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A Preschool and Kindergarten Numeracy and Communication Benchmark Screener for a Response to Intervention Model

by

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Abstract

The interrelationship between language and numeracy skill acquisition has been a topic of research in recent decades. In the early years of formal schooling, language/communication benchmark screening assessments have been utilized by school districts to establish the amount of support required for student success. Few benchmark screeners have been created to determine the support needed for successful numeracy knowledge attainment. Even fewer have been developed and implemented to determine the language/numeracy connection in early learners. The project is a preschool and kindergarten informal numeracy skills benchmark screener assessment which includes an emphasis on mathematical language. This screener is to be applied as part of the Response to Intervention model of instruction. The assessment is to be administered by a classroom teacher in the first term of kindergarten or the last term of preschool. The information and observation data are to be analyzed for an RTI level of support determination.

Keywords: Communication Disability, Dyscalculia, Response to Intervention, Benchmark screener, Informal numeracy knowledge, Formal Numeracy knowledge,

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Chapter 1

Introduction

The Preschool and Kindergarten years are essential for the acquisition of language, reading, and numeracy readiness skills. Language, prereading, and math skills have been traditionally taught as separate subjects during the course of the school day in formal education. Researchers have been studying the interrelationship of math and communication skills for many decades.

> Math skills are just one part of a larger web of skills that children are developing in the early years—including language skills, physical skills, and social skills. Each of these skill areas is dependent on and influences the others" (Bowman, Donovan & Burns, 2001, pp. 441-442).

Moreover, research states that a communication or language disability may impact the acquisition of numeracy skills. "Language is assumed to be one of the main inputs for learning and, therefore, the acquisition of early numeracy skills is highly dependent on language acquisition" (Duncan et al., 2007). The capability to comprehend and sequence numerical problems appear weakened in students with communication/language difficulties. In fact, children demonstrating delays in their language or having a language impairment may also demonstrate a disadvantage in early numeracy development (Arvedson, 2002). In addition, it has been argued that "adequate language skills are a prerequisite for learning early mathematics" (Kleemans et al., 2011a, p. 555). Therefore, it may be generally acknowledged that children with low language and numeracy skills are at-risk for learning disabilities in the formal education system.

A Preschool and Kindergarten Language and Numeracy Screener

Numeracy skills development is of importance to all students, not only students with communication/language difficulties. "Alberta students need strong literacy and numeracy skills to navigate and make meaning in an increasingly complex and technology-driven world" (Alberta Ministry of Education, 2017 p. 2). Accepting that language/communication and numeracy skills are interrelated, educators are requiring successful teacher assessments and targeted interventions to increase student improvement. Through a preschool/kindergarten benchmark screener, teacher's interventions and practice can improve the outcomes for children with communication/language and numeracy challenges.

Definition of Terms in Communication/Language and Mathematical Disabilities

In this project, the following codes from Alberta Education (2020/21) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-V, 2017) communication/language and/or mathematical disabilities will be defined. In addition, a study by Krajewski and Schneider (2009) will be used to describe a student's informal math skills and numeral knowledge:

Code 30 (Early Childhood Services-ECS) is defined as a child identified with a mild to moderate communication disorder/delay is one who: has a diagnosed mild or moderate disorder or identified mild to moderate delay in expressive and/or receptive language; or has a diagnosed disorder/delay in articulation, phonology, voice, fluency and/or social (pragmatic) communication; or is at risk for learning difficulties as demonstrated by education-based assessments, which may include tests of phonological awareness (Special Education Coding

Criteria of Alberta, 2020/21 ECS-Grade 12 2020/21 Mild/Moderate, Gifted, Talented and Severe p. 9).

Code 48 (Early Childhood Services-ECS) is a moderate language disorder that is assessed by a speech/language pathologist. It includes risk factors that are likely to persist into later childhood and have a functional impact on daily living that affects the child's ability to participate in school. Also, the student requires a moderate disorder or delay in expressive/and/or receptive language or two or more mild/moderate delays in fine/gross motor development, vision or hearing. The moderate range is the 3rd to 6th percentile. (Special Education Coding Criteria of Alberta, 2020/21 ECS-Grade 12; Mild/Moderate, Gifted, Talented and Severe p. 15).

Code 47 (Early Childhood Services-ECS) is a severe language delay that is assessed and diagnosed by a speech-language pathologist. The speech-language pathologist uses a variety of formal and informal assessment instruments such as standardized tests, checklists, observational measures, and parental interviews resulting in an interpretive report that supports the diagnosis of a severe language delay. Eligibility for a severe language delay is based on a child's overall speech/language development profile and assessment results, not on individual subtest scores.

An ECS child with a severe language delay is one who has been assessed and diagnosed with a severe language delay in expressive, receptive or total language and the assessment report includes results, based on the assessment tool administered, either below the 1st or 2nd percentile in expressive, receptive or total language; or has been assessed and diagnosed with a severe phonological delay; based on the assessment tool administered, is either below the 1st or 2nd percentile, and with moderate to severe total language delay (Special Education Coding Criteria of Alberta, 2020/21 ECS-Grade 12; Mild/Moderate, Gifted, Talented and Severe p. 14).

Dyscalculia is a mathematical disability. DSM-5 defines Dyscalculia as a specific learning disorder, an impediment in mathematics, evidencing problems with number sense, memorisation of arithmetic facts, accurate and fluent calculation, and accurate math reasoning (American Psychiatric Association, 2017).

Informal Numeracy Knowledge is defined as a set of skills that children generally learn prior to, and outside of, formal schooling which do not entail written mathematical symbols or algorithms (Gingsburg, 1977). According to Krajewski and Schneider (2009), children go through three overlapping levels of informal numeracy development. At the first level, children learn to distinguish among quantities by comparing exact sets while learning the verbal number word sequence. At the second level, children begin to make meaningful connections between these foundational skills by applying the verbal counting sequence to fixed sets via one to one correspondence and developing the cardinality principle through connecting number words to their quantities and subitizing. At the third level, children utilize knowledge constructed in the prior two levels to manipulate quantities to form new quantities (basic addition/subtraction through story problems; Purpura and Napoli, 2015, pg. 199).

Numeral knowledge is defined as the mapping of informal knowledge onto the Arabic numeral system (Purpura et al., 2013; Sinclair, Siegrist, and Sinclair, 1983).

These definitions are part of this project however, it is recognized that “techniques that are effective for students with disabilities are generally effective for all students. The techniques, practices, procedures, and in many cases, the content, are appropriate for most, if not all, learners.” (Cook and Schirmer, 2003, p 203). Schools in Alberta have adapted a researched-based framework called Response to Intervention to increase student learning and inclusive practises. This educational approach is based on the principle of universal, targeted, and

individual/specialized interventions that can be accessed by students. Response to Intervention is a pyramid of supports required ranging from universal (80%) to targeted (15%) to individualized (5%) for the student population.

Decisions regarding instruction are based on data information from a variety of assessment tools such as benchmark screeners and school-based assessments. As stated by Alberta Education (2020), what is built on the following two foundational ideas: With the right strategies, supports and interventions, all students can be successful learners and identifying the most effective supports for students is best done through a collaborative, problem-solving approach.

Benchmark Assessments, Response to Intervention and Inclusive Education

The Alberta Ministry of Education states,

> Inclusion is not just about learners with special needs. It is an attitude and approach that embraces diversity and learner differences and promotes equal opportunities for all learners in Alberta. Alberta's education system is built on a values-based approach to accepting responsibility for all children and students (Alberta Education, 2020).

Response to Intervention meets the needs of diverse learners within the classroom structure through a varying intensity of supports; therefore, successful inclusion is the foundation of this framework. Purpura and Lonigan (2015) maintain, "in an RTI framework, teachers and researchers need to be able to identify children's performance of individual skills to identify areas of deficit or their response to instructional activities" (p. 3). Although Response to Intervention

was initially developed for students diagnosed with a learning disability, it is now used for all students depending on the level of intervention required to acquire a skill or concept.

It is acknowledged that teachers must respond to the identification of delayed skills through screeners and provide intentional and targeted intervention. Through benchmark screeners, the lagging skills are identified and intentionally targeted. Moreover, Alberta Education (2020) asserts, "many Alberta schools use RTI in flexible ways to respond to student needs - for example, many schools use a problem-solving model that includes personalized learning, behaviour plans and a variety of assessment tools and interventions." Due to using the RTI approach, the interventions and supports provided to the students coded with a communication/language or math disability will benefit others within a universal approach because what is unique about special education is, as Vaughn and Linan-Thompson (2003) noted, "the delivery of instruction" (p. 145).

Personal Context

In Alberta, I work as a Learning Coach. Through my role, I have students referred to me due to experiencing difficulty in acquiring numeracy skills and concepts. After reading students' histories, I have observed that many students have a communication/language disability, as well as numeracy challenges. Interestingly, these students demonstrated poor results on both classroom and standardized assessments. Students with a communication/language disability (Code 30/47/48) diagnosis appear to be underperforming on the standardized mathematical assessments beginning in Grade Two. I found this surprising since the assessments usually require minimal literacy skills. In addition, the students are accommodated with a reader, when required, for all numeracy assessments. As I continued to analyze data with the classroom teachers, I became aware that they were noticing similar challenges such as lack of mastery in

place value, skip counting/multiples, number composition (decomposing and composing), math facts, and word problems. With the knowledge that this diagnosis may be impacting the acquisition of mathematical skills and concepts, we acknowledge that it would be of value to incorporate assessment and interventions in instruction in the early primary years. Preschool and Kindergarten teachers can use benchmark assessment data to provide evidence-based interventions in the areas of need through a Response to Intervention model. The British Columbia Early Numeracy Project (K-1) states "assessment helps teachers consider which children would benefit from intervention support in grade one and which need extra attention given to the development of specific skills." (British Columbia Ministry of Education, 2003, p. 8). As our professional discussions progressed, the question became, "What assessments and interventions do we include in our numeracy instruction for students with a language/communication disability?". It is apparent that this question is relevant to teachers at this time.

Purpose and Significance of the Project

The importance of language, informal numeracy development and numeral knowledge in the early years has been proven by research. Children's acquisition of early academic competencies such as reading and mathematics is critical in the long-term development of their academic and career success (Jordan, Hanich, & Uberti, 2003; National Early Literacy Panel (NELP), 2008; National Research Council (NRC), 2009; Snow, Burns, & Griffin, 1998). Students who continue to fall behind their peers in communication and numeracy acquisition skills, will quickly become disengaged.

