Contemporary Issues in Early Childhood
Volume 8, Number 4, 2007
www.wwwords.co.uk/CIEC

Contemporary Issues in EARLY CHILDHOOD

What Counts in Research? A Survey of Early Years' Mathematical Research, 2000-2005

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ABSTRACT This study reviews 208 articles on early childhood mathematics education sourced from the ERIC database and published between 2000 and 2005 in order to determine the adequacy of the literature. The document analysis identified a heavy emphasis on (1) mathematical concepts and instruction, and (2) articles addressing the school years compared with the prior-to-school years. Overall, this study revealed (1) a lack of peer-reviewed articles that discuss, investigate, examine, or debate early childhood mathematics; (2) a limited emphasis in the prior-to-school years; and (3) a paucity of literature on technology and problem solving, which are fundamental in the twenty-first century.

Introduction

Technological advances of the past few decades have increased the demand for mathematical proficiency in the everyday lives of adults and children. Adults who have acquired this proficiency are able to participate fully in everyday life. For example, there is substantial mathematics in reading and understanding the tables, charts, graphs and formulas in the sports, business, entertainment and weather sections of the newspaper. In contrast, those who fail to develop adequate mathematical proficiency are vulnerable because they lack the skills and knowledge to make informed decisions. Simply choosing a new mobile phone is a minefield that requires substantial mathematical know-how. Which is the best phone and plan for a combination of: broad coverage, low call costs, and cost-efficient text messaging? Thus, astute decisions about phone choice involve mathematical knowledge of the *cost* of the phone and plan, the *frequency* of use, and the geographical *coverage*, as well as aesthetics and functionality of the phone. Individuals who lack the requisite mathematical proficiency are vulnerable because they may pay more for their phone than necessary or acquire a product or service that does not suit their needs. Steen (1997) argues that the extent of mathematical vulnerability is enormous when individuals are unable to manage everyday mathematical situations effectively: 'an innumerate citizen today is as vulnerable as the illiterate peasant of Gutenberg's time' (p. xi). Thus, the *development* of mathematical proficiency is a key issue for children and their education. Of particular importance are the early childhood years (i.e. birth to eight years) because experiences and education in these years have long-term benefits and consequences for an individual's life outcomes (Organisation for Economic Cooperation and Development [OECD], 2001, 2006).

The past few decades have seen substantial changes in thinking about young children's ability to reason mathematically and their propensity to learn mathematical concepts and acquire

 http://dx.doi.org/10.2304/ciec.2007.8.4.301

associated skills (e.g. Baroody, 2000; Ginsburg et al, 2000; Clements & Sarama, 2007). For example, Perry & Dockett (2002) report that, 'The developments that occur in the early childhood years are remarkable for their speed, comprehensiveness, and complexity' (p. 83). These various research findings on children's early mathematical growth, together with the growing number of children who spend time in early childhood programs, has created an impetus for the creation of policies, curricula and guidelines that support the development of early years care and education (OECD, 2001, 2006) including mathematical proficiency (Clements, Sarama, & DiBiase, 2003; National Council of Teachers of Mathematics [NCTM], 2000; National Association for the Education of Young Children [NAEYC], 2002; Ball, 2004). However, the extent to which these documents impact on young children's outcomes in mathematics will depend largely on the practices they engage with prior to school and in their early years at school. In turn, the professional practices of early years' teachers, as distinct from caregivers, depend on their professional learning and the extent to which their practices are informed by research. Many countries are emphasising the importance of early childhood mathematics education (Ginsburg et al, 2007). Yet Hiebert (1999) cautions that an adequate evidence base is essential to inform teachers who are trying to improve children's achievement in mathematics.

A substantial review of mathematics education over the past two decades by Lubienski and others (Lubienski, 1999; Lubienski & Bowen, 2000) revealed limited attention to early childhood issues. They reported that of the 3011 research papers published between 1982 and 1998 only two percent focused on early childhood. An analysis of the content of this early childhood research or the ages of the children in the studies was unreported. However, knowledge of the adequacy of the literature base is important in identifying gaps in the literature and setting a research agenda. Thus, the purpose of this paper is to report on a more in-depth investigation of the early childhood research literature in mathematics education between 2000 and 2005 with particular attention to the coverage of key issues and topics in mathematics across the full age range of the early childhood years (i.e., birth to 8 years).

