Connect4Learning: The Pre-K Curriculum Addressing the Needs of Children from Underresourced Communities

Introduction

The early years have a profound impact on the course of children's lives. All children have a dynamic potential to learn, particularly when they are in responsive, nurturing, and stimulating environments. Conversely, there is a detrimental effect on children's learning and development when they are lacking those opportunities and resources. By choice and necessity, growing numbers of young children are spending significant amounts of time in out-of-home learning environments. Meanwhile, the requirements for school readiness upon entering kindergarten have risen considerably in recent years, with articulated national and state standards. These changing demographics and requirements fuel both the tremendous need and opportunity for research-based and practice-proven early childhood education.

An examination of preschool demographics finds that 48 percent of children ages three to five years—a total of 5.9 million—live in low-income families (Addy, Engelhardt, and Skinner 2013). The most recent ECLS-K report on kindergarten readiness found that 44 percent of children enter kindergarten with one or more risk factors associated with lower school readiness scores, particularly in literacy and mathematics (Bernstein et al. 2014). The persistent achievement gap for economically disadvantaged young children starts early in life and is difficult to reverse. Fortunately, a growing body of research is demonstrating that with intentional curriculum and professional development, it is possible to change the educational odds for children from underresourced communities so they may reach their highest potential (Schmit et al. 2013).

A Return on Investment

Researchers of early childhood education in the United States have a long history of investigating how to best serve and support children from underresourced communities, as well as documenting the return on investment. The landmark longitudinal HighScope Perry Preschool Study examined the lives of 123 children born into poverty and at risk for falling behind in school. The study found that children who participated in the preschool intervention grew up and achieved higher incomes and greater job security, committed fewer crimes, and were more likely to have graduated from high school than adults who did not receive high-quality preschool programming (Schweinhart et al. 2005). In recent years, Tulsa, Oklahoma, has served as a national model for providing preschool to all four-year-olds and is partnering with Head Start to pay for certified teachers in those preschool classrooms. Research findings from Tulsa shed light on a variety of strategies that may significantly improve outcomes for low-income children in the federally funded Head Start program, including intentional curriculum, strong partnerships, extensive professional development, and highly qualified teachers serving children in the classroom. Children's learning gains in Tulsa Head Start were similar to those of children in the Tulsa public schools and significantly larger than Head Start learning gains nationally (Barnett and Frede 2010; Gormley et al. 2004). Furthermore, longitudinal research data from Tulsa's universal pre-K program revealed that children who participated in the 2005–2006 preschool cohort demonstrated persistent positive gains in reading, writing, and mathematics through third grade, in comparison to children who did not participate (Gormley 2013). Finally, the Abbott Preschool Program Longitudinal Effects Study (APPLES) assessed the impact of New Jersey's Abbott Preschool Program on children's learning and development based on a cohort of children who were four years old in 2004–2005. The APPLES study estimated the impact of Abbott Preschool at kindergarten entry and second-grade follow-up, finding substantial positive impacts on language, literacy, and mathematics at both times. The fourth-grade and fifth-grade APPLES follow-up further revealed that the program had a long-term, positive effect on achievement in language arts and literacy, math and science, as well as a reduction in grade retention (Barnett, et al. 2013). Although not all evaluations of pre-K education have shown long-term positive effects, it is clear that high-quality programs can have lasting benefits.

High-Quality Early Childhood Education

Research, practice, and policy reveal the characteristics of high-quality early childhood education proven to support children from underresourced communities now and longitudinally, as they progress through school. The position statements made by the National Association for the Education of Young Children outline specific recommendations to help all children achieve their learning goals and reach their full potential. Developmentally appropriate practices require meeting children where they are, teaching according to their developmental status, and incorporating best practices that are based on evidence rather than assumptions about how children learn and develop (Copple and Bredekamp 2009). Furthermore, when young children have not had the learning opportunities required to succeed in school, early childhood programs are tasked with providing extended, enriched, and intensive learning experiences to compensate and narrow the persistent achievement gap (Copple and Bredekamp 2009). A curriculum that is effective and developmentally appropriate is grounded in what is known about the interrelationships and sequences of learning domains, such that young children's later knowledge and skills can be built on those already acquired (National Association for the Education of Young Children 2009). The early learning standards implemented and assessed in the classroom should recognize and accommodate variations in children's communities, such as individual characteristics, abilities, and disabilities (National Association for the Education of Young Children 2009). Recent research has found that preschool programs combining evidence-based curriculum, trained teachers, and coaching support produce positive effects on multiple domains of learning and school readiness, including language, literacy, mathematics, emotional development, as well as executive function skills such as working memory, inhibitory control, and attention shifting (Weiland and Yoshikawa 2013). It is deeply problematic that children from underresourced communities are more likely to be enrolled in early learning programs that are lower quality overall (Klein and Knitzer 2007). For example, educational research found that early learning classrooms comprised approximately 60 percent of children from low-income homes rated significantly lower in quality indicators of teaching, teacher–child interaction, and provisions for learning than classrooms with fewer low-income children (Pianta et al. 2005). Like all children, those from lower-resourced communities will respond to intentional curriculum implemented thoughtfully by caring educators.