Overview of the Project

The question guiding this project is, Through the practice of a preschool/kindergarten benchmark screener can teachers improve intentional targeted instruction/support for students with a communication/language disability (Code 30/47/48) and mathematical challenges (Dyscalculia) through a Response to Intervention Model? Through a preschool and kindergarten benchmark screener, the teachers will gain understanding of any lagging skills to provide the most successful supports and interventions in a Response to Intervention (RTI) model for students with communication/language and mathematical challenges. The benchmark screener will include language/communication, informal numeracy, and numerical knowledge skills. This screener will be available for preschool and kindergarten teachers to administer within the first of kindergarten or last two months of preschool. It is the expectation that the screener will provide valuable information for teachers.

Conclusion

Benchmark screeners are needed to provide teachers with valuable information to guide their Response to Intervention instruction. This project will include a literacy and numeracy screener at the preschool and kindergarten level that may be administered at the start of the formal school year. This benchmark screener may be beneficial for early primary teachers to gain insight into a child's literacy and numeracy skill competency. Teachers will have the opportunity to provide interventions through an RTI model. Currently, a district-wide formal numeracy assessment is given at the end of the kindergarten year to inform teachers of the skill development of each student.

Our provincial teachers continue to observe many students entering Preschool and Kindergarten with a mild/moderate or severe communication/language disability. In our Alberta Program of Studies 2017, communication is one of the competencies. We are recognizing that

the lack of communication competency appears to be impacting skills like mathematical challenges. The lack of a diagnostic benchmark numeracy screener in Preschool and Kindergarten has become a concern to early primary teams as they attempt to improve mathematical instruction. At present, preschool and kindergarten teachers require a benchmark screener to provide the most successful interventions and supports to students with communication/language, and numeracy challenges through a Response to Intervention model.

Chapter Two

Literature Review

The acquisition of numeracy skills among children with communication difficulties has been an area of study in recent years. The literature review of this topic will outline the connection of numeracy and communication domains. Through quantitative research studies, the relationship between these two disabilities has been investigated. The finding that "preschoolers' narrative abilities, particularly their ability to convey and relate all the main events of the story and to offer a perspective on the events in the story, predicts mathematics achievement two years later", (O'Neill, Pearce, & Pick, 2004) suggests that prior to formal mathematics instruction, student's numeracy skills are developing through the support of oral language/communication abilities.

The literature review is organized into three main topics. The first section will introduce the connection of numeracy acquisition and language development in the preschool and kindergarten school years. In the second section, examples of current numeracy interventions with a focus on the remediation of mathematical skills through targeted and individual instruction will be analysed. In the third section, the development of various numeracy assessments that measure the key skills for mathematical and/or language development will be considered. Finally, the conclusion will synthesize the information gathered.

The Literacy and Numeracy Connection

The Interrelated Role of Language and Mathematics.

Through numerous studies, the relationship between language and mathematical skill development has been researched. Clements, Lange, Sarama, and Wolfe (2012) conducted a study on the impacts of early math on oral language and emergent literacy. According to the researchers "mathematics and language appear to have co-mutual influences" (p.498). Studying various interventions, the authors assert "the study's positive effect on inferential reasoning in a narrative context supports that explanation and provides causal evidence that early mathematics can support the learning of language competencies" (p. 499). As we can surmise, the interrelation of language and mathematical skills may be reciprocal given that" a mathematics curriculum can have a positive effect on several critical oral language competencies" (p. 500). Hence, a student's communication ability may be influential in the acquisition of numeracy or mathematical skills.

Numeracy Acquisition with a Communication Disability.

Studies have concluded that students with a Specific Language Impairment (SLI) or Communication Disability have an increase in numeracy difficulties. In the study, *Precursors to Numeracy in Kindergarten with Specific Language Impairment* by Kleemans, Segers and Verhoeven (2011), an investigation into the extent children with specific language impairment differed in their early numeracy development compared to typical language children was sought. It concluded that students with a specific language impairment do better on nonverbal numeracy tasks than verbal numeracy tasks.

"Children with specific language impairment performed worse on verbal early numeracy tasks but did not differ on nonverbal early numeracy tasks" (Kleemans et al., 2011 p. 2907).

Explicit vs Implicit Instruction.

The explicit vs implicit research was discussed by Damuis, Segers & Verhoeven (2014) in an article within the *International Journal of Disability, Development and Education*. In the article, the authors gave remarkable results on vocabulary instruction. Of the three control groups, the one who received explicit teaching, had a more in-depth vocabulary knowledge.

> These effects sustained over time. Individual variation showed that in implicit instruction, children with low short-term memory seemed to gain more breadth of vocabulary in the short run, but also to forget more in the long run. In explicit instruction, verbal short-term memory and vocabulary tended to facilitate the breadth of vocabulary in the long run (Damuis, Segers & Verhoeven, 2014 p. 194).

Due to the fact that vocabulary knowledge is a foundational skill of numeracy, Pergetti, Segers & Verhoeven (2014 p. 190) stated in the article,

> "basic arithmetic involves the addition and subtraction of small numbers (Cowan, Donlan, Newton, & Lloyd, 2005) and a distinction can be made between canonical problem types (i.e., arithmetic problems with small numbers) and more advanced problems (i.e., word problems; cf. Stanescu-Cosson et al., 2000), and both have a strong link to language representations" (Dehaene, Piazza, Pinel, & Cohen, 2003).

Therefore, it is advantageous that kindergarten students receive explicit mathematical vocabulary instruction.

Furthermore, explicit vocabulary instruction is supported by the study *The Developmental Relationship Between Language and Low Early Numeracy Skills Throughout Kindergarten* (Toll and Van Luit, 2014). According to the authors, "the status of general language affects early numeracy development throughout Kindergarten" (p. 73). Furthermore,

"specific math language is an intervening variable within the developmental relation between general oral language and early numeracy" (p. 73). The article implies that explicit vocabulary instruction as an intervention is necessary for the development of numeracy.

Oral Language and Print Knowledge.

Although it is having been indicated by research that language and numeracy influence one another, two studies have unraveled the relationship further into the specific language skills. Preschool literacy skills include oral language, print knowledge and phonemic awareness skills. According to Purpura, Hume, Sims, and Lonigan (2011), oral language and print knowledge are the most important language factors in numeracy skill development. Purpura and Napoli (2015) further untangled the association into oral language/print and numeral knowledge in the development of informal math skills vs formal math skills. Oral language, print and numeral knowledge are essential in the development of informal math skills prior to school.

Informal Numeracy Skills, Numeral Knowledge and Formal Numeracy Skills.

In preschool, many children arrive with an understanding of mathematical skills, usually from the home experience. As the children receive instruction from a teacher, they develop their formal numeracy skills. Informal numeracy skills "are focused on flexibly connecting quantities to number words and understanding the relations among quantities" (Purpura, Baroody and Lonigan, 2013 p. 454). Furthermore, "children typically begin acquiring aspects of numeral knowledge soon after they begin acquiring aspects of informal numeracy knowledge" (Purpura, Baroody and Lonigan, 2013 p. 3). "Numeral knowledge has been found to be a strong, if not the strongest predictor of later formal mathematics ability" (Purpura, Baroody and Lonigan, 2013 p. 3). This may be likely because it is the essential foundational skill for formal numeracy

development. In Kindergarten, students are introduced to formal numeracy instruction. “This instruction includes conventional written numerical notation and written algorithms” (Purpura, Baroody and Lonigan, 2013 p. 2).

Numeracy Acquisition and other Cognitive Factors

Other factors have been studied that may influence on numeracy acquisition although generally the research included language as a prominent influence on numeracy acquisition. A study conducted by Kleemans, Segers, and Verhoeven (2014) concentrated on the “role of both cognitive factors (non-verbal intelligence, working memory) and linguistic factors (phonological awareness, grammatical ability) in basic arithmetic skills (addition and subtraction) in first-language and second-language learners from second-grade classrooms in the Netherlands”. The authors established that both cognitive and linguistic factors correlate to numeracy acquisition abilities in young first-language and second-language students. Furthermore to having a relationship with cognitive aspects, current research indicates that basic numeracy skills are also comparatively related to the language system (Kleemans, Segers, & Verhoeven, 2012). A second study by Praet, Teteca, Ceulemans and Desoete (2013), concluded that logical thinking, counting, and estimating, as well as language influence numeracy acquisition. The authors suggested that language is only one of the significant factors.

Moreover, Archibald et al. (2013) conducted a study within thirty-four schools in London, Ontario, Canada. Children participated in the study by completing a 10-minute screening protocol in Sentence Recall, Math Fluency, Sight Word Reading, and Phonemic Decoding Efficiency. The results indicated, “unique learning profiles could be further distinguished by differing abilities in underlying cognitive processes including immediate memory intelligence and phonological awareness” (pg. 9). In addition, research on the effect of

executive functioning has provided some surprising results. Clark et al. (2010), studied the effects of executive functioning on mathematics in preschool. In this study, "findings suggest that individual differences in children's developing executive function abilities have important implications for the acquisition of mathematical knowledge and abilities" (p. 1189). In addition, "An overall measure of executive function was also strongly associated with children's later mathematical achievement, as most (63%) of the children identified as having delays in executive function development relative to their peers during preschool also exhibited below average mathematics performance two years later" (p. 1187). It can be concluded that executive functioning skills and cognitive abilities may also impact mathematical knowledge during the preschool and kindergarten years.

Examples of Numeracy Interventions for Preschool and Kindergarten

There are many math myths that elementary teachers believe are true. Although they may be partly true, the myths may negatively impact student achievement. For example, "early math is just counting, young children need to do mathematics concretely, math centers are all you need, or the best way to teach math is through teachable moments" (Clements & Samara, 2018). These myths may have influenced our intervention and instruction in the past. High quality and researched-based interventions are required for early learners with a communication disability to acquire formal numeracy skills. Specialized targeted instruction and intervention may be beneficial for students with deficit factors. "Remedial early numeracy education or intervention aiming to support early numeracy is effective" (Jordan et al. 2012 p.647). Currently, "very few research-based early numeracy interventions are available for students prior to first grade" (Smith. 2018 p. iii).