Method

This study examined the literature on mathematics education and early childhood during the six-year time span between 2000 and 2005. The two research questions were:

1. What were the predominant topics of focus in early childhood mathematics research?
2. How representative was the early childhood mathematical research of different age groups within the birth-to-eight-years age range?

Knowing the dominant topics and the focus on particular age groups is important because it provides a step towards developing a strategic research agenda in early childhood mathematics education and is consistent with the approach advocated by Ball (2004) to foster mathematical proficiency: 'To yield maximum returns from the resources that are available for investment in mathematics education research and development, the program must focus on high-leverage areas of need' (p. xii).

The two research questions were addressed using a similar methodology to Lubienski and Bowen (2000). In essence, this approach consisted of identifying a data set of articles for review from a large database, limiting the data set to include only relevant articles, and ascertaining the representativeness of the literature through a thematic categorisation of the articles and a frequency count of the various types of article.

The Education Resources Information Center (ERIC) database on EBSCOhost was the data source for this study. ERIC, which is sponsored by the US Department of Education, Institute of Education Sciences, was used because it is easily accessible. It provides free access to more than 1.2 million bibliographic records of journal articles and other education-related materials and, if available, includes links to full text documents. A large range of abstracts representing the breadth of national and international education-related books, papers and articles published between 2000 and 2005 was available through ERIC. However, similar to Lubienski and Bowen (2000), we reviewed only articles from peer-reviewed journals because they (a) reflect the interests and values of mainstream research communities and (b) have a degree of quality control and credibility through the peer-review process. We acknowledge that articles sourced from ERIC are limited to

those published in English. However, within mathematics education, English is recognised as the primary language for professional communication.

The articles for this study were identified from a key word search of the ERIC database with the assistance of the ERIC thesaurus. A primary feature of the ERIC database is the comprehensive thesaurus from which ERIC document-type codes were used to identify peer-reviewed articles. The codes were used to broadly define four ERIC categories – namely: (1) general, descriptive or evaluative reports; (2) research or technical reports; (3) information analysis articles; and (4) viewpoints. General, descriptive or evaluative reports were articles that described, discussed and/or evaluated curriculum, standards, programs or methods. Research or technical reports were research-based documents that reported and analysed research conducted specifically within the early years' mathematics field. Information analysis articles provided reviews of literature or previous research. Viewpoint articles were position papers on particular topics relating to young children and mathematics. For this study, articles from all four categories were included.

The data set for this study was identified by an ERIC data search and the establishment of search terms and limiters from the ERIC thesaurus. These terms were then used to identify appropriate articles that addressed both early childhood and mathematics themes. The first step was to locate items published relating to the broad descriptors of young children or early childhood or kindergarten or elementary education. This search identified 12,850 refereed articles from 2000 to 2005. The broad ERIC descriptors of mathematics curriculum or elementary school mathematics or mathematics activities were applied to the original search outcome, which reduced the data pool significantly. This second search, which applied further limits to the preliminary data set, reduced the set to 369 (2.87% of the initial data pool). The third step was to manually check that all articles were refereed and meeting the descriptors. Consistent with Lubienski & Bowen's (2000) approach, only peer-reviewed articles were included. Whilst most of the 369 articles were refereed articles relating to early childhood mathematics, conference papers, regional curriculum documents, or articles not representing the early years' cohort were eliminated from the data set. This reduced the final data set to 208 articles (1.68% of the initial data pool).

These 208 articles were sourced from 77 journals (Table I). These journals represented the fields of mathematics education, early childhood, general education, psychology, technology and special needs and were predominately publications based in North America or the United Kingdom. The majority of articles on early childhood mathematics education (ECME) appeared in general education journals (28.9%). The number of articles in these journals ranged from one in approximately two-thirds of these journals to 28 from *Teaching Children Mathematics*.

The abstracts of the 208 identified articles in the data set were then analyzed by (1) content and (2) age of the child participants. The focus of the content analysis was to identify emergent themes from the abstracts and key words with consideration of major and minor ERIC descriptors. This was a straightforward process in which the abstracts and key words of each article were read to establish the focus of the article and then a relevant category was assigned by matching key words or their synonyms. Articles were assigned more than one code if they used more than one descriptor. Categories were established that best represented the content theme of the articles. These articles were also analyzed for the cohorts to identify the specific age groups within the early childhood years that featured in the articles. It is important to note that the validity of our results relies significantly on the accuracy of both the ERIC descriptors and our interpretation of the descriptors. Like Lubienski & Bowen (2000), we acknowledge the severe limitations of simply counting the number of articles relating to a theme. Our methodology does not address the quality of the article. The quality was determined by the early childhood and/or mathematics education communities through the peer-review process and in the subsequent publication of the articles. Notwithstanding these limitations, this analysis is able to provide an indication of the popular topics and age groups of research in early childhood mathematics education, and hence, alert us to under-researched areas.

