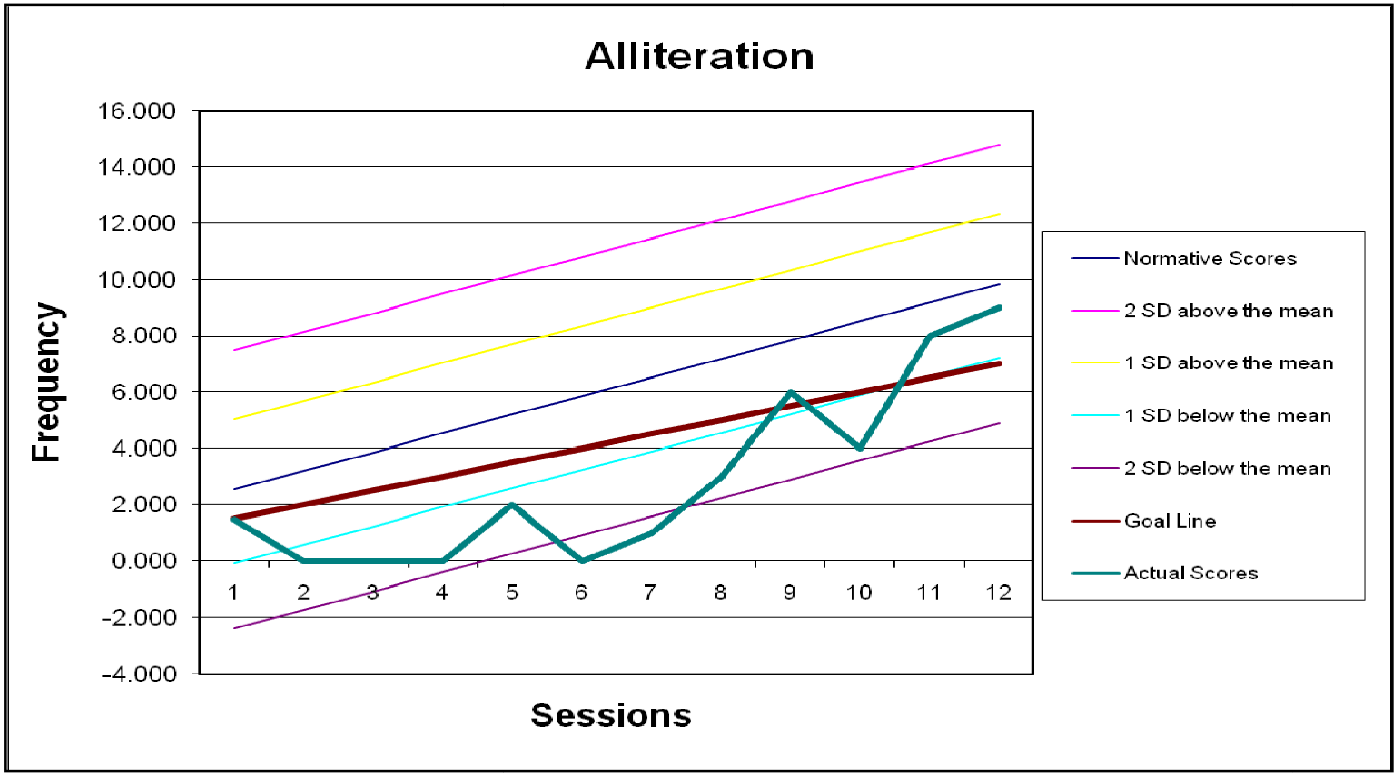
Rhyming

Wave	Norm	+2 SD	+1 SD	-1 SD	-2 SD	Goal Line	Data Entry	Goal Line 2
0	4.272	12.369	8.320	0.224	-3.825	0	0	
1	5.174	13.271	9.222	1.126	-2.923	0.5	6	
2	6.076	14.173	10.124	2.028	-2.021	1	9	
3	6.978	15.075	11.026	2.930	-1.119	1.5	13	
4	7.880	15.977	11.928	3.832	-0.217	2	11	
5	8.782	16.879	12.830	4.734	0.685	2.5	10	8
6	9.684	17.781	13.732	5.636	1.587	3	8	8.5
7	10.586	18.683	14.634	6.538	2.489	3.5	10	9
8	11.488	19.585	15.536	7.440	3.391	4	10	9.5
9	12.390	20.487	16.438	8.342	4.293	4.5	14	10
10	13.292	21.389	17.340	9.244	5.195	5	16	10.5
11	14.194	22.291	18.242	10.146	6.097	5.5	14	11

Alliteration							
Wave	Norm	+2 SD	+1 SD	-1 SD	-2 SD	Goal Line	Data Entry
0	2.560	7.498	5.029	-0.091	-2.379	1.5	1.5
1	3.223	8.161	5.692	0.572	-1.716	2	0
2	3.886	8.824	6.355	1.235	-1.053	2.5	0
3	4.549	9.487	7.018	1.898	-0.390	3	0
4	5.211	10.150	7.681	2.561	0.273	3.5	2
5	5.874	10.813	8.344	3.224	0.936	4	0
6	6.537	11.476	9.006	3.887	1.599	4.5	1
7	7.200	12.139	9.669	4.550	2.262	5	3
8	7.863	12.802	10.332	5.213	2.924	5.5	6
9	8.526	13.464	10.995	5.876	3.587	6	4
10	9.189	14.127	11.658	6.538	4.250	6.5	8
11	9.852	14.790	12.321	7.201	4.913	7	9


