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Early Childhood Mathematics: an Insight into Strategies for Developing Young Children Mathematical Skills

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Abstract

The purpose of this work is to examine early childhood math and some strategies on how early childhood math can be enhanced. Math is an important subject in the school curriculum that cannot be overlooked. The young child's math abilities or skills need to be developed for future life. Some methods on how to improve young children's abilities were reviewed. It was a qualitative study. From the review, it was revealed that developing young child math abilities is vital for them to progress in future math. Also, the reviews indicated that math assists young children in building up their math ability to solve problems and think critically. The findings demonstrate the importance of early childhood mathematics programs as a foundation for subsequent math teaching. Young children require a mathematical foundation from an early age in order to develop the concepts and abilities needed to succeed in school, multiple professions, and even daily life.

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INTRODUCTION

The early childhood mathematics program is a vital stepping stone for future math instruction. The start of a child's mathematics education is extremely important. Youngsters must explore and learn the mathematical ideas and concepts present in their environment during the formative years of their life. It promotes young children in developing their critical thinking, reasoning, and worldview both inside and outside of the classroom, which eventually helps them establish a solid basis for their academic success (Onoshakpokaiye, 2020). Children must grasp the ideas, concepts, and manipulative abilities required to understand the fundamentals of mathematics before they can function as adults. To develop the ideas and skills required to excel in school, numerous professions, and even daily life, young children need a mathematical foundation from an early age.

For young pupils to succeed in their coursework that prepares them for digital literacy and higher education, mathematics fluency or competency is necessary (Onoshakpokaiye, 2020). Early childhood mathematics instruction and learning are increasingly being thrust into the forefront of policy debates in light of recent results that link academic achievement to early exposure to mathematics (Whyte, Stein, Kim, Jou & Coburn, 2018). A particularly strong predictor of later academic achievement is kindergarten math skills (Duncan et al., 2007, Whyte, Stein, Kim, Jou & Coburn, 2018). Math abilities, which have traditionally been the focus of early childhood education programs, were found to be even more

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predictive than early literacy, attention, and socio-emotional abilities (Duncan et al., 2007).

A joint position statement from the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) was published in 2002 and later revised in 2010. It demanded that children aged three to six get rigorous, excellent, and accessible mathematics instructions. Without thorough training of early childhood professionals, with teacher education playing a crucial role, this vision cannot be accomplished. Since early childhood educators are typically expected to have an in-depth knowledge of child development and offer children meaningful, relevant educational experiences, mathematicians are going into uncharted territory (Baroody, Lai, & Mix, 2006). Therefore, it is now the responsibility of math educators to come up with innovative ways to present ideas in early mathematics. All students need to have a solid understanding of the topic from a young age because of how crucial mathematics is to academic performance in all classes (Sadler & Tai, 2007).

RESEARCH METHOD

A review of the literature on early childhood math is the methodology adopted. The information in this research comes from a variety of linked academic works. Early childhood math research papers are the related literature that is referenced.

RESULTS AND DISCUSSION

Mathematics Education for young children's teachers

A growing body of studies demonstrates that young infants enter preschool having a remarkable amount of informal math knowledge (Baroody et al., 2006, Clements & Sarama, 2007, Ginsburg, Lee, & Boyd, 2008). The young children's interactions with objects, parents and their surroundings are thought to have given them some pre-math knowledge. Early childhood educators need to possess the necessary arithmetic skills, as well as knowledge of child development and pedagogical content, to effectively build on this informal or pre-mathematical knowledge (Whyte, Stein, Kim, Jou & Coburn, 2018). For early childhood educators to effectively teach and facilitate learning, they must fully grasp these numerous informational threads (Bransford, Brown, & Cocking, 2000). In a discussion on content knowledge in education in 2000, Bransford and his colleagues proposed the following: Expert teachers should be familiar with the organizational principles of their fields because this familiarity provides them with cognitive road maps that direct the assignments they give their students, the assessments they use to determine their progress, and the questions they pose during the give-and-take discussions that take place in the classroom.