Introducing Connect4Learning

Connect4Learning (C4L) is an interdisciplinary early childhood curriculum, the development of which was funded by the National Science Foundation, which aims to synthesize research-based approaches in four domains of learning: mathematics, science, literacy, and social-emotional development. The curriculum uses an interdisciplinary approach to address growing concerns that the majority of preschool instructional time is devoted to literacy at the expense of other content areas, particularly mathematics and science. To address this concern, the C4L units build on a sequence of math and science topics that are grounded in research-based learning trajectories and developmental pathways. Literacy and social-emotional skills are developed through focused lessons and in the context of these math and science topics. Research shows that children from lower-resourced communities are even less likely than their more advantaged peers to receive substantial and intentional math and science instruction in preschool, thus making the C4L approach particularly relevant for them.

C4L aims to further develop cognitive process goals that are simultaneously domain specific and applicable across all four domains of learning. These process goals include skills that address executive function learning, such as persistence, self-regulation, reasoning, problem solving, and innovating. Cognitive process goals lead to high expectations for all children participating in the C4L curriculum, including those with more limited resources and experiences, thus preparing them for success in school.

Research-Based Best Practices with C4L

An intentional early childhood curriculum is based on research, driven by content, emphasizes active engagement with children, includes attention to social and regulatory skills, and is responsive to children from a variety of communities and backgrounds. A special focus on these strategies is important because many children from underresourced communities fall behind early and remain significantly behind their peers in reading and mathematics (Lee and Burkam 2002). C4L's intentional curriculum incorporates research-based best practices designed to respect the strengths and support the needs of children from underresourced communities. The following sections highlight these practices in detail with specific examples of how C4L translates research into action for all children.

Practice 1: Leading with Math and Science Content

Research has long revealed that math and science proficiency in the United States is low in comparison to other developed countries and that the achievement gap is even wider for children who live in poverty and are members of linguistic and ethnic minority groups (Arnold and Doctoroff 2003; National Research Council 2001, 2007, 2009). These achievement gaps originate in early childhood when children from low-income families, on average, already possess less extensive math and science knowledge than middle-income children due to fewer high-quality learning opportunities at home and at school (Blevins-Knabe and Musan-Miller 1996; Brenneman, Massey, and Metz 2009). Science is specifically emerging as an area of concern, with research revealing that among the eight Head Start Learning Outcomes, children entered kindergarten with lower science readiness scores than in any other domain (Greenfield et al. 2009).

Despite these discouraging findings, children at an early age exhibit a natural mathematical and scientific curiosity. Children's innate desire to explore and make sense of the world around them naturally leads to their use of early math concepts, such as telling how many or how much, comparing, ordering, and manipulating items as they build and play. The learning trajectories approach—building activities that match children's natural way of thinking about and learning math at each developmental level—emphasizes the math concepts within and extended from children's natural activity through the use of engaging stories and activities. Recent studies (Maloney et al. In press;

Research into Practice with Connect4Learning

The Connect4Learning (C4L) early childhood curriculum addresses the above research by building on math and science content. C4L departs from the more common preschool strategy of building the curriculum around literacy and instead relies on a sequence of science and math topics as a foundation, grounded in research and learning trajectories, and draws meaningful connections between math and science. The mathematics approach in C4L has been shown to be effective in past studies (Clements et al. 2011; Clements and Sarama 2008; and Clements and Sarama 2007). This instruction is grounded in the learning trajectories funded by the National Science Foundation. That is, for each topic, research and the wisdom of expert practice are used to determine the developmental progressions children follow—the levels of thinking through which they progress in learning each topic. The curriculum addresses key domains of number sense, quantity, geometric and spatial reasoning, and measurement, as well as weaving core mathematical subthemes throughout, including sorting, sequencing, and patterns. Curriculum lessons are based on preschool children's experiences and interests with a particular emphasis on supporting mathematical thinking and reasoning. Similarly, C4L addresses science through the Preschool Pathways to Science (PrePS) curricular planning framework that encourages children to think critically about a particular science concept for an extended period of time (Gelman et al. 2009). Curriculum planned with the PrePS approach incorporates science practices that children use repeatedly across content areas, such as observing, predicting, comparing, contrasting, and experimenting. C4L incorporates elements of PrePS and other high-quality, standards-aligned science approaches by providing opportunities for children to practice inquiry skills through deep engagement with science concepts; by engaging children in life science, physical science, earth and space science, and engineering; and by incorporating mathematics and literacy as critical to the scientific endeavor.