Picture Naming
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
frequency
1
2
3
4
5
6
7
8
9
10
11
12
Sessions
Mean
2 SD above the mean
1 SD above the mean
1 SD below the mean
2 SD below the mean
Goal Line 1
Actual Scores
Goal Line 2


Rhyming
Frequency
25.000
20.000
15.000
10.000
5.000
0.000
-5.000
-10.000
1 2 3 4 5 6 7 8 9 10 11 12
Sessions
Mean
2 SD above the mean
1 SD above the mean
1 SD below the mean
2 SD below the mean
Goal Line 1
Actual Score
Goal Line 2


Alliteration
Frequency
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
-2.000
-4.000
1
2
3
4
5
6
7
8
9
10
11
12
Sessions
Normative Scores
2 SD above the mean
1 SD above the mean
1 SD below the mean
2 SD below the mean
Goal Line
Actual Scores

Appendix E. Likert Teacher Surveys

Early Literacy Study Evaluation Survey

Treatment group 1

This survey is intended to gauge your personal evaluation of the early literacy study that took place in your classroom over the course of the majority of the academic year (September 2007 to April 2008). Please answer the following questions to the best of your ability regarding your experience in the early literacy study. Your answers will be kept both private and confidential.

For the purposes of this survey the term "*progress-monitoring*" refers to the assessments with the Individual Growth and Development Indicators (IGDIs) that took place with your students on a biweekly basis.

The term "*consultation*" refers to the meetings and interactions which occurred to discuss your students' data between you and the lead researcher.

<u>Progress-Monitoring</u>

1. Bi-weekly progress-monitoring of early literacy skills (with the Individual Growth and Development Indicators [IGDIs]) was a valuable addition to current assessment methods which occur in my classroom.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

2. Progress-monitoring data helped me be better informed to make instructional decisions for my students.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

3. Progress-monitoring is a useful method for assessing student performance on a frequent basis.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

Teaching and Pedagogy

4. I feel that my ability to evaluate student *early literacy performance* has improved because of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

   For the following question the phrase “*evaluate student data*" is referring only to your ability to see changes in the data. For example: student 1improved his or her score from week 1 to week 3.

5. I feel that I am better able to **evaluate** *student data* as a result of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

   For the following question the phrase “*use student data to make educational decisions*” is referring to your ability to go further and not only evaluate the data but also use it in meaningful ways to make educational decisions. For example, not only can you notice that student 1 has improved from week 1 to week 3, you can use that data to change instruction.

6. I feel that I am better able to use *student data* **to make educational decisions** as a result of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

7. In the future, I am likely to continue using a progress-monitoring measure like the one used in this study in the assessments I complete with my students.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

8. After participating in this study I feel that I use research to inform my teaching more than I did before participating in the study.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

9. After participating in this study I feel that my students were offered more opportunities to respond during classroom instruction.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

Data-based Decision Making and Computer-based Graphing Program

10. Assessment is an integral part of my planning and teaching.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

11. Assessment ***does not*** inform my instruction.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

*****When answering questions 12 through 17 please reflect on your use and experience specifically with the EXCEL graphing program*****

For the following question the phrase "*evaluate my student's progress*" is referring only to your ability to see changes in the data within the EXCEL graphing program. For example: student 1 improved his or her score from week 1 to week 3.

12. The EXCEL graphing program improved my ability to **evaluate** my student's progress.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

For the following question the phrase "*inform instructional changes*" is referring to your ability to go further with the data in the EXCEL graphing program and not only evaluate it, but also use it in meaningful ways to make educational decisions. For example, not only can you notice that student 1 has improved from week 1 to week 3, you can use that data to change instruction.

13. The EXCEL graphing allowed me to use my student's data to **inform instructional changes**.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

14. I feel comfortable using the EXCEL graphing program on my own after participating in this study.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

15. I am likely to continue using the EXCEL graphing program.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

16. The EXCEL graphing program was easy to navigate.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

17. When I had questions about the EXCEL program they were quickly resolved.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○ Not Applicable ○

18. How often during this study did you spend reviewing student data?

Once a day	Three times a week	Twice a week	Once a week	Once every other week	Less than every other Week
○	○	○	○	○	○

Consultation Process

19. The consultation meetings allowed me to gain a better knowledge of student performance.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

20. I feel the consultation experience was a critical component in this study.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

21. In the future, I would participate in consultative services similar to those provided in this study.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

Personal Information

To put your answers in context, we would like to gather some personal information from you. Of course, your answers will be held in the strictest confidence. Please answer only those questions you feel comfortable with.

22. I have been teaching for ___________ years.

23. In my class I teach students who are:

In Early Childhood Special Education	Typically Developing Children	Both
○	○	○

24. I am _____________years old.

25. I am of ________________ethnicity.

Overall impressions

26. I feel that participating in this study was a ***negative*** experience.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

27. I would be willing to implement the strategies investigated in this study in the future.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

28. I believe my students' (who participated in the study) ***early literacy achievement improved*** as a result of participation in this study.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	○

29. Was your experience in this study worth the time you invested in the study? If so, what value did you receive? If not, please explain.