Furthermore, experts in the field of early childhood education have stated that they are not interested in seeking additional professional development in mathematics (Simpson & Linder, 2014). The way early childhood educators feel about math may contribute to their lack of preparedness in this area. Teachers' decisions about classroom instruction are influenced by their understanding of mathematics and mathematics teaching (Bransford et al., 2000). We are aware that a lot of early educators hate math and aren't confident in their math skills (Copley,

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2004). There will be an effect on their instruction if early childhood math educators detest math and don't believe they are math-competent.

Early childhood educators need both pre-and in-service training if they want to encourage early mathematics. Unfortunately, the bulk of pre-service teacher preparation programs, that are offered, pay little to or no attention to math content because it is nearly never taught separately from other topics; early childhood mathematics stand-alone courses are rare. This element of planning is lacking. Most of these early childhood educators do not receive sponsorship from the relevant body to train them for the profession (Maxwell, Lim, & Early, 2006, Whyte, Stein, Kim, Jou & Coburn, 2018). Furthermore, even when pre-service teachers are exposed to courses that emphasize children's mathematical development or the subject knowledge necessary to support it; these programs frequently target teachers of students in grades K–3 (Maxwell et al., 2006).

Comprehensive early childhood programs are lacking in many countries, and early childhood educators frequently do not have access to worthwhile professional development opportunities. Many teachers who are aware that they will be teaching in pre-kindergarten settings lack the necessary training. Only 33 out of 1,127 early childhood practitioners had finished mathematics-related professional development, according to a survey of those who had received professional development conducted by Simpson and Linder (2014) in their research on early childhood professional development. Early childhood educators may miss out on opportunities to learn more about the teaching and learning of early mathematics once they are in the classroom.

It is crucial to comprehend how math educators conduct their profession when considering how to promote early mathematics instruction. Their teaching strategies and the outside factors that affect their instruction are two significant topics. Teachers need to be knowledgeable about the subject matter they are teaching and cautious when selecting pedagogical strategies. As an illustration, current supported professional development practices mandate that math educators give up one-time professional development sessions, give specific illustrations of the ideas and techniques they are advocating in early childhood classrooms, and offer ongoing support for putting these ideas and techniques into practice, frequently through coaching and mentoring (Winton, Synder & Goffin 2016, Desimone & Garet, 2015, Whyte, Stein, Kim, Jou & Coburn, 2018). These changes to teacher education techniques mirror socio-cultural assumptions about learning by providing an opportunity for groups of people to interact with potential new mathematical concepts and procedures (Lave & Wenger, 1991). The significance of policy and the workplace environment is revealed when the factors that affect math educators' jobs are examined. Education policy tends to place more of an emphasis on classroom-based teaching and learning in recent years (Spillane, 1999). Understanding the guidelines that math educators follow is crucial as they affect the learning opportunities that present themselves as well as the resources that teachers make available to their classrooms.

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Table 1. List of Articles

S/N	Authors' name	Published Article	Title	Research method	Results
1	Simpson & Linder	2014 Early Childhood Education Journal, 42(5), 335–342	An examination of mathematics professional development opportunities in early childhood settings	It was a survey method to find out how and how much pre-service and in-service early childhood educators were prepared to help young children develop their mathematical abilities and thought processes.	The research demonstrates that professional growth in mathematics is insufficient. Only a small number of professional development opportunities cover the Common Core State Standards in Mathematics or concentrate on certain mathematical subject areas. In addition, the majority of possibilities for professional development are hourly programs that last only one to two hours.
2	Whyte, Stein, Kim, Jou & Coburn	2018, Journal of Early Childhood Teacher Education, 39(3), 213-231	Mathematics in early childhood: Teacher educators' accounts of their work	It was a survey technique used as part of a bigger project that created resources for teacher educators working with both pre- and in-service early childhood mathematics teachers.	It was discovered that the ways they expressed what they teach, how they teach it, the references they use, and what influences their work only had minor variances.
3	Harris and Petersen	2019 Mathematica Policy Research https://www.mathematica.org/publications/developing-math-skills-in-early-childhood pages 1-6	Developing Math Skills in Early Childhood	It was a succinct issue-based strategy to aid in the early development of math skills in young children. The strategy integrates the effect of parents, the home environment, and pediatric healthcare professionals.	The research found that infants start learning math even before they can sit up. They compare the size and shape of items, compare variations in quantity, and employ basic mathematical concepts while playing and in other activities throughout the day.