Sarama and Clements 2009) indicated the power of the learning trajectories approach for math achievement, with especially promising results not only in mathematics performance but also in oral language skills. Similarly, young children also display a natural capacity and inclination to observe, explore, predict, and discover the world around them (National Research Council, 2012). These are examples of core science skills that can and should be encouraged and supported among children in the early years. Furthermore, recent research indicated that young children have the capacity for constructing conceptual understanding and for developing the ability to use the scientific practices of reasoning and inquiry (National Research Council 2007, 2012), both of which are critical as they transition to learning science in the elementary grades. According to the position statement released by the National Science Teachers Association (2014) on early childhood science education, young children need multiple and varied opportunities to engage in science exploration and discovery, because children develop their science knowledge through both formal and informal learning opportunities and those skills develop over time through sustained engagement with new ideas and concepts. The National Science Teachers Association further recognized that science provides a purposeful context for developing literacy skills and concepts, including speaking, listening, and vocabulary development.

Practice 2: Supporting Social-Emotional Development

It is widely accepted among educators, researchers, and policy makers that early childhood education must attend to young children's social-emotional development. Emotional well-being and social competence provide a strong foundation for emerging cognitive abilities, and together, they are the brick and mortar that comprise the foundation of human development (National Scientific Council on the Developing Child 2007). Children develop emotionally by becoming more aware of their feelings and needs. They develop socially by becoming more aware of the feelings and needs of others. When children develop self-awareness, their social awareness increases simultaneously (Shonkoff and Phillips 2000). Children need instruction and guidance, however, to become self-aware and learn to self-regulate their behavior. Self-awareness positively affects motivation, interest, and persistence in school. Research shows that children's ability to regulate their own emotions and behaviors affects their ability to build and maintain healthy relationships with others, which in turn has a direct impact on academic success (Graziano et al. 2007). Therefore, developing social and emotional skills in the early years has a lasting impact on children's learning (Cohen 2001; Jones, Greenberg, and Crowley 2015). Furthermore, both self-control and self-regulation contribute to the development of executive function skills. Executive functions involve the ability to manage emotions and behavior, make and carry out plans, solve problems, and think flexibly. A growing body of research is demonstrating that executive function skills in the early childhood years are a strong predictor of later school success (Blair and Razza 2007; Tough 2009).

Play is also crucial to healthy social-emotional development during the early years. Play promotes key abilities that enable children to learn successfully. In high-level dramatic play, for example, the collaborative planning of roles and scenarios and the impulse control required to stay within the play's constraints develops children's self-regulation, symbolic thinking, memory, and language—all skills critical to later learning, social competence, and school success (Copple and Bredekamp 2009). Circumstances in the homes of some children from underresourced communities may limit opportunities for high-level dramatic play that would afford them so many cognitive, social, and emotional benefits. As a result, it is vital for early childhood programs to provide opportunities for sustained high-level play with teacher support in the classroom.

Research into Practice with Connect4Learning

When designing all instructional activities, the principal investigators of Connect4Learning (C4L) reviewed practices related to the promotion of social-emotional development and the prevention of problem behaviors. They consistently emphasized three key areas, 1) designing the learning environment to promote children's engagement with activities, materials, and peers; 2) supporting the development of children's social skills and emotional competencies, particularly self-regulation; and 3) implementing a planned and intentional approach to preventing and addressing challenging behaviors. The C4L curriculum incorporates the principles and practices associated with the *Pyramid Model for Promoting Social-Emotional Competence* (Fox et al. 2003; Hemmeter, Ostrosky, and Fox 2006) as its foundation for social-emotional development. This model provides guidance for early childhood educators on the use of effective research-based instructional practices and behavior support for all children, including those from more underresourced backgrounds and with the most severe behavioral challenges. The *Pyramid* is a framework of best practices rather than a specific curriculum. As such, it can be seamlessly integrated into an interdisciplinary curriculum with an adaptive approach that is uniquely tailored to the characteristics of the context and the individual needs of the children being served. C4L further addresses current research on the importance of play by melding explicit instruction with playtime. The curriculum encourages intentional dramatic play during collaborative projects and diverse learning centers, making play a primary context for helping children learn social-emotional skills and develop their executive function competencies.