Toll &Van Luit performed two research studies (2014, 2015), on the relationship between low language and low numeracy skills and the remediation most effective. *Remedial Early Numeracy Education: Can Children Identified as Having a Language Deficiency Benefit?* (Toll &Van Luit 2015) was a research inquiry in the Netherlands examining if remedial early numeracy education in kindergarten is beneficial for students with a language impairment or communication disability (scoring below the 25th percentile on two standardized language assessments). The intervention examined was The *Road to Mathematics* (Toll &Van Luit, 2012). The results were assessed for early numeracy basic skills in kindergarten and grade one. Not surprisingly, language-impaired students in the remedial group scored better in language assessments than those in the regular classroom in both kindergarten and grade one. Interestingly, they were able to improve their numeracy skills to that of their language-proficient peers.

The intervention program, *Building Blocks*, was developed by Clements and Sarama in 2007. Its basic approach is "finding the mathematics in and developing mathematics from children's activity" (Clements, Sarama, Spitler, Lange and Wolfe, 2011 p. 132). The educational goals include improving proficiency in two foundational domains. The first domain is number concepts which include counting, subitizing and number operation, and the second domain is spatial and geometric concepts/processes. These domains are structured on research-based trajectories that are developmentally appropriate. Teachers receive professional development on the learning trajectories which include "mathematical content knowledge by explicating the mathematical concepts, principles and processes involved in each level and the relationships across the levels and topics." (Clements, Sarama, Spitler, Lange and Wolfe, 2011 p.133). Several studies have proven that *Building Blocks* increase numeracy knowledge of preschoolers more

than other supplemental programs. “Children taught by teachers using Building Blocks outperformed children in the control group on four of the oral language subtests” (Sarama, Lange, Clements & Wolfe, 2012 p. 499).

Griffith studied the numeracy intervention *Number Worlds* (formerly Rightstart) published by McGraw-Hill. *Number Worlds* focuses on the area of numbers. It is based on five instructional principles: build upon a child's current knowledge, follow the developmental progression, teach computational fluency, provide hands-on learning, problem-solving and communication, and expose the child to many number representations. “In several evaluation studies conducted with children from low-income communities, children who received the *Number Worlds* program made significant gains in conceptual knowledge of number and in number sense, when compared to matched-control groups who received readiness training of a different sort” (Griffin, 2004 p. 178). One aspect of the intervention is the use of vocabulary cards to improve mathematical language. Communication is an important factor in this intervention as students are required to communicate their thinking. Therefore, “teachers claim that they facilitate discussions regarding mathematical language and concepts rather than dominate it” (Griffin, 2004 p. 179). It can be concluded that this intensive early numeracy intervention may be effective for Preschool, Kindergarten students with a communication disability.

Reading Stories to Learn Math: Mathematics Vocabulary Instruction for Children with Early Numeracy Difficulties is a study focused on math communication by B. Hassinger-Das, N. C. Jordan and N. Dyson (2015). The researchers investigated “whether a story book reading intervention targeting mathematics vocabulary would increase at-risk children’s vocabulary knowledge and number competencies” (p. 242). The targeted intervention studied was the

Storybook Number Competencies (SNC). The *SNC* intervention introduced "mathematics vocabulary words to reinforce number concepts related to counting, number relations, and number operations" (Hassinger-Das, Jordan, Dyson, 2015 p. 250). The study found that "children in the *SNC* group had the advantage of making sustained gains in mathematics vocabulary, which can provide a beneficial foundation for formal math instruction in first grade" (pg. 259). Previous research has supported this assertion.

Previous research studies propose that storybook interventions support considerable improvement in either vocabulary understanding (Beck & McKeown, 2001a; Biemiller & Boote, 2006; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004; Han, Moore, Vukelich, & Buell, 2010; Justice, Meier, & Walpole, 2005; Roskos & Burnstein, 2011; Wasik & Bond, 2001) or early mathematical knowledge (e.g., the count sequence, number combinations, and number comparisons) (Hong, 1996; Jennings, Jennings, Richey, & Dixon-Krauss, 1992; Young-Loveridge, 2004).

It is the goal that the SNC intervention will improve low language preschool and kindergarten students acquire mathematics vocabulary and conceptual understanding using a storybook framework.

Smith conducted a study on the use of technology with preschool and kindergarten students to increase early numeracy skills. "With the increase in access to technology in the classroom, research on the effectiveness of interventions provided through technology has begun to spark interest" (Smith, 2018 p.14). Using a PowerPoint and target-skill worksheets intervention (Numeracy Development Modules), she studied emerging numeracy skills and concepts; number identification, object counting and number writing. The results for this study were favorable. Results show that all the students' emerging number skills increased and were

maintained after the intervention discontinued. At-risk students (including students with a communication disability) had the opportunity to have academic instruction on an individual basis for less than fifteen minutes per day. Moreover, the direct academic instruction could be repeated until the numeracy skill was acquired. "This study provides evidence that Numeracy Development Modules (NDM) would be a useful tool for teachers and interventionists to use with at-risk pre-k and kindergarten students" (p. 38). Using technology for numeracy intervention has demonstrated to be purposeful for early childhood learners with skill deficits.

Examples of Preschool and Kindergarten Benchmark Assessments

Prior to implementing interventions and support, screeners need to be utilized to obtain skill deficit information. Using a screener to determine a student's mathematical and language ability is a necessity in the preschool and kindergarten year. "Children begin to develop individual differences in numeracy skills even by the preschool years and these differences predict their later achievement" (Purpura, Reid, Eiland and Baroody, 2015 p. 41). As Smith states, "once a skill deficit is identified, interventions that target that skill can be implemented to remediate the issue" (Smith., 2018 p. 2). Through the use of screeners, students who are below standardized grade-level benchmarks are considered at-risk of falling behind and academic failure (Smith, 2018 pg. 5). Within an RTI model, teachers may apply the information to provide targeted or intensive intervention. Fuchs et al, stated in 2008, "pinpointing the area of difficulty for students yields valuable information for instructional purposes" (p. 41). As Purpura and Lonigan stated in 2015, "effective risk status identification and of evaluation instruction effectiveness are dependent on having appropriate assessment tools" (p.14).

A brief preschool and kindergarten screener for children with math difficulties was studied by researchers, Purpura, Reid, Eiland and Baroody in 2015. They developed the screener

Preschool Early Numeracy Skills Screener-Brief Version (PENS-B), which could be administered in a five-minute time frame. The screener assessed the following mathematical skills: verbal counting, counting forward/backward, counting error identification, one to one correspondence, cardinality, resultative counting, subset counting, subitizing, estimation, ordinality, relative size, number comparison, set comparison, number order, sequencing, set reproduction, numeral identification set to numerals, addition/subtraction with objects, story problems, initial equivalence, two-set addition/subtraction, equivalent sets, number composition/decomposition and number combinations. The screener requires teachers to be trained for maximum efficiency. Although this screener is effective in mathematics, it is limited in assessing cross-domain relationships such as literacy or language.

Purpua and Lonigan (2015) developed a preschool numeracy scale in their *Early Numeracy Assessment research study. The Preschool Numeracy Scal*e includes the task assessment of verbal counting, one-to-one correspondence, cardinality, counting subsets, set comparison, subitizing, numeral comparison, set comparison, number order, set-to-numerals, story problems and number combinations. These 12 numeracy skills were designed to assess the "foundational numeracy skills identified by the NCTM Standards and Focal Points (2006), the NMAP (2008), and NRC (2009) as critically important for young children's mathematical development" (pg. 13). The numeracy scale reliability and validity measures were established through the development process. In addition, broad mathematics tasks were assessed using the Woodcock-Johnson III Tests of Achievement subsets of Applied Problems and Calculation. The authors assert that "these assessment tools have practical applications for both practitioners and researchers that can lead to important educational advances. First, identifying the specific areas in which a child needs further instruction. Secondly, to assess the effectiveness of targeted

instructional efforts." (p.14). This benchmark screener may be used in an RTI model of instruction effectively as it offers reliable and valid information.

Numeracy Screener by Nosworthy and Ansari is a Canadian benchmark screener. The researchers created this benchmark screener at the Numerical Cognition Laboratory at Western University. "The motivation behind designing the numeracy screener was to build a simple paper-and-pencil tool that could be administered efficiently and with ease without requiring technology" (numeracyscreener.org/about-the-test.html). The 2-4-minute assessment tests the student's capability to determine which set is larger in both a symbolic form (numeral) and non-symbolic form (a set of dots). The authors suggest that the screener be administered twice with a one or two-week gap to increase the reliability of the results. In her doctoral thesis, Nosworthy maintains that "results demonstrated that participants' performance on the paper-and-pencil test in kindergarten was a significant predictor of their math grade in Grade 1" (p. iii). A student's language skills are not assessed using this screener.

Benchmarks for purchase include *the Bracken School Readiness Assessment–Third Edition (BSRA-3*). This assessment is available in Canada for preschool to grade 2 screening. The *BSRA-3* is composed of both language (receptive and expressive) and numeracy domains. The six basic concepts assessed are colors, letters, numbers/counting, sizes, comparisons, and shapes. Once the individual assessment is administered, the benchmark level is established through the number of questions answered accurately. The assessment's completion time is approximately 10-15 minutes; however, it is not a timed test. The assessment kit is available for purchase through Pearson Publishing.

A web-based screening measure available for purchase is *easy CBM* which was developed by J. Alonzo, G. Tindal, K. Ulmer and A. Glasgow at the University of Oregon. This

screener and progress monitoring assessment is available for the RTI model in the kindergarten year. It offers over 1150 benchmark and monitoring measures in three subjects: math, Spanish and reading. Within the math domain, number operations, algebra, geometry, measurement, and the American common core math standards are evaluated. The reading domain assesses letter names and sounds, phoneme segmenting, word reading fluency, passage reading fluency, vocabulary, and reading comprehension. Educators use the website to submit student scores to determine the targeted or individualized interventions required.