____
____
____
____
____

30. Please describe any suggestions or concerns you have had during your experience in this study.

____
____
____
____
____

Thank you for your time!

To return this survey you can chose one of two methods:

1. Place the completed envelope in the included self-addressed stamped envelope and place it in the mail.
2. Give it directly to Alisha Wackerle-Hollman (lead researcher of this study) at a scheduled pick up time.

Once your completed survey is returned you will receive the $30.00 Lake Shore learning gift card, as originally stated at the beginning of the study

Early Literacy Study Evaluation Survey

Treatment group 2

This survey is intended to gauge your personal evaluation of the early literacy study that took place in your classroom over the course of the majority of the academic year (September 2007 to April 2008). Please answer the following questions to the best of your ability regarding your experience in the early literacy study. Your answers will be kept both private and confidential.

For the purposes of this survey the term "*progress-monitoring"* refers to the assessments with the Individual Growth and Development Indicators (IGDIs) that took place with your students on a biweekly basis.

Progress-Monitoring

1. Bi-weekly progress-monitoring of early literacy skills (with the Individual Growth and Development Indicators[IGDIs]) was a valuable addition to current assessment methods which occur in my classroom.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

2. Progress-monitoring data helped me be better informed to make instructional decisions for my students.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

3. Progress-monitoring is a useful method for assessing student performance on a frequent basis.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

Teaching and Pedagogy

4. I feel that my ability to evaluate student *early literacy performance* has improved because of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

   For the following question the phrase "*evaluate student data*" is referring only to your ability to see changes in the data. For example: student 1improved his or her score from week 1 to week 3.

5. I feel that I am better able to **evaluate** *student data* as a result of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

   For the following question the phrase "*use student data to make educational decisions*" is referring to your ability to go further and not only evaluate the data but also use it in meaningful ways to make educational decisions. For example, not only can you notice that student 1 has improved from week 1 to week 3, you can use that data to change instruction.

6. I feel that I am better able to use *student data* **to make educational decisions** as a result of my participation in this study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

7. In the future, I am likely to continue using a progress-monitoring measure like the one used in this study in the assessments I complete with my students.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

8. After participating in this study I feel that I use research to inform my teaching more than I did before participating in the study.

   Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

9. After participating in this study I feel that my students were offered more opportunities to respond during classroom instruction.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

Data-based Decision Making and Computer-based Graphing Program

10. Assessment is an integral part of my planning and teaching.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

11. Assessment ***does not*** inform my instruction.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

*****When answering questions 12 through 17 please reflect on your use and experience specifically with the EXCEL graphing program*****

For the following question the phrase "*evaluate my student's progress*" is referring only to your ability to see changes in the data within the EXCEL graphing program. For example: student 1 improved his or her score from week 1 to week 3.

12. The EXCEL graphing program improved my ability to **evaluate** my student's progress.

Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

For the following question the phrase "*inform instructional changes*" is referring to your ability to go further with the data in the EXCEL graphing program and not only evaluate it, but also use it in meaningful ways to make educational decisions. For example, not only can you notice that student 1 has improved from week 1 to week 3, you can use that data to change instruction.

13. The EXCEL graphing allowed me to use my student's data to **inform instructional changes**.

Strongly Agree ○ | Agree ○ | Disagree ○ | Strongly Disagree ○

14. I feel comfortable using the EXCEL graphing program on my own after participating in this study.

Strongly Agree ○ | Agree ○ | Disagree ○ | Strongly Disagree ○

15. I am likely to continue using the EXCEL graphing program.

Strongly Agree ○ | Agree ○ | Disagree ○ | Strongly Disagree ○

16. The EXCEL graphing program was easy to navigate.

Strongly Agree ○ | Agree ○ | Disagree ○ | Strongly Disagree ○

17. When I had questions about the EXCEL program they were quickly resolved.

Strongly Agree ○ | Agree ○ | Disagree ○ | Strongly Disagree ○ | Not Applicable ○

18. How often during this study did you spend reviewing student data?

Once a day	Three times a week	Twice a week	Once a week	Once every other week	Less than once every other week
○	○	○	○	○	○

Personal Information

To put your answers in context, we would like to gather some personal information from you. Of course, your answers will be held in the strictest confidence. Please answer only those questions you feel comfortable with.

19. I have been teaching for ___________ years.

20. In my class I teach students who are:

In Early Childhood Special Education ○ Typically Developing Children ○ Both ○

21. I am _____________years old.

22. I am of ________________ethnicity.

Overall impressions

23. I feel that participating in this study was a ***negative*** experience.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

24. I would be willing to implement the strategies investigated in this study in the future.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

25. I believe my students' (who participated in the study) ***early literacy achievement improved*** as a result of participation in this study.

    Strongly Agree ○ Agree ○ Disagree ○ Strongly Disagree ○

26. Was your experience in this study worth the time you invested in the study? If so, what value did you receive? If not, please explain.

____
____
____
____
____

27. Please describe any suggestions or concerns you have had during your experience in this study.

____
____
____
____
____

Thank you for your time!