Practice 3: Narrowing the Vocabulary Gap

Language skills, including receptive and expressive vocabulary development, are among the most important skills to develop during a child's first five years of life. Strong vocabulary skills help children learn and express knowledge across all developmental domains. There is a long history of research, however—most notably with Hart and Risley's (1995) seminal work, "Meaningful Differences," which highlights both the vocabulary gap, on average, between children from lower- versus higher-resourced communities, as well as how children's lack of early exposure to words is strongly linked to delays in reading achievement years later. Circumstances in lower-resourced communities are such that children may not experience the range of words, repeated exposures to words, and systematic opportunities to use new words that are needed to narrow the persistent vocabulary gap (Neuman and Dwyer 2009).

Research into Practice with Connect4Learning

As noted above, Connect4Learning (C4L) is an interdisciplinary curriculum synthesizing literacy with math, science, and social-emotional development. The C4L literacy approach focuses on receptive and expressive language within each of these domains, as well as words that are used in multiple domains. In C4L, vocabulary is used as a meaningful tool for learning, rather than being taught in isolation. Read-alouds provide one important source of vocabulary learning, including using informational books that have rich vocabulary, syntax, and content. C4L includes more than 120 children's books, both trade and custom, to promote the development of vocabulary skills in all children and to help narrow the vocabulary gap. In addition, every week the teacher will see highlights of new vocabulary words that will be introduced during the week. This vocabulary is incorporated multiple times and in multiple ways throughout the week's lessons, providing children with extensive exposure and repeated practice.

During the preschool years, children must acquire the words necessary to communicate their needs, understand teacher expectations and instructions, and develop deep content knowledge. Vocabulary instruction in early childhood is ideally designed to build children's understanding of word meaning, the concepts underlying words, and the ways that words relate to each other. Research suggests that vocabulary instruction for young children can be effective with explicit instruction of new words, guided practice with multiple opportunities to use new words, systematic review of words, and regular progress monitoring to inform ongoing instruction (Neuman and Dwyer 2009).

Practice 4: Constructing World Knowledge

World knowledge, in addition to word knowledge, is essential for constructing meaning from text (Duke and Carlisle 2011; Hirsch 2003). However, as explained earlier, preschool curricula typically offer limited opportunities for children to develop world knowledge, particularly in science. Moreover, children typically have very little exposure to, or experience with, informational and expository text in early childhood. Furthermore, as is often the case, children from underresourced communities experience this disparity the most (Duke 2000). These children are even less likely to be provided opportunities to interact with informational text in school, just as they are less likely to have opportunities to develop content area knowledge (Halvorsen 2003; Sarama and Clements 2009). Despite these findings, recent research showed that incorporating literacy into science curriculum planning, such as with theme-specific nonfiction read-alouds, is an educational and meaningful practice for preschoolers (Brenneman and Louro 2008; Gelman et al. 2009).

Educators and researchers know that young children's development is strongly interconnected, with positive outcomes in one area relying on development in other domains (National Association for the Education of Young Children 2009). As such, preschool is the optimal time to foster children's natural curiosity about their environment and leverage it to help them develop critical thinking, observation, and problem-solving skills necessary for all future learning (National Institute for Early Education Research 2009; Neuman et al. 2007). An interdisciplinary curriculum helps children make sense of the world around them while building the foundational knowledge needed for academic learning (National Institute for Early Education Research 2009). Curriculum that engages children across developmental domains promotes integrated learning and repetition of concepts in varied contexts, both of which support increased world knowledge and curiosity.