Assessing Student Proficiency in Early Number Sense (ASPENS) Mathematics is a valid and reliable numeracy assessment tool for kindergarten and grade one teachers created by researchers Clarke, Gersten, Domino and Rolfhus. It is "a series of three curriculum-based measures administered for the purposes of universal screening of students' mathematical proficiency" (https://intensiveintervention.org, 2020). The ASPENS kindergarten assessment includes three subsets: numerical identification, magnitude comparison, and missing number. Each subtest applies numbers ranging from 0 to 20. The student is scored on the number of correct answers within a 1 or 2-minute timeframe. This American assessment requires additional training of educators to administer and calculate the scores in numeracy. A language assessment is not provided with this benchmark screener.

Lastly, *the Early Years Evaluation Direct Assessment (EYE-DA*) tool was developed by Willms and Bewick. The *EYE-DA* evaluates 3-6-year-old students in 4 domains: Cognitive, Awareness of Self and Environment, Language and Communication and Fine/Gross Motor Skills. Within the Cognitive domain prerequisite numeracy skills are measured. These skills include counting, one to one correspondence, sets, subitizing, and problem solving. In addition, the Language and Communication domain measures both receptive and expressive language.

The individually administered assessment requires approximately thirty to forty-five minutes to complete by a trained educator. Scores are analyzed on an online data system according to age. A printed parent and school report are generated using green, yellow, and red indicators in each domain. Results can be utilized in an RTI model for targeted or individualized interventions. Several Canadian school districts have purchased the *EYE-DA* to include it in their assessment portfolio for preschool and kindergarten programs.

Conclusion

This chapter examined the literacy and numeracy connection concisely. Several studies in the past decade have proven the interrelation between the two domains. The chapter also demonstrated examples of interventions and benchmark screener available to educators. The interventions discussed were for the targeted and individualized tiers in the RTI model. Prior to developing interventions and intensive instruction, a succinct benchmark screener is required to display the deficit areas. Current examples of numeracy and language screeners were described. Chapter three will consider how the project incorporated the literature review into a significant and practical product for educators.

Chapter 3

Project Proposal and Plan

Project Overview

This chapter provides an overview of the kindergarten language/numeracy screener created for implementation in the first part of the kindergarten or near the completion of the preschool year. The title of the project is *A Preschool and Kindergarten Language and Numeracy Benchmark Assessment for Response to Intervention.* The guiding question is as follows, *Through the practice of a preschool/kindergarten benchmark screener can teachers improve intentional targeted instruction/support for students with a communication/language disability (Code 30/47/48) and mathematical challenges (Dyscalculia) through a Response to Intervention Model*? The product to be designed is a benchmark screener with a personal information, stimulus, record and instruction booklet to be used by preschool and kindergarten educators. The main purpose for initiating this project is to screen students to determine the level of support needed with numeracy skills/concepts attainment through an RTI model.

Support for the Project

Currently, there are few numeracy benchmark screeners of informal mathematical skills prior to grade one. The numeracy skills assessments available are typically part of a comprehensive screener which evaluate several domains. Few details and observations are acknowledged in these current screeners. Rationales for the tasks are rarely provided to the assessor and the application to future formal mathematical skills/concepts are not realized. In addition, the connection between language skills and numeracy skills has a limited amount of research and assessment tools available.

A Detailed Description

The Preschool/Kindergarten Language and Numeracy Screener is composed of 15 informal numeracy subtests because, according to Purpura and Napoli (2015), "oral language, print and numeral knowledge are essential in the development of informal math skills prior to school". The research assessment completed by Purpura, Baroody, Eiland and Reid's *Early Numeracy Skills Screener-Brief Version (PENS-B*, 2015) assesses the informal and formal skills of verbal counting, counting forward/backward, counting error identification, one to one correspondence, cardinality, resultative counting, subset counting, subitizing, estimation, ordinality, relative size, number comparison, set comparison, number order, sequencing, set reproduction, numeral identification set to numerals, addition/subtraction with objects, story problems, initial equivalence, two-set addition/subtraction, equivalent sets, number composition/decomposition and number combinations. In addition, a second research study, Purpua and Lonigan's Early *Numeracy Assessment research study. The Preschool Numeracy Scal*e (2015), is utilized in the development of the preschool/kindergarten language and numeracy benchmark screener. The numeracy scale includes the assessment of verbal counting, one-to-one correspondence, cardinality, counting subsets, set comparison, subitizing, numeral comparison, set comparison, number order, set-to-numerals, story problems and number combinations. The researchers studied and administered some formal numeracy subtests that did not align with the Kindergarten Alberta Program of Studies, therefore, the 15 subtests were developed for Alberta teachers. Each subtest reveals the rationale of the skill being assessed and the application for future mathematical skills/concepts since, "numeral knowledge has been found to be a strong, if not the strongest predictor of later formal mathematics ability" (Purpura, Baroody and Lonigan, 2013 p. 3). Four of the subtests have an alternative assessment for the

assessor to further evaluate a student's skill level and understanding. As stated by Kleemans et al in 2011, "Children with specific language impairment performed worse on verbal early numeracy tasks but did not differ on nonverbal early numeracy tasks" (p. 2907). Therefore, giving an alternative non-verbal or limited verbal instruction prior to the assessment may be beneficial for students with a Communication Disability. Moreover, classroom teachers are given the opportunity to use professional judgement through the observation section on the record booklet.

The Preschool/Kindergarten Language Numeracy Benchmark Screener Subtests

Verbal Counting to 10. Oral counting is an informal numeracy skill that is an essential skill for later mathematical concepts and mental math strategies. It is a foundational skill for addition. Counting teaches students that the numbers are sequential and repeatable. This is the concept of Stable Order of numbers.

Counting Backward from 10. Counting backward is an informal numeracy skill that is the precursor to the concept of subtraction. In addition, it assists students in developing mental math strategies. Children tend to develop this skill after mastering counting forward.

One to One Correspondence to 10. One to one correspondence is the concept that objects can only be counted once. It is considered an informal numeracy skill.

Cardinality. Cardinality is the concept of counting a set and the last item in the set is the amount. When prompted, the child can restate the set quantity without recounting. It is considered an informal numeracy skill.

Making Sets to 10. Sets are a group of objects that measures quantity. Students must use the skills of resultative counting and irrelevant order. Making sets of 10 is the unitizing concept that is the basis for the base-ten number system in place value.

Resultative Counting. Resultative Counting is a concept combining both number cardinality and conservation. Students count a set of objects (without pointing to the objects) to determine the quantity or "result". It is an informal math skill that is an initial skill to addition and multiplication.

Subitizing to 5. Subitizing numbers is the ability to visualize a small quantity of objects without counting (usually within 3 seconds). In this assessment, students are requested to subitize perceptually dots on a card. It is considered an informal numeracy skill.

Subset Counting to 9. Subset counting requires the student to count out smaller sets from a larger set. For example, in a set of 9 objects, the student can count 3 objects to make a subset. It is the basis for the concept of hierarchical inclusion-understanding that previous numbers are included in an ascending number (e.g., there are 4 objects within a group of 7 objects).

Ordinality to 3. Ordinal numbers tell the position of an object compared to other objects in a series. First, second, third are informal math vocabulary words prior to formal instruction.

Set Comparison- more/less to 5. Set comparison compares groups of objects to determine less, least, and more. This is an introductory skill for number order and comparison.

Numeral Comparison- more/less to 5. Numeral comparison is the skill to determine a student's abstract numeral knowledge. It is an initial skill for greater than/less than and equal to

comparisons. Furthermore, numeral comparison determines a student's sequential and value concept knowledge.

Numerical Order to 5. Number order is a skill by placing numerals in ascending order sequentially.

Set Reproduction to 5. Set reproduction is an essential informal math skill for early learners. It is the initial skill toward the concept of equivalency.

Numeral Identification to 10. Numeral identification is an abstract concept. Children require strong foundational skills in numerals 1-5 prior to recognizing the higher numerals 6-10.

Story Problems. Story problems is an informal numeracy skill that requires a student to apply flexible number knowledge to real life settings. It entails complex number skills to determine an addition or subtraction story problem.

Sections of the Language and Numeracy Benchmark Assessment

The Personal Information Page is the initial document that gathers the information of the student. Information such as use of glasses, hearing aids or modifications are noted. In addition, through observation, it addresses the language and executive functioning components of the screener. Student response to the screener is observed and recorded under the "Behavior" section. Furthermore, a referral to a Speech and Language Pathologist is documented for further data on the student's language and communication skills.

The Stimulus Booklet provides the visuals and questions for the subtests. The tests are either verbal, visual or use manipulatives. The questions are italicized and highlighted in yellow. The assessor is to ask the questions verbatim. The assessor may use professional judgement to

adjust questioning of a student as it may convey additional information. Alternative assessments may be given to assist the student in following the verbal directions. All details of the alternative questioning should be recorded.

The Record Booklet documents the student responses and the observations of the assessor. Yes/No boxes and Observation sections are provided for the assessor to document the task performance. Observations should be as detailed as possible as it may offer valuable data on the student, especially in regards to understanding mathematical vocabulary. As Clements, Lange, Sarama, and Wolfe (2012) state, "mathematics and language appear to have co-mutual influences" (p.498). The observations may be utilized to generate RTI math vocabulary interventions. According to Toll and Van Luit, 2014, "the status of general language affects early numeracy development throughout Kindergarten" (p. 73). Therefore, mathematical language is an applicable intervention for students with communication challenges.

The Instruction Booklet presents the rationale, instructions and observational details of each subset. The assessor is given the particulars on the administration and overall observation specifics. Familiarity with the instruction booklet is required by the assessor prior to the administration. It is written in user-friendly terms with the intention that professional development is not required preceding the administration.

Purpose of the Project

The assessment screener is designed to be administered in the fall of the kindergarten year or the completion of preschool. Ideally, prior to October 31st or June 30th, respectively. The data collected from the screener can be used to determine the level of support required in an RTI model of instruction. Students with similar competence in the subtests may be clustered in a tier

two or three intervention group to receive explicit formal instruction. Parts of the assessment screener may be re-administered after the intervention is complete to determine the mathematical language and numeracy acquisition gains. It is the hope that the screener will be distributed through the school district prior to implementation in September 2021.