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Description of early math

Early math covers a range of fundamental concepts, such as numbers, measurement, spatial relationships, forms or shapes, and pattern recognition (National Research Council, 2009, Weisberg, Hirsh-Pasek & Golinkoff, 2013, Harris & Petersen, 2017). Children investigate these concepts when they interact with their environment because they are inherently curious about the world (Weisberg, Hirsh-Pasek & Golinkoff, 2013, Harris & Petersen, 2017). Young children can explore math while playing, such as when they build towers out of blocks. As they sort the blocks by size and colour, pay attention to spatial relationships, and build reasoning skills, they learn which forms can be stacked on top of one another, which ones will topple the tower they have made, and how to mix shapes to make familiar items (Jordan & Levine, 2009, Harris & Petersen, 2017).

Parental involvement in developing young children's math abilities

Fostering early learning is crucial to enhancing children's sense of security, self-worth, and confidence. Since this is the time when the majority of brain development and significant developmental milestones occur, young children, require loving interactions and a nurturing home environment. While playing, preschoolers explore patterns and forms and may count or compare diverse objects (Seo & Ginsburg, 2004). However, kids need adult interaction to learn the terms that explain the basic math ideas they come across. Parents and other adults can incorporate this developmental support into their everyday schedules. During the first few years of life, parents and the home environment have the most effects on brain development, which have effects outside of the classroom(Institute of Medicine (IOM) & National Research Council(NRC), 2015, Center for the Developing Child, Harvard University,2017). Language-rich interactions between parents and children promote not just the development of the parent-child relationship but also the cognitive and linguistic development of the latter (Center for the Developing Child, University of Harvard, 2017). When reading stories or building towers with young children, parents can point out various sizes and shapes and use words to describe them. By encouraging toddlers and older children to count or sort the items in the laundry basket, parents and other adults can use commonplace activities like washing laundry as a teaching opportunity for toddlers and older children.

Figure 1 Parent and their child at the dinning section

By having them set the table for supper, you may encourage them to think mathematically as seen in Figure 1. At the dinner table, parents or other adults can inquire of a child how many spoons, forks, and plates of food are needed, the number of chairs present at the dining and so on. Children need to engage with

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adults to understand the terms that define the basic math concepts they encounter. Having books around the house, reading them, and conversing with them have a positive impact on a child's capacity to learn language and literacy even as young babies (Institute of Medicine (IOM) & National Research Council, 2015, Evans, Kelley & Sikora, 2014, Harris &Petersen, 2017). As adults, children who had their parents speak to them frequently and in a variety of ways as children, for example, had larger vocabularies than their classmates whose parents spoke to them less (Harris &Petersen, 2017, Weisleder & Fernald, 2013).

Figure 2 Parent and their children at the sitting room

As seen in Figure 2 above. Parents can also ask the young child to look around the sitting room to identify different objects, their shapes, patterns, and numbers and so on. By so doing the children are being taught basic mathematics and its concepts. Things around the homes and environment can be used by the parents or other adults to involve or develop the young children's math abilities. Parent-child interactions also have an impact on a child's early development of math skills. In comparison to toddlers who are exposed to fewer arithmetic-related vocabularies, preschoolers have a deeper understanding of math (Berkowitz, et al, 2016, Pruden, Levine & Huttenlocher, 2011). When caregivers immerse young children in math-related activities, they learn more quickly and are more likely to succeed in school. (Berkowitz, et al, 2016, Van Voorhis, Maier, Epstein & Lloyd, 2013). But for many parents, supporting their child's early mathematical development is a task riddled with anxiety brought on by their own traumatic math experiences or a lack of confidence in their capacity to teach their children math. Early perceptions of arithmetic anxiety in young children may have long-lasting effects (Cannon, & Ginsburg, 2008, Harris & Petersen, 2017).To help parents encourage their children's early math skills, initiatives should focus on three things: (a) increasing their awareness of early math and its importance; (b) helping them get over their own math anxiety, and (c) giving them practical tools to support their children's learning through everyday activities (Cannon & Ginsburg, 2008). It is advantageous to teach parents how to do this since early children who had trained parents had better pre-primary math skills than children who had untrained parents (Harris &Petersen, 2017).