To return this survey you can chose one of two methods:

28. Place the completed envelope in the included self-addressed stamped envelope and place it in the mail.

29. Give it directly to Alisha Wackerle-Hollman (lead researcher of this study) at a scheduled pick up time.

Once your completed survey is returned you will receive the $30.00 Lake Shore learning gift card, as originally stated at the beginning of the study

Appendix F. IGDI Data Recording Forms

Teacher Recording Form

Teacher____________________________ School__________________Date_____________

Student	*Picture Naming*	*Rhyming*	*Alliteration*	Notes

Teacher____________________________ School__________________Date_____________

Student	*Picture Naming*	*Rhyming*	*Alliteration*	Notes

Teacher____________________________ School__________________Date_____________

Student	*Picture Naming*	*Rhyming*	*Alliteration*	Notes

Get it Got it Go!

Student Tracking Form
Page of

Student: DOB: Printed:
Teacher: School: Group/Class:

Test Name	Assessment Date	Score*	Comments

*Score is the number of correct answers

Appendix G. HMLM Analysis Output

Table G-1.

HMLM Output

Treatment Group	Measure	Disability Status
IGDIs Alone	*Picture Naming*	Typically developing
		Special education
	Rhyming	Typically developing
		Special education
	Alliteration	Typically developing
		Special education
IGDIs + Consultation	*Picture Naming*	Typically developing
		Special education
	Rhyming	Typically developing
		Special education
	Alliteration	Typically developing
		Special education

Appendix H. Descriptive Analysis of IGDI Measures and TOPEL

by Treatment Groups and Waves

Table H-1.

Picture Naming Descriptive by Treatment Group and Wave

	n	Minimum	Maximum	Mean	SD
Control					
Baseline	47	.00	26.00	10.40	6.67
Wave 11	35	.00	32.00	17.60	8.48
IGDIs Alone					
Baseline	50	.00	26.00	14.33	6.67
Wave 1	39	3.00	33.00	14.92	6.71
Wave 2	42	5.00	29.00	17.83	6.27
Wave 3	42	5.00	31.00	19.04	6.28
Wave 4	43	7.00	35.00	22.93	6.90
Wave 5	42	10.00	45.00	24.02	7.47
Wave 6	37	10.00	43.00	24.27	7.70
Wave 7	41	6.00	41.00	25.85	7.12
Wave 8	46	7.00	40.00	25.45	7.15
Wave 9	38	14.00	36.00	24.94	5.17
Wave 10	40	6.00	35.00	24.47	6.03
Wave 11	46	3.00	39.00	26.76	6.50

	n	Minimum	Maximum	Mean	SD
		IGDIs + Consultation			
Baseline	160	.00	26.50	12.88	6.94
Wave 1	87	.00	33.00	14.97	7.19
Wave 2	96	.00	39.00	18.93	7.65
Wave 3	91	.00	31.00	19.64	6.75
Wave 4	97	1.00	35.00	22.18	7.21
Wave 5	93	.00	45.00	23.75	7.25
Wave 6	88	.00	43.00	24.06	7.57
Wave 7	90	2.00	41.00	24.57	7.04
Wave 8	96	.00	40.00	24.84	7.19
Wave 9	87	3.00	37.00	25.00	6.15
Wave 10	89	2.00	37.00	24.86	6.79
Wave 11	129	.00	39.00	23.79	8.13

Table H-2.

Rhyming Descriptive by Treatment Group and Wave

	N	Minimum	Maximum	Mean	SD
			Control		
Baseline	47	.00	13.00	0.66	2.15
Wave 11	35	.00	19.00	1.71	3.73
			IGDIs Alone		
Baseline	50	.00	14.00	1.77	3.04
Wave 1	39	.00	13.00	3.13	4.02
Wave 2	42	.00	19.00	3.76	5.34
Wave 3	42	.00	17.00	4.52	5.42
Wave 4	43	.00	20.00	4.91	6.41
Wave 5	42	.00	25.00	5.19	7.48
Wave 6	37	.00	26.00	5.40	6.59
Wave 7	41	.00	30.00	6.15	7.77
Wave 8	46	.00	25.00	6.63	7.73
Wave 9	38	.00	29.00	7.39	8.46
Wave 10	40	.00	26.00	6.83	8.11
Wave 11	46	.00	33.00	8.09	9.07

	N	Minimum	Maximum	Mean	SD
		IGDIs + Consultation			
Baseline	63	.00	11.00	1.56	2.89
Wave 1	48	.00	20.00	2.63	4.61
Wave 2	54	.00	18.00	2.87	4.72
Wave 3	49	.00	20.00	3.71	5.43
Wave 4	54	.00	21.00	3.43	5.65
Wave 5	51	.00	20.00	5.02	6.75
Wave 6	51	.00	21.00	4.78	6.52
Wave 7	49	.00	24.00	5.27	7.09
Wave 8	50	.00	24.00	4.86	7.18
Wave 9	49	.00	31.00	6.69	7.65
Wave 10	49	.00	28.00	5.71	6.73
Wave 11	48	.00	23.00	6.10	6.98

Table H-3.