Conclusion

The Preschool/Kindergarten Language and Numeracy Benchmark Screener will be created to assist classroom teachers in supporting students with numeracy acquisition. The specific and observational data it collects will guide teachers to initiate an RTI model for numeracy skill improvement. Although the language section is brief, it identifies students with a comorbid language/communication disability. This may indicate the need for specific formal tier two or three interventions for students who demonstrate incompetency with both language and numeracy attainment. The data obtained will help facilitate the support level implemented for a specific group of students. Re-administration of specific sections of the assessment screener can be utilized to determine level of support effectiveness or if intensive instruction is required.

The level of executive functioning is addressed on the personal information page. Teachers are requested to observe and document the student's task initiation, persistence and ability to shift attention. Although there is limited research on executive functioning and numeracy acquisition, it is worth noting to ascertain the level of support required.

Chapter 4

Reflection

This chapter stipulates the final concluding comments about the project, including the successes, limitations, application and next steps of the product. Throughout the creation of the benchmark screener, I began to understand there is an interrelationship with language and informal mathematical skills acquisition. In assessments, we use mathematical language and it may impact the results assuredly. This led me to develop an instruction booklet to alleviate the impact of academic language on the assessment. I have instructed teachers to verify the students understanding of the task prior to administration. In addition, I came to the realization that utilizing numerical spreadsheets could be of value in determining RTI interventions. The sole purpose of the project is the collection of important data for preschool and kindergarten teachers.

Successes of the Project

As I developed the numeracy benchmark screener, I developed increased confidence in numeracy attainment for students with limited communication abilities. As a learning coach, I recognized the numeracy and communication interrelationship and the challenges that ensue for students with a Communication Disability. This project allows for the classroom teacher to use professional judgement when assessing students with limited language. Alternative instructions may be applied to assess the non-verbal informal numeracy skills therefore, providing the assessor with critical information in the development of RTI interventions

Limitations of the Project

The most notable limitation of the project is the time it requires to administer. Although, this was taken into consideration, classroom teachers may be tasked with large class size and limited time to administer benchmark screeners. In addition, teachers may not be provided with coverage to administer the assessment in a timely manner. The assessment is meant to provide data early in the school year. Lengthy administration may not provide data in a timely manner that is useful for teachers.

Furthermore, the data could be represented in a more useful format for teachers in determining or implementing appropriate interventions.

Applications of the Project

The project may provide crucial numeracy and language data on kindergarten and preschool students. The early administration of the benchmark screener provides the classroom teacher with the informal mathematical skill level of students. Consequently, RTI lessons can be delivered in a timely manner to support any numeracy and language gaps in learning. The interventions can be developed to increase the knowledge and skills of early learners prior to formal education.

Moreover, the assessment will provide a school district with data regarding kindergarten students' informal math skills prior to joining the formal education system. Professional development and resources can be provided for early learning teachers to increase confidence in numeracy instruction and interventions.

Next Steps

The creation of a spreadsheet with a numerical grading system will provide classroom teachers with information 'at a glance'. The questions can be assessed by using 1-3 scale with

corresponding colors put on the spreadsheet. For example, a #1-red, #2-yellow, and #3-blue. The higher the numeral, the more precise the answer.

The spreadsheet may provide a quick snapshot for teachers to view with the purpose of developing appropriate RTI lessons and activities. Although the observational data is invaluable, it may be cumbersome for teachers with large class sizes. Some teachers may find a data spreadsheet more manageable for RTI information.

Conclusion

This project is a teacher-friendly assessment which is meant to provide valuable data regarding the numeracy and mathematical language skills of students. The process of determining the subtests that corresponded with the Alberta curriculum was a challenge. The research subtests used numerals to twenty however, the Alberta Program of Studies' learning outcomes use numerals to ten. Therefore, the tests had to be revised to be beneficial to Alberta teachers.

The assessment will hopefully provide school districts with data to determine the supports required for student success in numeracy. Currently, districts have employed phonemic awareness or communication screeners, however, few districts have implemented a numeracy screener prior to grade two. Knowing that early intervention is the most effective, valuable time is being lost for formal numeracy knowledge acquisition.

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Appendix

A Preschool and Kindergarten Language and Numeracy Benchmark Screening Assessment

TABLE OF CONTENTS

Student Information

Personal Information

Name: _____ Date: _____

Birthdate: _____ Age: _____

Examiner: _____ Code: _____

Accommodations

Glasses: Y☐ N☐

Hearing Aids: Y☐ N☐

Required Modifications: Y☐ N☐

_____

_____

Behaviors

Child was able to initiate tasks independently Y☐ N☐

_____

_____

Child was able to sustain attention throughout tasks Y☐ N☐

_____

_____

Child was able to shift between tasks easily Y☐ N☐

_____

_____

Child was able to answer questions appropriately Y☐ N☐

_____

_____

Child used appropriate grammar, sentence structure, speech fluency Y☐ N☐

_____

_____

Child referred for a Speech/Language Assessment? Y☐ N☐

_____

_____

Kindergarten Numeracy Screener-Instruction Booklet

(*Kindergarten Entry Administration*)

- **Verbal Counting to 10-(Starting at 1)**
  Rationale: Oral counting is an informal math skill that is an essential skill for later numeracy concepts and mental math strategies. It is a foundational skill for addition. Counting teaches students that the numbers are sequential and repeatable. This is the concept of Stable Order of numbers.

  Instructions*: Student counts to 10 without any verbal prompts from the assessor.*

  Observations: Any counting miscues between 1-10. Document the miscues.

- **Counting Backward from 10**
  Rationale: Counting backward is the precursor to the concept of subtraction. In addition, it assists students in developing mental math strategies. Children tend to develop this skill after mastering counting forward.

  Instructions*: Assessor may verbally prompt the student to count back from 10 to 1 by providing the numerals 10, 9 _ _ _.*

  Alternative assessment*- give the student 10 counters and have the student take one counter away while counting backward.*

  Observations: Any counting miscues between 10-1. Document the miscues and any prompts required.

- **One to One Correspondence to 10**
  Rationale: One to one correspondence is the concept that objects can only be counted once.

  Instructions*: Student points to each picture while counting in sequence.*

  Observations: Unable to point or touch objects as they are being counted. Observe at what number the miscues begin.

- **Cardinality**
  Rationale: Cardinality is the concept of counting a set and the last item in the set is the amount. When prompted, the child can restate the set quantity without recounting.

  Instructions*: The assessor requests the student to count the set and the reveal the last number.*

Alternative Assessment*-Ask the student to tell you how many counters are in the set without recounting.*

Observations: Unable to recall last number of the set when prompted. Need to recount the set they just counted.

- **Making Sets to 10**

Rationale: Sets are a group of objects that measures quantity. Students must use the skills of resultative counting and irrelevant order. Making sets of 10 is the unitizing concept that is the basis for the base-ten number system in place value.

Instructions*: The assessor will request the student to make sets using objects.*

Observations: student is able/unable to make the requested sets. Document the sets that students are able to create. Document the strategy that the student used to make the set (rote counting, counting on).

- **Resultative Counting**

Rationale: Resultative Counting is a concept combining both number cardinality and conservation., students count a set of objects (without pointing to the objects) to determine the quantity or "result". It is an initial skill to addition and multiplication.

Instructions*: Students count the pictures and tell the resultative number without pointing to the pictures.*

Observations: Objects are placed in a random order (not a line), observe if the student counts objects more than once when not able to point to each object.

- **Subitizing to 5**

Rationale: Subitizing numbers is the ability to visualize a small quantity of objects without counting (usually within 3 seconds). In this assessment, students are requested to subitize perceptually dots on a card.

Instructions*: Students say the number of dots on a card within a 3 second timeframe. Students do not point to the dots.*

Observations: student is able/unable to name the quantity of dots within a 3 second time frame. Note the number that the students could subitize successfully.

- **Subset Counting to 9**

Rationale: Subset counting requires the student to count out smaller sets from a larger set. For example, in a set of 9 objects, the student can count 3 objects to make a subset. It is the basis for

the concept of Hierarchical Inclusion- understanding that previous numbers are included in an ascending number (e.g.: there are 4 objects within a group of 7 objects).

Instructions*: Assessor requests the student to count 4, 6 and 8 objects out of a set of 9.*

Observations: student is able/unable to make small subsets independently. Observe the number of objects that the student is able to provide a subset. Additional subsets may be required to determine the level of understanding.

- Ordinality to 3

Rationale: Ordinal numbers tell the position of an object compared to other objects in a series. First, second, third are ordinal numbers.

Instructions*: Student points to the teddy bear in the "th" place.*

Observations: Student is able/unable to point to the first, second or third teddy bear when requested. Document the student's understanding of the vocabulary words- first, second or third.

- **Set Comparison- more/less (1, 4 / 3, 5 / 2, 3)**

Rationale: Set comparison compares groups of objects to determine less, least, and more. This is an introductory skill for number order and comparison.

Instructions*: The assessor presents the 2 sets of dots and asks which set is less/more. The students respond verbally.*

Observations: student is able/unable to determine the sets quantity (more/less) verbally or by gesturing. Document the strategy the student used. Document the student's ability to understand the vocabulary words-more/less.

- **Numeral Comparison- more/less (1, 4 /3, 5 / 2, 3)**

Rationale: Numeral comparison is the skill to determine a student's abstract numeral knowledge. It is an initial skill for greater than/ less than and equal to comparisons. Also, numeral comparison determines a student's sequential and value concept knowledge.

Instructions*: The assessor presents the 2 numerals and asks which numeral is less/more. The students respond verbally or by gesturing.*

Observations: student is able/unable to determine numerals position as less or more. Document if the student was able to compare any of the numerals. Document the student's ability to understand the vocabulary words-more/less.

- **Numerical Order to 5**

  Rationale: Number order is a skill by placing numerals in ascending order sequentially.

  Instructions*: Student is able to sequence numerals 1-5 on a line. Student glues the numerals in order starting with 1 on the left and finishing with 5 on the right.*

  Observations: student is able to place the numerals from 1-5 starting at the left rectangle. Document if the student counts the numerals to determine the next one as a strategy-using sequential rote counting.

- **Set Reproduction to 5 (1, 3, 5)**

  Rationale: Set reproduction is an essential math skill for early learners. It is the initial skill toward the concept of equivalency.

  Instructions*: Student is able to reproduce sets that the assessor creates independently.*

  Observations: student is able/unable to reproduce the sets using objects in the blue oval. Document if the student uses the vocabulary word- equal. Also, document if the student counts the assessor's set prior to creating an equal set as a strategy.