STRATEGIES FOR DEVELOPING YOUNG CHILDREN MATHEMATICAL SKILLS

Promoting math learning in young children

The first three years of a child's education, from birth through third grade, provide the groundwork for all future learning. Early math aptitude predicts subsequent success in arithmetic as well as later reading performance far more

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reliably than early reading aptitude. Young children have an amazing ability for understanding complicated math (The Progress of Education Reform, 2013). Children in preschool who begin receiving good mathematics instruction at an early age will have the chance to build on these core skills with significant mathematical learning throughout their primary years (The Progress of Education Reform,2013).

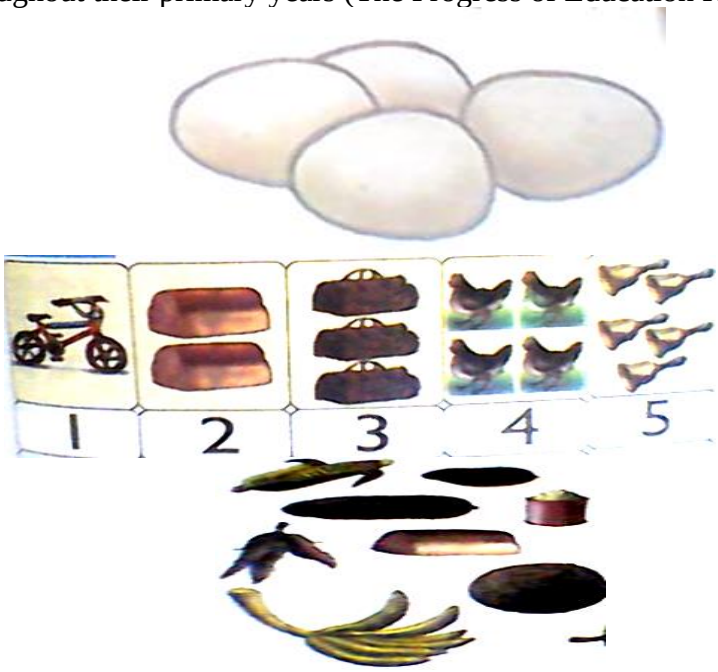

Figure 3 using concrete objects to teach the children math

Observing common or concrete objects they see in their homes and environments can contribute to their learning of math at the early stage of life (see Figure 3). The young children's math skills can be developed or enhanced through the counting of concrete objects they come across and matching the objects with their numbers as they count. Through this method, the counting abilities or skills of young children are developed. Also, their mathematics skills are being built up for future and formal math learning. Preschooler math competence affects how well they do in high school. Most interestingly, it predicts reading performance substantially better than early reading abilities (Duncan, et al, 2007, Farran, Aydogan, Kang & Lipsey, 2005, Lerkkanen, Rasku-Puttonen, Aunola, & Nurmi, 2005). More mathematics practice improves conversational language skills, according to studies (Sarama, Lange, Clements & Wolfe, 2012).

Children's ability to solve problems and think critically is aided by math (National Research Council, 2001, Institute of Medicine (IOM) & National Research Council, 2015; Harris & Petersen, 2017). For kids to succeed in school and life, it's important to develop their problem-solving and critical-thinking skills, but not all kids develop the requisite math skills (Mullis, Martin, Foy & Hooper 2016, Harris & Petersen, 2017). To learn mathematics, a child's capacity for reasoning is crucial. The ability to reason mathematically is a crucial cognitive ability, and children's proficiency in math from a young age indicates how successful they will be at math as adults (Clements & Sarama, 2009, Denton & West, 2002).