Alliteration Descriptives by Treatment Group and Wave

	N	Minimum	Maximum	Mean	SD
		Control			
Baseline	47	.00	4.00	0.16	0.68
Wave 11	35	.00	5.00	0.71	1.40
		IGDIs Alone			
Baseline	51	.00	6.00	1.19	1.60
Wave 1	39	.00	17.00	2.58	3.82
Wave 2	42	.00	11.00	1.33	2.39
Wave 3	42	.00	14.00	1.54	3.23
Wave 4	43	.00	11.00	1.74	3.00
Wave 5	42	.00	10.00	1.73	3.10
Wave 6	37	.00	14.00	1.81	3.28
Wave 7	41	.00	18.00	2.26	4.04
Wave 8	46	.00	19.00	2.71	4.43
Wave 9	38	.00	19.00	3.97	5.15
Wave 10	40	.00	20.00	4.27	5.39
Wave 11	46	.00	23.00	4.04	5.68

	N	Minimum	Maximum	Mean	SD
		IGDIs + Consultation			
Baseline	63	.00	13.50	.97	2.52
Wave 1	48	.00	9.00	1.18	2.46
Wave 2	54	.00	13.00	1.66	3.40
Wave 3	49	.00	11.00	1.97	3.21
Wave 4	54	.00	18.00	2.22	4.11
Wave 5	51	.00	18.00	2.64	4.75
Wave 6	51	.00	17.00	2.84	4.47
Wave 7	49	.00	17.00	2.26	4.11
Wave 8	50	.00	23.00	2.30	4.80
Wave 9	49	.00	23.00	3.38	5.82
Wave 10	49	.00	23.00	3.18	5.30
Wave 11	48	.00	18.00	2.89	4.06

Table H-4

TOPEL Descriptives by Wave and Treatment Group

	N	Minimum	Maximum	Mean	Std. Deviation
			Control		
Time 1 Early literacy Index	43	45.00	108.00	74.18	17.31
Time 1 Print Knowledge	43	.00	26.00	7.16	7.81
Time 1 Definitional Vocabulary	43	.00	57.00	24.13	15.60
Time 1 Phonological Awareness	43	.00	17.00	4.37	4.26
Time 2 Early Literacy Index	36	50.00	107.00	77.66	17.03
Time 2 Print Knowledge	36	.00	33.00	9.25	9.42
Time 2 Definitional Vocabulary	36	.00	59.00	29.77	16.57
Time 2 Phonological Awareness	36	.00	18.00	6.36	5.36

	N	Minimum	Maximum	Mean	Std. Deviation
			IGDIs Alone		
Time 1 Early literacy Index	48	52.00	121.00	81.12	18.67
Time 1 Print Knowledge	48	.00	33.00	11.10	9.48
Time 1 Definitional Vocabulary	48	1.00	62.00	35.58	18.27
Time 1 Phonological Awareness	48	.00	26.00	7.50	6.96
Time 2 Early Literacy Index	48	50.00	118.00	88.02	17.42
Time 2 Print Knowledge	48	.00	36.00	20.41	11.27
Time 2 Definitional Vocabulary	48	.00	64.00	40.39	14.78
Time 2 Phonological Awareness	48	.00	26.00	11.77	6.17

	N	Minimum	Maximum	Mean	Std. Deviation
		IGDIs + Consultation			
Time 1 Early Literacy Index	63	40.00	119.00	77.88	18.71
Time 1 Print Knowledge	62	.00	35.00	11.35	10.70
Time 1 Definitional Vocabulary	62	1.00	65.00	32.40	17.94
Time 1 Phonological Awareness	62	.00	23.00	7.01	6.44
Time 2 Early Literacy Index	55	53.00	120.00	87.98	16.81
Time 2 Print Knowledge	55	1.00	35.00	17.70	11.78
Time 2 Definitional Vocabulary	55	.00	66.00	41.05	16.40
Time 2 Phonological Awareness	55	2.00	25.00	12.18	6.77

Note ** Print Knowledge, Definitional Vocabulary and Phonological Awareness are all TOPEL subtests that comprise the Early Literacy Index

Table H-5.

Summary of TOPEL Descriptives by Treatment Group

	Minimum	Maximum	Mean	SD
	Control			
Early literacy Index	47.50	107.50	75.92	17.17
Print Knowledge	.00	29.50	8.21	8.82
Definitional Vocabulary	.00	58.00	26.95	16.10
Phonological Awareness	.00	17.50	5.37	4.81
	IGDIs Alone			
Early literacy Index	51.00	119.50	84.57	18.04
Print Knowledge	0.00	34.50	15.76	10.38
Definitional Vocabulary	0.50	63.00	37.99	16.53
Phonological Awareness	.00	26.00	9.64	6.57
	IGDIs + Consultation			
Early Literacy Index	46.5	119.50	82.93	17.76
Print Knowledge	0.50	34.00	11.23	11.24
Definitional Vocabulary	0.50	65.50	36.73	17.17
Phonological Awareness	1.00	24.00	9.60	6.61

Appendix I. Tests of Normality

Table I-1.