Research into Practice with Connect4Learning

Connect4Learning (C4L) offers an important step forward in building world knowledge in the preschool years by providing children from underresourced communities with substantial attention to science and other neglected domains and significant informational reading and writing opportunities. C4L incorporates elements of the project-based approach by which children collaborate toward a larger, long-term goal throughout a unit of instruction. Units are designed to inspire imagination, broaden children's horizons, enhance their personal and social skills, and increase their world knowledge. A holistic approach to literacy helps children to gain a deep knowledge of the natural and social world through extensive use of nonfiction and informational read-alouds. For example, Unit 2 titled "Our Environment" focuses on learning about the people, plants, animals, and earth features of the local environment, as well as their interconnectedness and interdependence. In this unit, children apply what they learn about their local environment to the study of a coral reef, transforming their classroom into an elaborate life-like reef as the unit's central project. The coral-reef project integrates math, science, literacy, and social-emotional development, as well as emphasizing fine motor skills, visual arts, and music. From informational read-alouds in particular, children learn a variety of important concepts and knowledge that can be transferred and applied outside the unit of instruction—in this example, how to reuse, reduce, and recycle. As their world knowledge is constructed and grows, children begin to ask questions, make connections, and develop a natural love of learning.

Practice 5: Expecting and Exceeding

All children have the potential to learn and the capacity to succeed, regardless of diverse circumstances and abilities. High expectations for all children, including those from more underresourced communities, improves their approaches to learning, which include how children will engage with learning new concepts, hold information in their minds, manage their behavior, and apply the skills necessary to achieve their goals (Sesame Workshop 2014). Children meet and exceed expectations when they have teachers who encourage communication and reasoning and who construct an atmosphere of respect, confidence, and enthusiasm for learning (Early et al. 2006). Having high expectations is especially critical for achieving better outcomes for the most vulnerable of children who may require additional supports, experiences, and opportunities to help them learn and develop (Early et al. 2006). Early childhood classrooms and curriculum with high expectations for all children will lead to improved achievement, motivation, self-confidence, and resilience for children.

Research into Practice with Connect4Learning

The Connect4Learning (C4L) curriculum sets high expectations for all children by not underestimating their abilities and potential but instead developing an early childhood community of learners engaging with content on a deep level. C4L raises the bar for children from underresourced communities through a consistent approach of rich content, responsive teaching, meaningful classroom tools, iterative learning cycles with reflection and practice, and project-based learning. In addition, the unique C4L process goals ensure that children who may be at risk for academic difficulties are practicing and mastering skills that are applicable across all domains of learning and correlated to later success in school. These high expectations, consistent for children from all backgrounds, lead to increased initiative and curiosity in the classroom. Children reveal an interest in learning and talking about a range of topics and ideas. They display self-confidence in approaching new challenges, including an openness to learning more and an empowerment to tackle new problems while developing new skills. Children have the opportunity to think and play imaginatively, which paves the way for flexible thinking and problem solving—skills that will serve them well in school, career, and life.

Conclusion

Recently, the C4L principal investigators began collecting empirical evidence to evaluate the appeal, usability, and effectiveness of the C4L curriculum. Early pilot data on the effectiveness of C4L reveal that the program shows promise for young children's learning. Children in five classrooms of children from families representing a range of social-economic status that implemented the C4L curriculum significantly outperformed children in control classrooms on measures of math, science, and literacy. The graphs that follow highlight the difference in pre- and post-test achievement for children who received the C4L curriculum and those who did not.

Figure 1: Number Sense Performance on the Preschool Early Numeracy Skills Test (PENS-B)

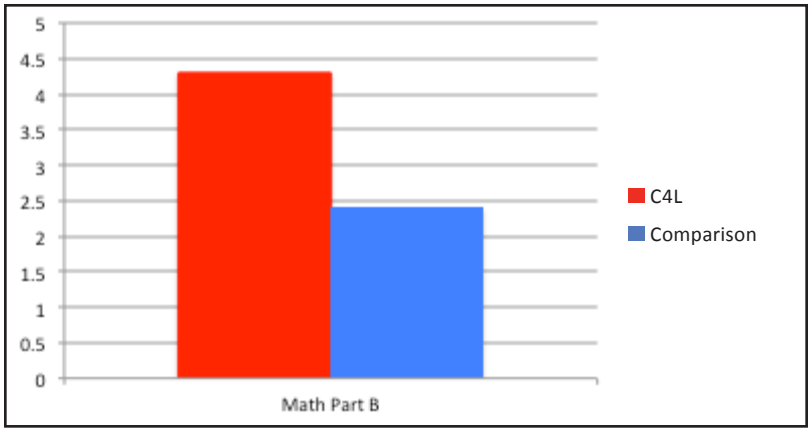


Figure 2: Early Literacy Performance on the Phonological Awareness Literacy Screening (PALS)