- **Numeral Identification to 10**

  Rationale: Numeral identification is an abstract concept. Children require strong foundational skills in numerals 1-5 prior to recognizing higher numerals 6-10.

  Instruction*: Student is able to identify the numerals 1-10 out of sequence. The assessor points to the numerals 1-5 and the student responds orally. If successful, the assessor points to the numerals 6-10 and the student responds orally.*

  Observations: student is able to identify numerals to 5 prior to identifying the numerals 6-10. Document the numerals the student is able to identify.

- **Story Problems (1)**

  Rationale: Story problems require students to apply flexible number knowledge to real life settings. It entails complex number skills to determine an addition or subtraction story problem.

  Instruction*: Student is able to solve an oral addition problem.*
  Alternative Assessment*: Uncle Bob is building a tree house using 4 posts. 1 of the posts breaks. How many does he have now?*

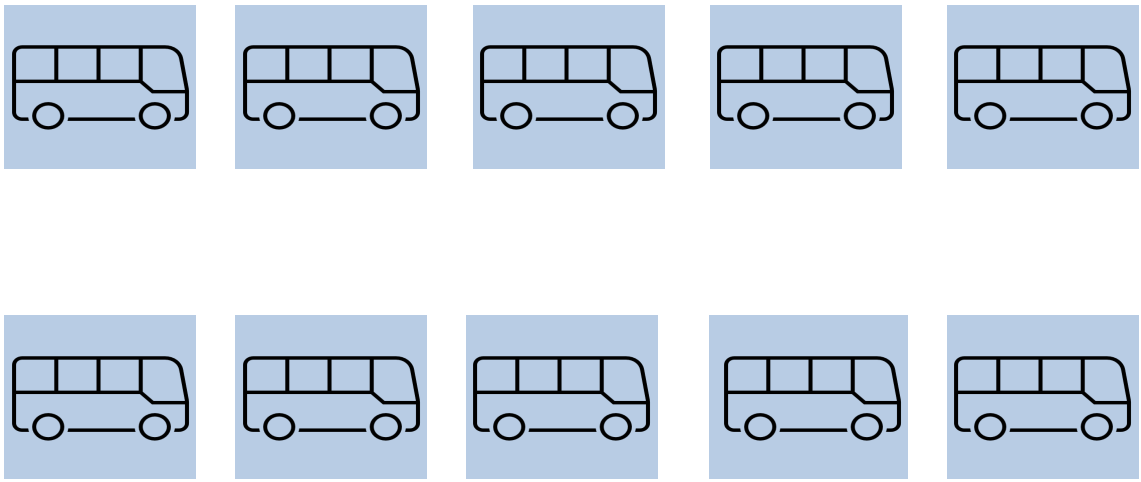
  Observations: student is able/unable to solve the story problem(s) verbally. Document any strategy the child uses to solve the problem (using fingers, objects, rote counting etc…).

Numeracy Benchmark Screener Stimulus Booklet

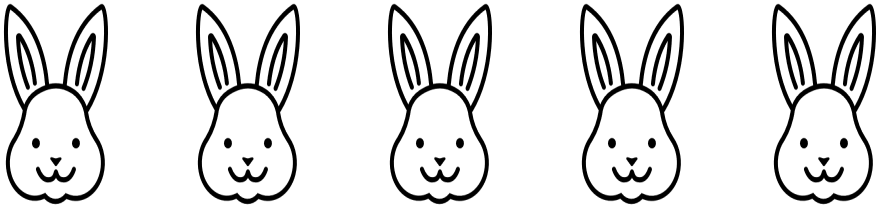
1. Can you count to ten? (start at 1)

2. Can you count to five? Now try backwards (may give prompt 5,4___)

3. Count the buses starting on the first one (point to the first bus)?



4. How many bunnies?



5. Pick up 3 counters and give them to me.

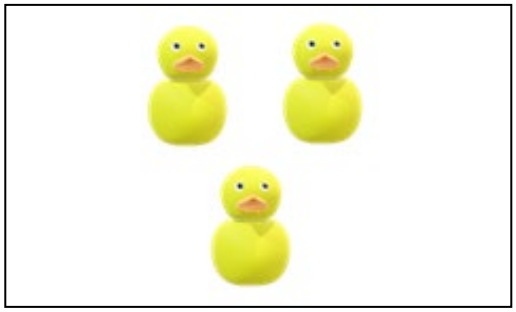
   Pick up 6 counters and give them to me.

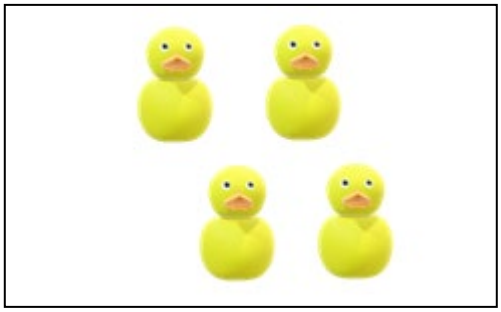
   Pick up 10 counters and give them to me.

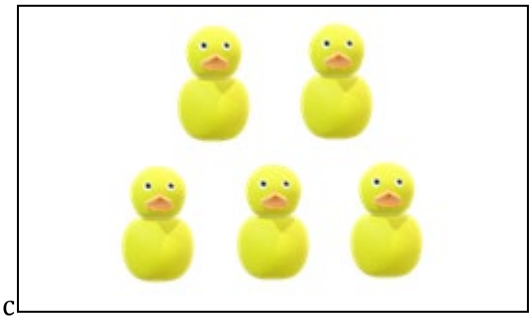
6. Show me the one that has 3

Show me the one that has 5

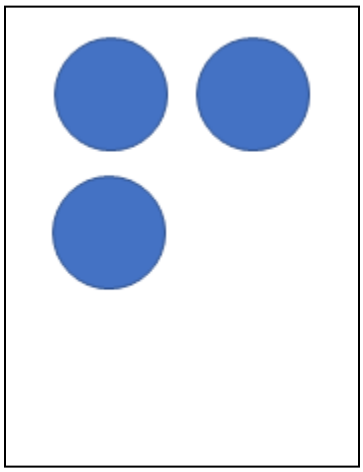
Show me the one that has 4

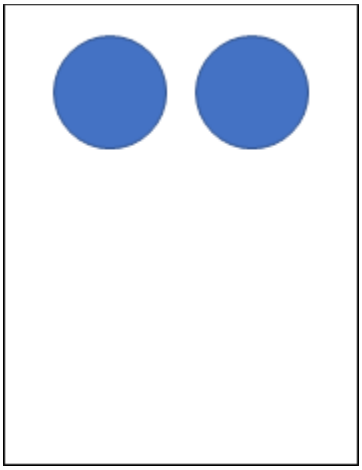
a 

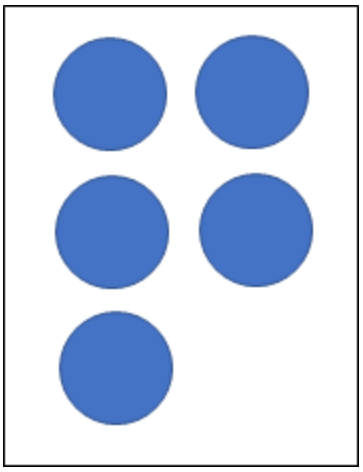
b 

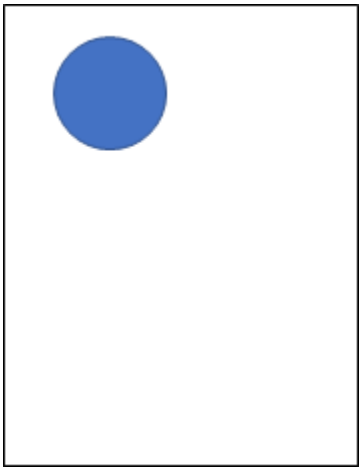
c 

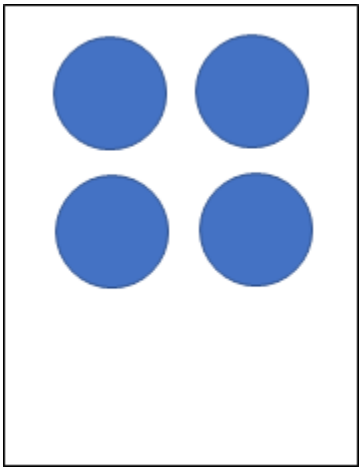
7. Can you tell me how many without counting?