IGDI Tests of Normality at Baseline

Treatment Group		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
		Statistic	*Df*	Sig.	Statistic	*df*	Sig.
Baseline							
Picture Naming	*IGDIs + Consultation*	.13	63	.01	.95	63	.01
	Control	.11	47	.20*	.96	47	.16
	IGDIs Alone	.10	50	.20*	.98	50	.37
Rhyming	*IGDIs + Consultation*	.37	63	.00	.62	63	.00
	Control	.41	47	.00	.35	47	.00
	IGDIs Alone	.28	50	.00	.65	50	.00
Alliteration	*IGDIs + Consultation*	.38	63	.00	.44	63	.00
	Control	.51	47	.00	.25	47	.00
	IGDIs Alone	.29	50	.00	.75	50	.00

*Note *p >.05* indicating normality is acceptable

Table I-2.

IGDI Test of Normality at Wave 11

Treatment Group		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
		Statistic	*df*	Sig.	Statistic	*df*	Sig.
		Wave 11					
Picture Naming	*IGDIs + Consultation*	.10	48	.20(*)	.95	48	.03
	Control	.08	35	.20(*)	.97	35	.40
	IGDIs Alone	.11	46	.20(*)	.95	46	.03
Rhyming	*IGDIs + Consultation*	.24	48	.00	.83	48	.00
	Control	.36	35	.00	.53	35	.00
	IGDIs Alone	.19	46	.00	.85	46	.00
Alliteration	*IGDIs + Consultation*	.28	48	.00	.75	48	.00
	Control	.47	35	.00	.57	35	.00
	IGDIs Alone	.28	46	.00	.75	46	.00

*Note *p >.05* indicating normality is acceptable.

Appendix J. Raw Score Mean Performance by Treatment Group

Figure J-1.

IGDI Mean Performance by Wave and Treatment Group

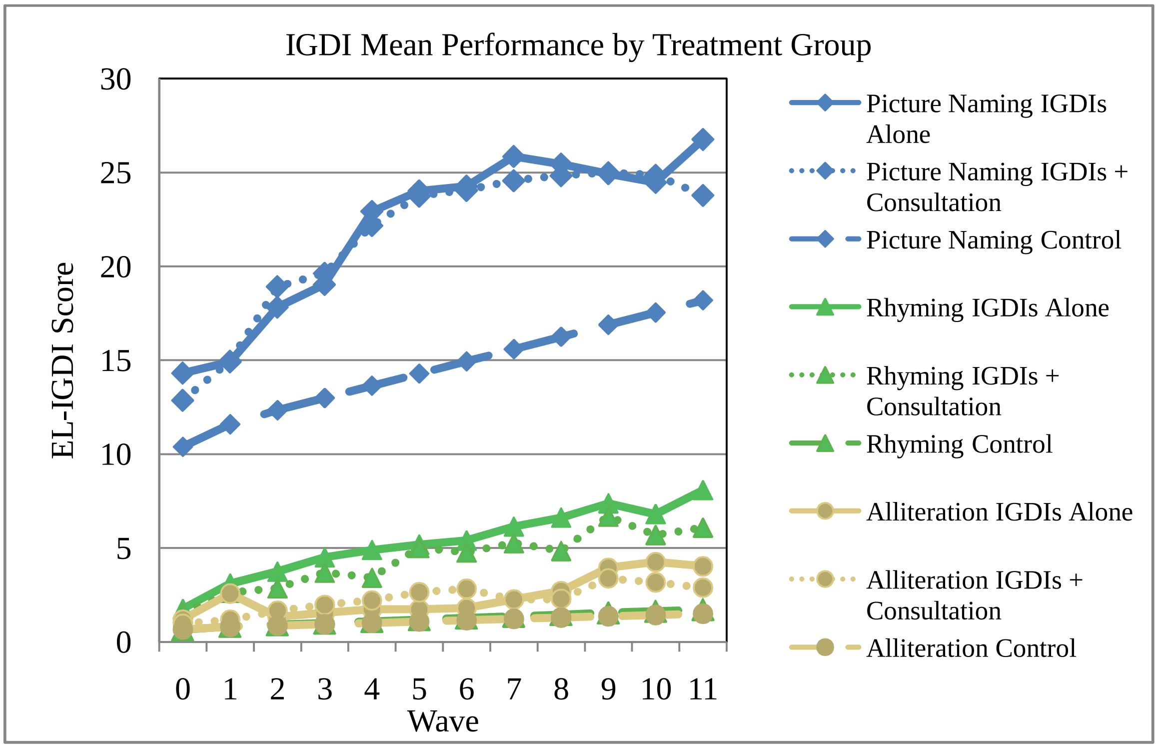


Figure J-2.