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Do not downplay children's math ability

The mathematical aptitude of young children should not be disregarded; they learn arithmetic intuitively at home through a variety of means. When given the chance to learn, young children have an extremely deep, extensive, and advanced informal understanding of mathematics (Baroody, 2004, Clarke, Clarke, and Cheeseman, 2006). These young children need the chance to demonstrate everything they have learned through various techniques, which may happen while they play with various household objects. When kids play, they typically engage in far greater activity. Preschoolers can solve basic math problems, and nearly all of them spend a significant amount of their leisure time engaging in pre-mathematical activities (Sarama and Clements, 2009, The Progress of Education Reform, 2013). The most time during play children touch their fingers and toes and the same time count them. When the children are asked to touch their toes or fingers they are indirectly learning how to identify objects and learning how to count (see Figure 4). Children playing with their toes and legs are an avenue for developing math skills and concepts. It is an effective way of actively seeking out new information. Every available means and any objects that they can have access to should be used to teach the children concepts in math.

Figure 4 using available objects to learn math

Hirsh-Pasek, et al, (2015) identified four pillars of learning that describe how people learn best in their recent assessment of the literature on the science of learning, which included studies from the fields of neuroscience, education, psychology, and cognitive science. Children learn most effectively when they are: actively seeking out new information; attentive (not distracted); meaningfully interacting with the subject; and, last, socially engaged. The combination of these four elements is essential for enjoyable learning. Playful learning includes all forms of unstructured play and games. Children are engaging in free play when they use objects, interact with other children or adults, or describe activities. Free play is something that children initiate and control. Even when they aren't asked to, many children incorporate math into their autonomous free play.

Play as a means of teaching young children math

Even though the majority of early childhood educators do not see the importance of play as a method of effective teaching, they do not include it in their programs, play is very important when teaching math to young children. Higher-level free play, which aids kids with self-control and executive function, has increased in early childhood programs that include more math. Children investigate spatial relationships, patterns, and shapes through higher-order play. They count the items as well as compare sizes (Seo & Ginsburg, 2004, The Progress of Education Reform, 2013). These game-based investigations have a previous mathematical relationship. All children can use their innate mathematical ability with the aid of

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excellent instruction (Doig, McCrae & Rowe, 2003, Thomson, Rowe, Underwood & Peck, 2005).

Even before they can sit up, infants begin to learn math. They use fundamental mathematical concepts while playing and in other aspects of their daily lives to differentiate between variations in quantity, compare the size and shape of objects, and analyze variations in quantity (Jordan &Levine, 2009, Harris & Petersen, 2017). The majority of children are stuck on a path to failure if excellent mathematics instruction doesn't begin in preschool and continues throughout the early years (Rouse, Brooks-Gunn & McLanahan, 2005). Since early mathematics development is essential for success in the future, it is imperative to have pedagogical tools that encourage mathematics learning from the earliest ages. One way that playful learning, a thorough pedagogical technique that incorporates games, free play, and guided play, supports early mathematics acquisition is by providing a productive, research-based teaching approach (Hassinger-Das, Zosh, Hirsh-Pasek & Golinkoff,2018).

Don't undervalue children's prior knowledge.

The majority of teachers of young children vastly underestimates what the kids already know and are capable of doing or learning (Clements & Sarama, 2009). The abilities of young children are grossly underrated by many education professionals (Aubrey, 1997). One study found that groups of preschool teachers, teacher trainers, and counsellors underestimated the mathematical aptitude of these same kids when they entered kindergarten (The Progress of Education Reform, 2013). For instance, the adults thought that 20% to 50% of kids could count, but in fact, more than 80% of kids could count out nine marbles. In comparison to all adults who correctly predicted less than 10%, more than 40% of youngsters were able to subtract 10 from 8 without the help of any materials. Teachers and those who assist them in their job will not provide suitable, demanding math problems if adults underestimate what children already know and are capable of learning.

Tutoring in math is required for young children

Young children require help or encouragement to deal with any challenges they may face because this is their first formal exposure to math. A math intervention benefits the majority of kids (Clements & Sarama, 2011). According to studies by Schoenfeld and Stipek (2011), Duncan and Magnuson (2011), Harris and Petersen (2017), and Duncan, et al, (2007), early math ability may be the best predictor of future achievement in both reading and arithmetic. Deficits in math abilities, however, begin early and become apparent by the time children enter kindergarten.