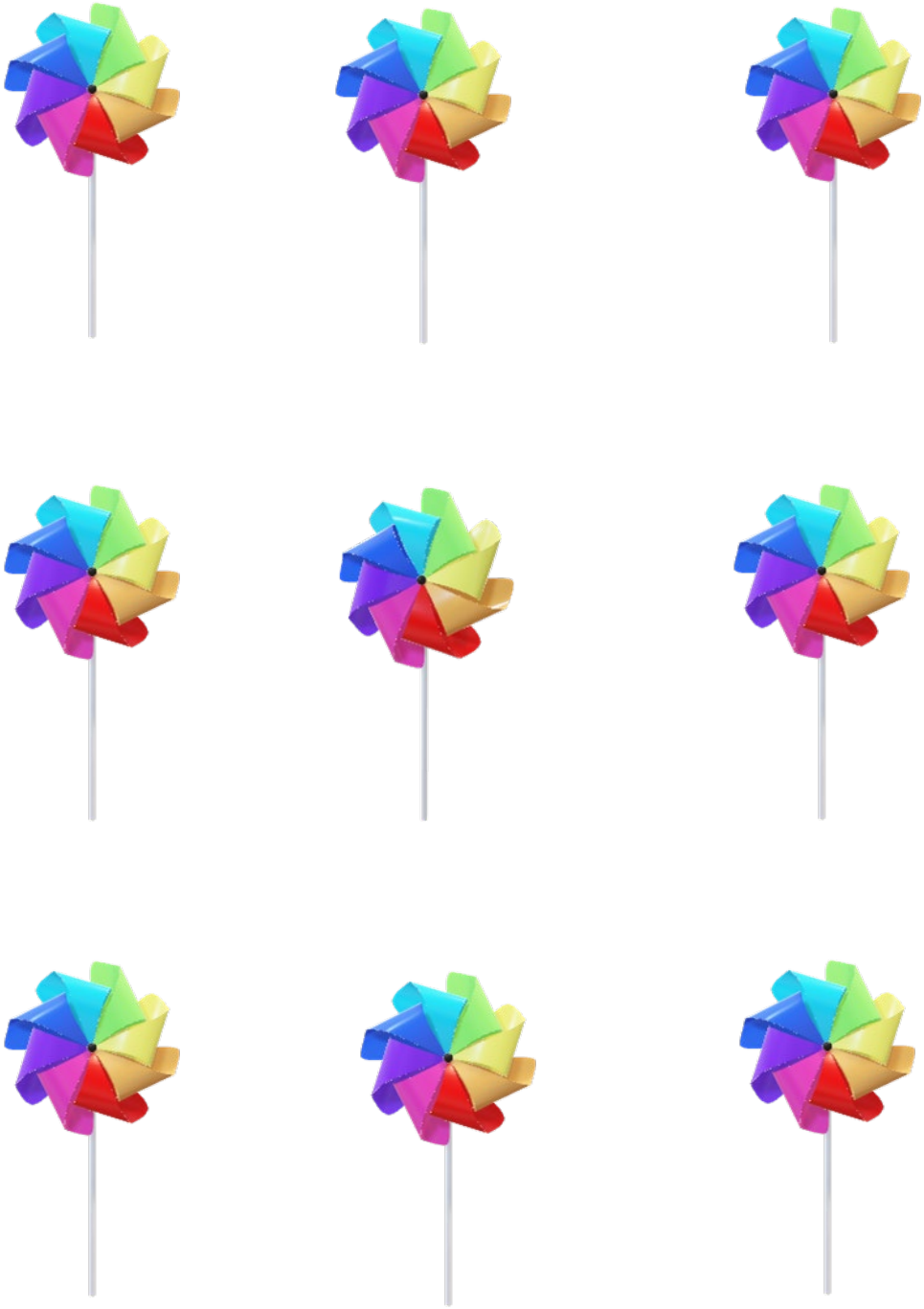




8. Can you count 4?

Can you count 6?

Can you count 8?

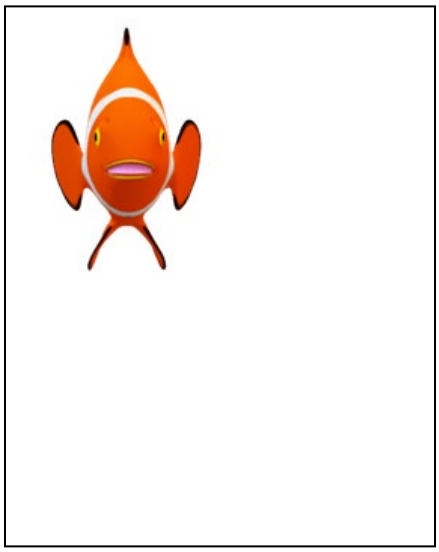


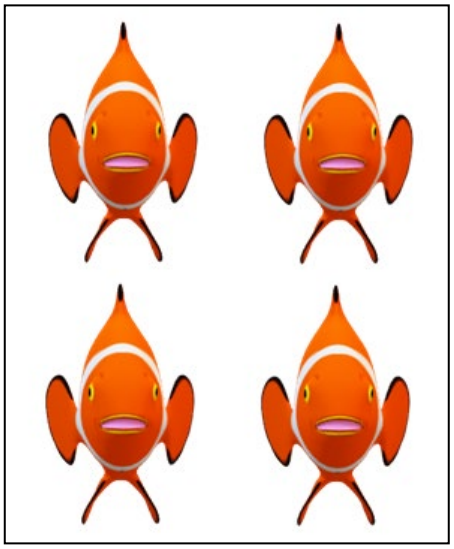
9. Which is the first bear?

Which is the third bear?

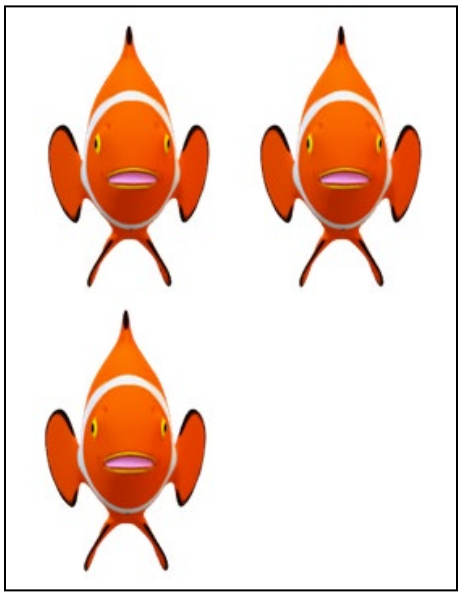
Which is the fifth bear?

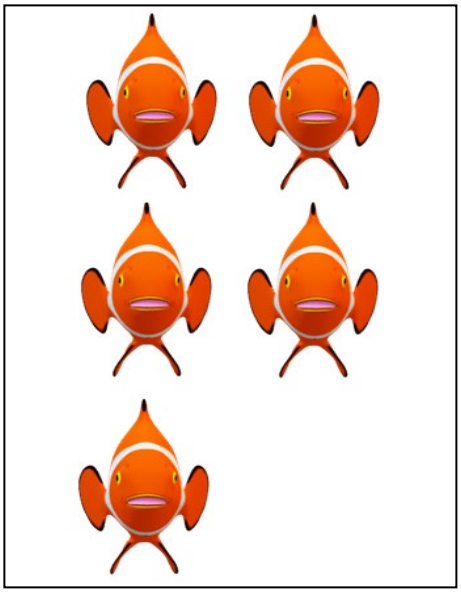
10. a. Which one has more?





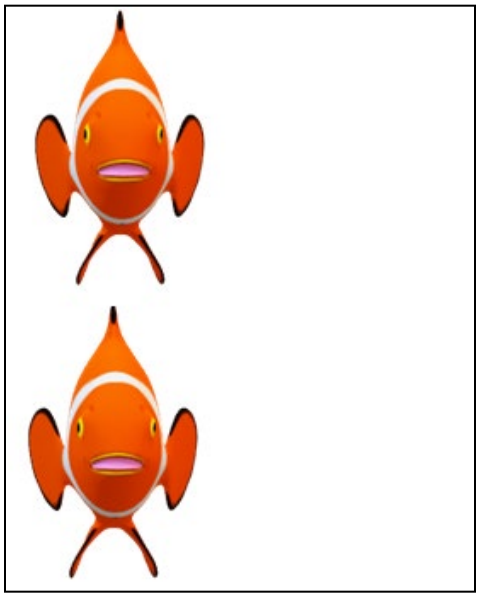
b. Which one has less?

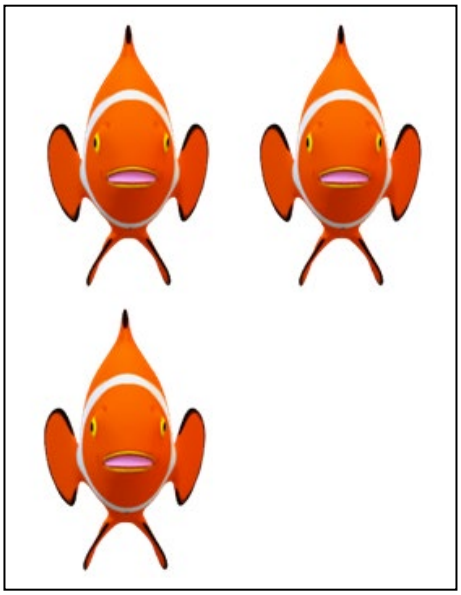




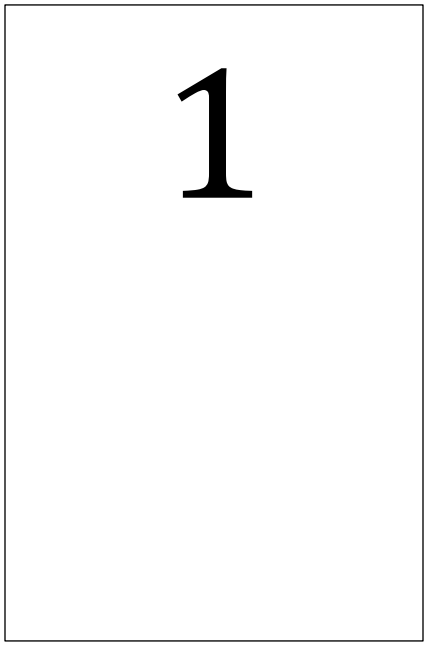
c. Which one has more?

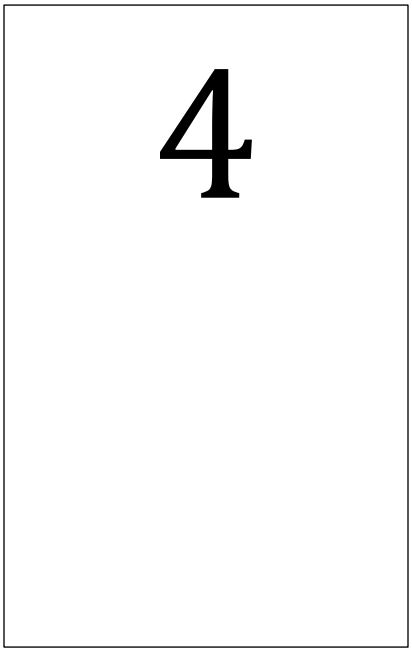
Which one has less?