Mean Performance for *IGDIs Alone* by Wave, Disability Status and Measure

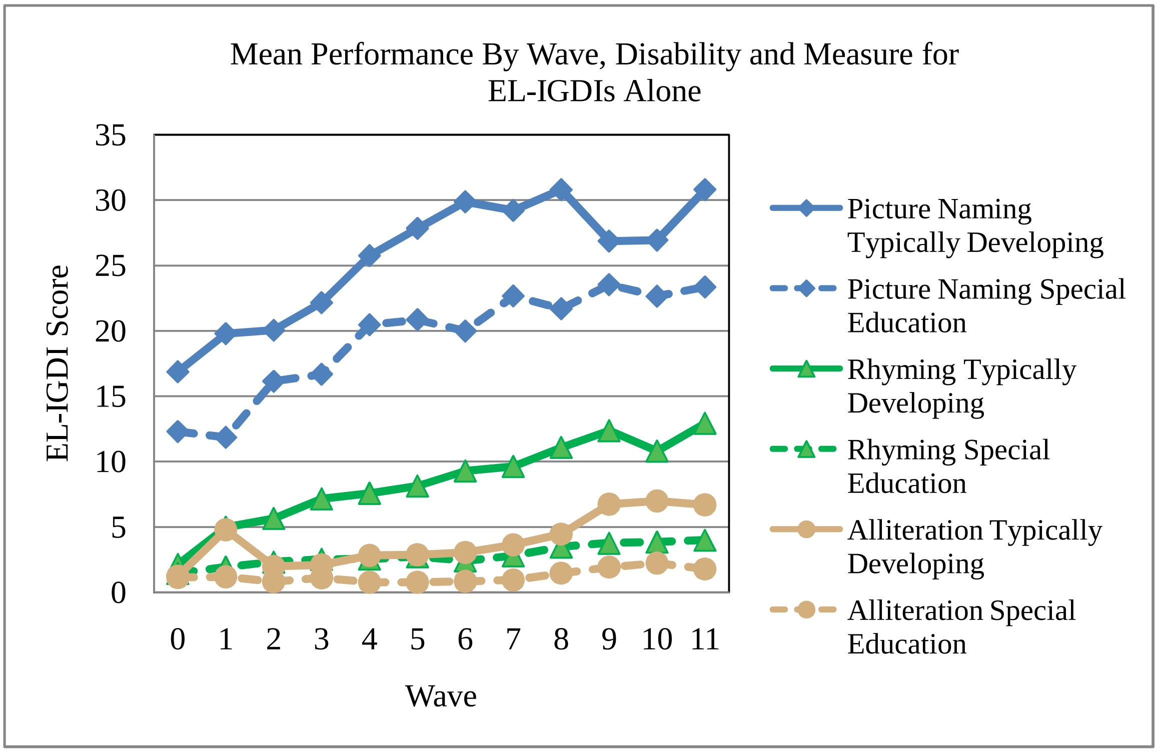
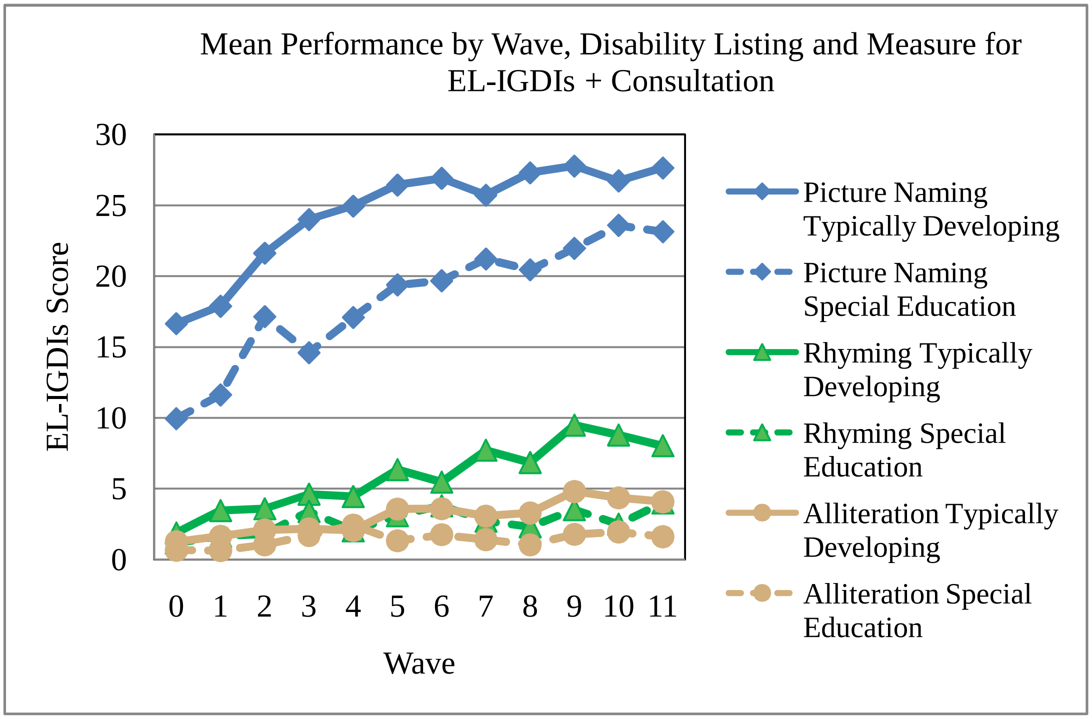


Figure J-3.

Mean Performance for *IGDIs + Consultation* by Wave, Disability Status and Measure



Appendix K. Effect Size Comparison Groups

Table K-1.