Sadly, kindergartens who have difficulty with math are likely to fall behind their peers in later years (Watts, Duncan, Siegler & Davis-Kean, 2014, Duncan & Magnuson, 2011, Weisberg, Hirsh-Pasek, Golinkoff & McCandliss, 2014, Siegler, et al, 2012, Harris &Petersen.2017). Not just the poorest children, but all young children need interventions (Pianta, Barnett, Burchinal & Thornburg, 2009). Most kids start kindergarten behind their peers from the wealthiest neighbourhoods. Children who enter preschool with poor foundational math skills stay behind their peers (Jordan & Levine, 2009, Hassinger-Das, Zosh, Hirsh-Pasek & Golinkoff,

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2018). To ensure academic success for all children, these expanding gaps must be addressed as soon as possible. To achieve better outcomes and assist in reducing content-area gaps, we must take advantage of how children learn most effectively.

WHAT LINK DO EARLY MATH AND EARLY LITERACY DEVELOPMENT HAVE?

One common concern is that supporting early math could mean spending less time on early literacy. This is not, however, a need. According to Harris and Petersen (2017), the Institute of Medicine (IOM) and the National Research Council (2015), early math and early reading skill development are interwoven, and efforts can be undertaken to assist both at the same time. When math is taught alongside other subjects, such as reading, children learn the subject more effectively than they would if it were the only subject covered (National Research Council, 2009, Harris & Petersen, 2017). Kids are taught language and math in a similar order. Infancy is the time when language and literacy skills start to grow as children's vocabulary, phrase complexity, and sentence length rise.

Children learn how to express their thoughts in words by increasing their vocabulary, understanding of syntax, and ability to use longer, more complex sentences (Kipping, Gard, Gilman & Gorman, 2012). According to the Institute of Medicine (IOM) and National Research Council (2015) and Janzen (2008), learning basic arithmetic terminology, recognizing math in everyday situations, and eventually mastering more challenging math concepts involving measurement, geometry, and reasoning are all stages of the early math learning process. Reading books, sharing tales, and employing "math talk" are all effective, simple approaches to integrate and advance early numeracy and early literacy skills. Children's books frequently emphasize math in different ways.

WAYS TO IMPROVE EARLY CHILDHOOD MATH

Advocating for competent math Teachers

Pre-K through third-grade teachers should be certified with an emphasis on pedagogical competency in addition to subject-matter expertise (more specifically, a solid mastery of the math taught in the early and elementary years). The best way for young kids to learn arithmetic is to have a teacher that is knowledgeable about the subject and the best teaching methods. For the curriculum to be successful, early math teachers must be experts in these fields. A school may assign one instructor to teach arithmetic to every student in every grade as a possible fix.

Putting in place an early math education program that works

Early math isn't typically emphasized in programs for becoming teachers. As a result, both pre-service and in-service instructors lack subject-matter competencies, such as a working knowledge of mathematical concepts and techniques. More importantly, they lack the expertise needed to teach mathematics, including understanding how mathematical concepts relate to one another and the outside world, how students understanding of mathematical concepts changes as they get older, and how to instruct mathematical concepts effectively (Clements & Sarama, 2009). They have detrimental impacts, such as math anxiety and a lack of

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confidence in one's mathematical ability and teaching skills, beliefs that devalue mathematics education or obstruct successful instruction.

Programs are required to help professionals become more productive. Therefore, early childhood mathematics professional development needs to cover topic (mathematical) knowledge, especially math knowledge for teaching, as well as pedagogical understanding, emotional concerns, and other pertinent subjects (Ball &Bass,2000).

CONCLUSION

From the study, we discovered that the math ability of young children needs to be developed early to enable them to succeed in future math. Different strategies were discovered. Mathematics instruction is usually of poor quality, especially in the early years, even though learning settings vary in quality. A comprehensive math curriculum and instruction that meets the needs of all kids must be supported if legislators and school administrators want a program to be truly effective.

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