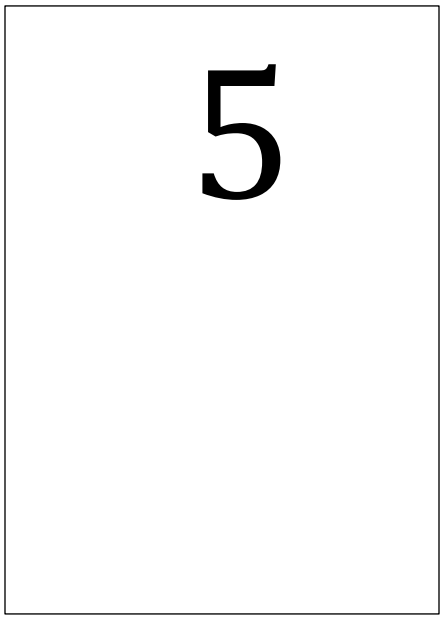


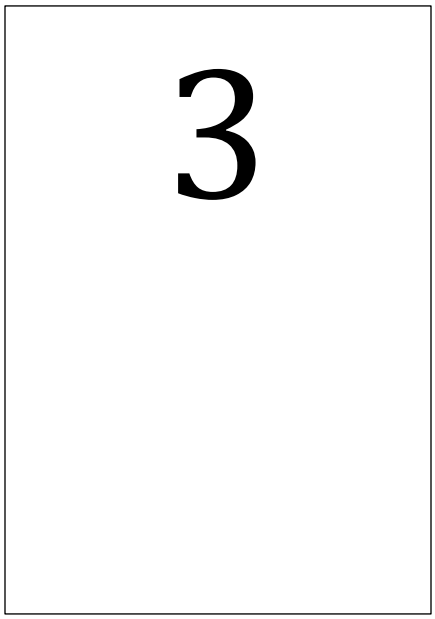
11. Which numeral is more?





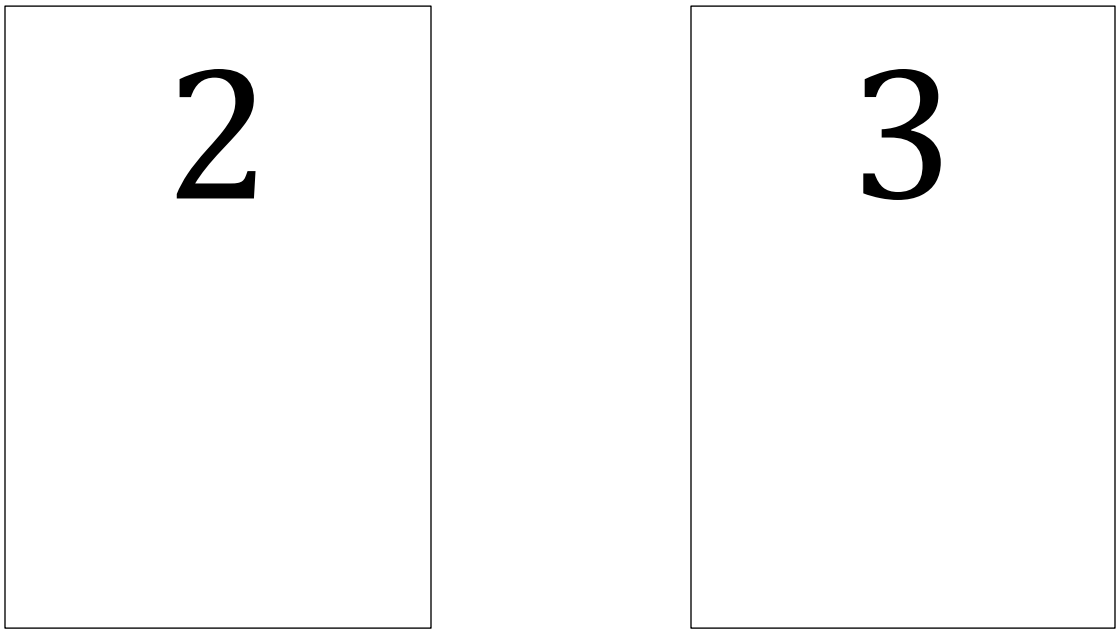
b. Which numeral is less?





c. Which numeral is less?

Which numeral is more?



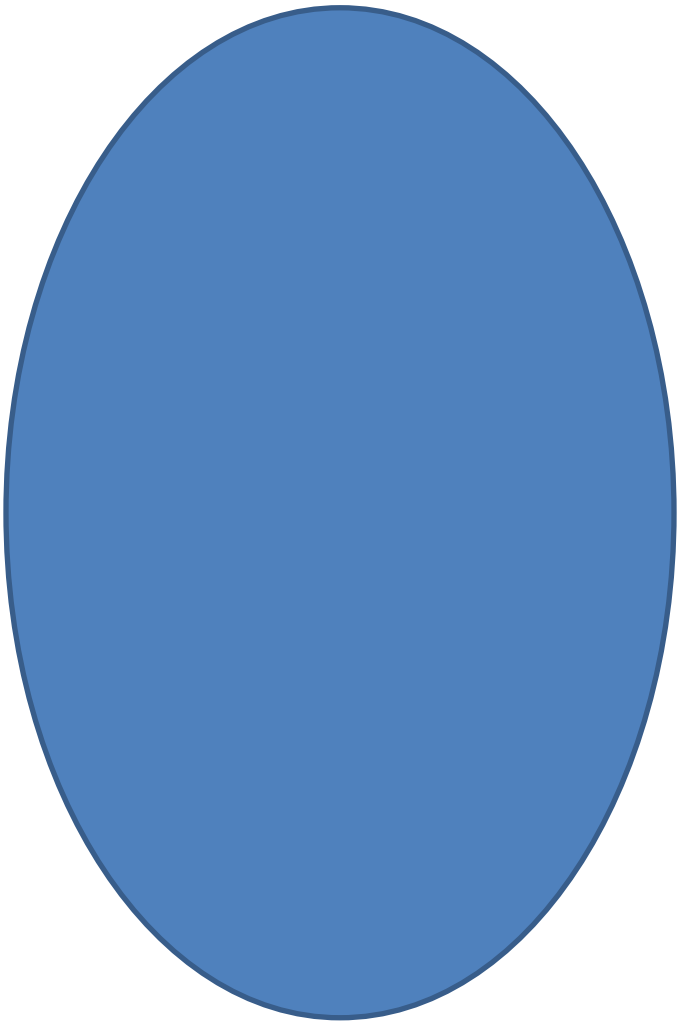
12. Can you put these numerals in order? Please glue the numerals in order.

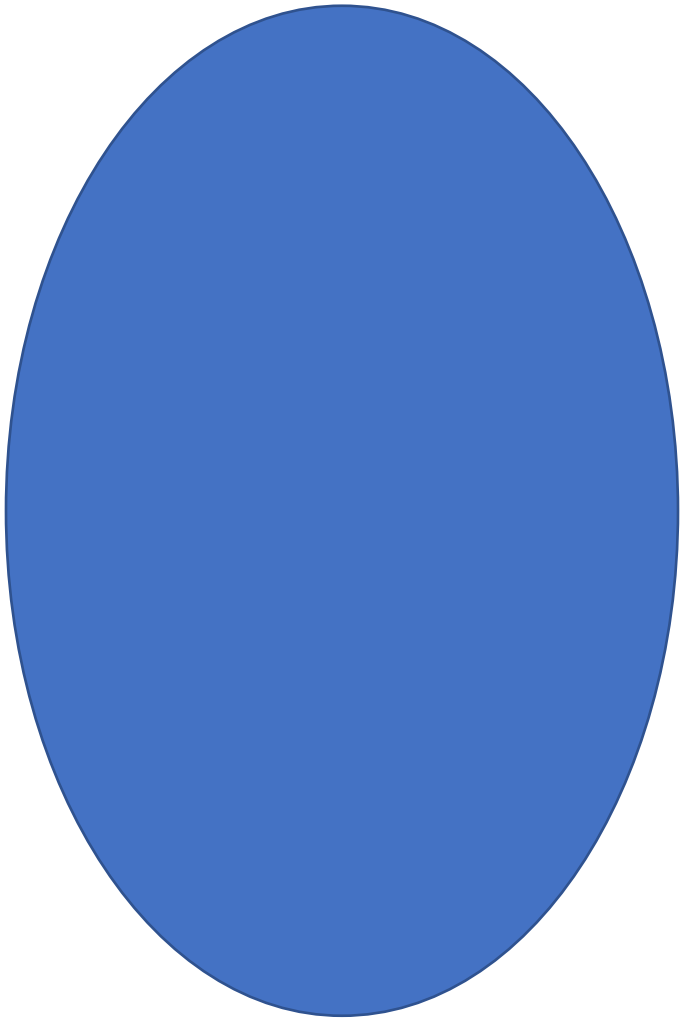
*(please cut out numerals for child and he/she will glue into place) *

3	1	4	5	2

13. Can you show me the same set?

use manipulatives to make sets





14. Can you tell me these numerals names?

3	5	7	4	9
2	10	8	6	1

15. If you have 2 cookies and Grandma gave you 1 more, how many cookies would you have now?

* child may use manipulatives if requested*

Kindergarten Numeracy Screener-Record Sheet

(*Kindergarten Entry Administration*)

- **Verbal Counting to 10-(Starting at 1)**

  Y☐ N☐

  Observation:_____
  _____
  _____
  _____

- **Counting Forward/Backward to/from 5**

  Y☐ N☐

  Observation:_____
  _____
  _____
  _____

- **One to One Correspondence to 10**

  Y☐ N☐

  Observation**:**_____
  _____
  _____
  _____

- **Cardinality**

  Y☐ N☐

  Observation:_____
  _____
  _____
  _____

- **Making Sets to 10**

  a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

  Observation:_____
  _____

_____
_____

- **Set Counting**

a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

Observation:_____
_____
_____
_____

- **Subitizing to 5**

a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N☐

Observation:_____
_____
_____
_____

- **Resultative Counting to 5**

a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

Observation:_____
_____
_____
_____

- **Ordinality to 3**

a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

Observation:_____
_____
_____
_____

- **Set Comparison- more/less (1, 4 / 3, 5 / 2, 3)**

a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

Observation:_____
_____
_____
_____

- **Numeral Comparison- more/less (1, 4 /3, 5 / 2, 3)**
  a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐
  Observation:_____
  _____
  _____
  _____

- **Number Order to 5**
  Y☐ N☐
  Observation:_____
  _____
  _____
  _____

- **Set Reproduction to 5 (1, 3, 5)**
  a. Y ☐ N ☐ **b.** Y ☐ N ☐ **c.** Y ☐ N ☐

  Observation:_____
  _____
  _____
  _____

- **Numeral Identification to 10**
  Y☐ N☐
  Observation**:**_____
  _____
  _____
  _____

- **Story Problems (1)**
  Y☐ N☐

Observation:_____
_____
_____
_____