Effect Sizes for IGDIs by Treatment Group and Disability Status

Treatment Group by Measure	Disability Status	Effect Sizes	
		Absolute Effect Size	Relative Effect Size
Picture Naming			
IGDIs + Consultation	Typically Developing	5.02	1.92
	Special Education	4.76	1.83
IGDIs Alone	Typically Developing	6.00	2.90
	Special Education	4.43	1.50
Control	Typically Developing	3.10	--
	Special Education	2.93	--

Treatment Group by Measure	Disability Status	Effect Sizes	
		Absolute Effect Size	Relative Effect Size
Rhyming			
IGDIs + Consultation	Typically Developing	2.73	0.70
	Special Education	0.70	0.10
IGDIs Alone	Typically Developing	4.26	2.23
	Special Education	1.18	0.58
Control	Typically Developing	2.03	--
	Special Education	0.60	--

Treatment Group by Measure	Disability Status	Effect Sizes	
		Absolute Effect Size	Relative Effect Size
Alliteration			
IGDIs + Consultation	Typically Developing	1.45	0.51
	Special Education	0.62	0.36
IGDIs Alone	Typically Developing	2.61	1.67
	Special Education	0.43	0.17
Control	Typically Developing	0.94	--
	Special Education	0.26	--

Note: All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

Appendix L. HMLM Summary Statistics Table

Table L-1.

Summary Statistics for HMLM Analyses

Research Question	Treatment Group	Disability Status	IGDI Measure	Intercept β_{00}	Sig.	Slope β_{10}	Sig.
1	*IGDIs Alone*	NA	*Picture Naming*	15.30	0.00**	1.17	0.00*
1	*IGDIs Alone*	NA	*Rhyming*	2.40	0.01*	0.52	0.00*
1	*IGDIs Alone*	NA	*Alliteration*	0.94	0.05*	0.27	0.00*
2	*IGDIs Alone*	Typically Developing	*Picture Naming*	17.82	0.00**	1.17	0.00*
2	*IGDIs Alone*	Typically Developing	*Rhyming*	4.37	0.25	0.43	0.00*

Research Question	Treatment Group	Disability Status	IGDI Measure	Intercept β_{00}	Sig.	Slope β_{10}	Sig.
2	*IGDIs Alone*	Typically Developing	*Alliteration*	0.94	0.46	0.42	0.00*
2	*IGDIs Alone*	Special Education	*Picture Naming*	13.46	0.00*	1.18	0.00*
2	*IGDIs Alone*	Special Education	*Rhyming*	0.64	0.23	0.15	0.00*
2	*IGDIs Alone*	Special Education	*Alliteration*	0.87	0.18	0.12	0.03*
3	*IGDIs + Consultation*	NA	*Picture Naming*	16.82	0.00*	1.15	0.00*
3	*IGDIs + Consultation*	NA	*Rhyming*	0.89	0.17	0.46	0.00*
3	*IGDIs + Consultation*	NA	*Alliteration*	0.65	0.12	0.20	0.00*

*$p<.05$

Research Question	Treatment Group	Disability Status	IGDI Measure	Intercept β_{00}	Sig.	Slope β_{10}	Sig.
4	*IGDIs + Consultation*	Typically Developing	*Picture Naming*	19.75	0.00*	0.97	0.00*
4	*IGDIs + Consultation*	Typically Developing	*Rhyming*	1.00	0.38	0.72	0.00*
4	*IGDIs + Consultation*	Typically Developing	*Alliteration*	0.97	0.25	0.35	0.00*
4	*IGDIs + Consultation*	Special Education	*Picture Naming*	12.47	0.00*	1.46	0.00*
4	*IGDIs + Consultation*	Special Education	*Rhyming*	1.18	0.21	0.19	0.00*
4	*IGDIs + Consultation*	Special Education	*Alliteration*	0.41	0.42	0.11	0.00*
4	*IGDIs + Consultation*	Typically Developing	*Picture Naming*	19.75	0.00*	0.97	0.00*

*$p<.05$

Appendix M.

Definitions

General Outcome Measures*:* General Outcomes Measures are a type of assessment tools that aim to measure skills representative of a more global outcome. These measures are generally generic measurement procedures used with stimulus materials that are not drawn directly from the curriculum, but rather are a more global representation of a particular skill set. To be identified as a General Outcome Measure the tool must meet at least 6 criteria: it must be inexpensive, easy to use, instructionally relevant, brief (1 to 2 minutes), it must be a robust measure of the domain and attend to long term goals (for at least a year), and finally they must not require teachers to construct instructional hierarchies before assessment can occur.

Individual Growth and Development Indicators*:* Individual Growth and Development Indicators (IGDIs) are a set of three emergent literacy tasks that assess the more global domain of emergent literacy. These tasks include one vocabulary task and two phonemic awareness tasks (*Rhyming* and *Alliteration*). The IGDIs are General Outcome Measures and demonstrate adequate reliability and validity to assist in determining if instructional modifications are needed through progress monitoring.

Progress Monitoring: The process of measuring students on a specific skill (e.g. reading, vocabulary etc.) over very brief periods of time to assess and monitor student growth.

Data-based Decisions: Any decision regarding a student's emergent literacy skills that has been informed by documented IGDIS scores for a period of at least three data points.

Emergent Literacy Skills: Those skills representative of emergent/emergent literacy, which include within the frame of this study, but are not limited to: vocabulary acquisition and phonemic awareness.

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