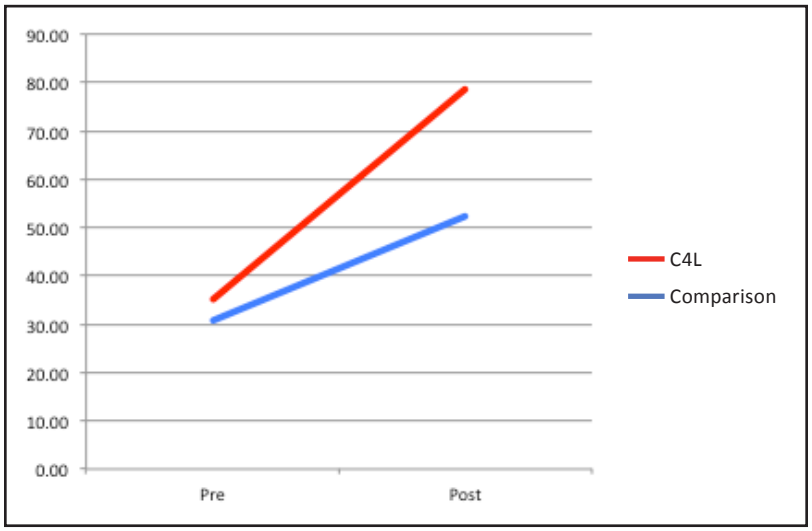


Figure 3: Vocabulary Performance

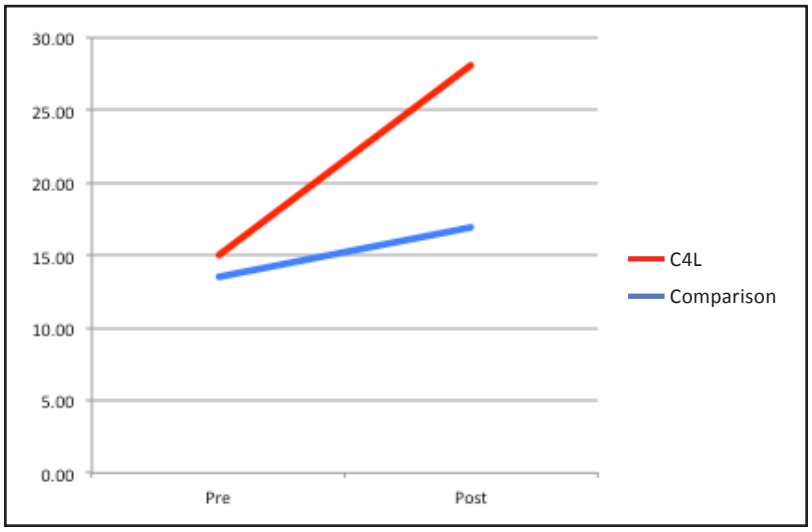
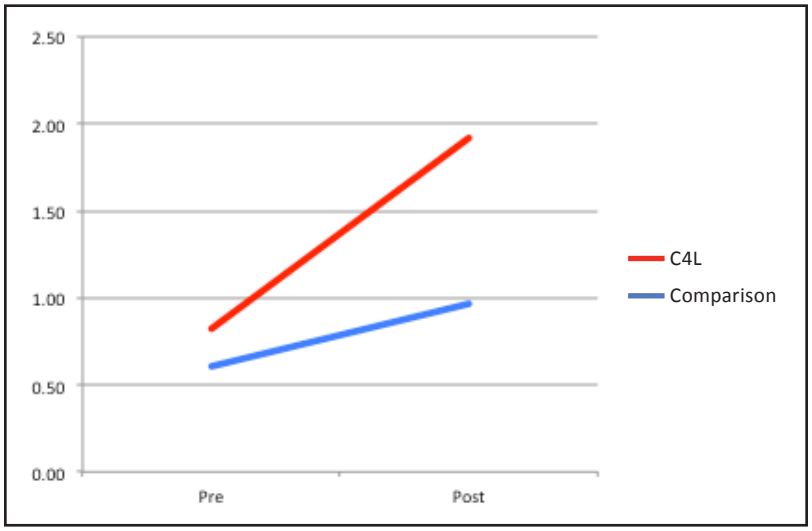


Figure 4: LENS on Science Performance



As evidenced, C4L is an interdisciplinary early childhood curriculum ideally positioned to serve the needs of children from underresourced communities. By leading with math and science content, supporting social-emotional development, narrowing the vocabulary gap, and broadening children's horizons, C4L ensures that all preschoolers can meet the high expectations set for them and achieve their highest potential.

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