Psychology Journals (*n* = 23)
Cognition (14)
Journal of Experimental Child Psychology (10)
Journal of Educational Psychology (7)
Journal of Early Education and Family Review (6)
European Journal of Educational Psychology (3)
Developmental Psychology (3)
Journal of Marriage and Family (1)
Method and Evaluation in Counselling and Development (1)
Journal of School Psychology (1)
School Psychology Review (1)
International Journal of Experimental Educational Psychology (1)
Journal of Applied Developmental Psychology (1)
Journal of Instructional Psychology (1)
Journal of Educational Psychology (1)
Cognitive Instruction (1)
Cognitive Development (1)

Early Childhood Journals (*n* = 16)
Young Children (17)
Early Childhood Research Quarterly (12)
Child Development (11)
Early Childhood Development and Care (7)
European Early Childhood Education Research Journal (3)
Early Childhood Education Journal (4)
Journal of Research in Early Childhood (3)
International Journal of Early Years Education (2)
Journal for Early Education and Family Review (2)
Early Childhood Today (3)
International Journal of Early Childhood (1)
Child Care Information Exchange (1)
Childhood Education (1)
Canadian Journal of Research in Early Years (1)
Early Education and Development (1)
Canadian Children (1)

General Education Journals (*n* = 16)
British Journal of Teacher Education (5)
Elementary School Journal (4)
Reading Teacher (1)
Education Measurement Issues and Practices (1)
Scandinavian Journal of Educational Research (1)
Education Teaching Research and Development (1)
Cambridge Journal of Education (1)
Educational Leadership (1)
Journal of Education and Teaching (1)
Action in Teacher Education (1)
International Journal of Research and Practice (1)
Principal (1)
Teacher Educator (1)
Kappa Delta Phi (1)
Teaching and Teacher Education (1)
Comparative Education (1)
Curriculum Inquiry (1)
Teaching Exceptional Children (1)
Educational Studies (1)
Exceptionality (1)
Hands On (1)
Journal of Educational Research (1)
Teaching Pre-kindergarten – 8 (1)

Mathematics Education Journals (*n* = 11)
Teaching Children Mathematics (28)
International Journal of Mathematical Theory and Learning (3)
Mathematics Teaching (2)
Journal of Research in Mathematics Education (3)
Journal of Mathematics Teacher Education (2)
Australian Primary Mathematics Classroom (2)
Mathematics Educator (1)
New England Mathematics Journal (1)
Australian Mathematics Teacher (1)
Educational Studies in Mathematics (1)
International Journal of Mathematical Thinking and Learning (1)

Special Needs Journals (*n* = 6)
Journal of Learning Disabilities (3)
Journal of Research in Special Education Needs (2)
Journal of Early Intervention (2)
Journal of Deaf Studies and Deaf Education (1)
Learning Disability Quarterly (1)
Topics in Early Childhood Special Education (1)

Technology Journals (*n* = 5)
Journal of Educational Computing Research (6)
Computers and Education (1)
Technology Trends (1)
Education Technology Review (1)
International Journal of Computers (1)

Note: The numbers (*n* =) referred to represent the number of identified articles (not codes).

Table I. Categorisation of journals sources by discipline.

Results and Discussion

The results report, first, on the outcomes of the content analysis, and second, on the analysis of the age cohorts in the 208 identified articles on early childhood mathematics education.

What Were the Predominant Topics of Focus in Early Childhood Mathematics Research?

Nine content themes emerged from the analysis of the literature: mathematics concepts, instruction, mathematics curriculum, social and cultural focus, assessment, technology, problem solving, or mathematical development. The analysis of the 208 articles resulted in 311 codings according to these themes. Although 115 articles received a single theme code, 93 articles were assigned two or more theme codes because the articles had multiple foci. For example, an article that discussed an instructional technique for algebra would have been assigned (1) a code for instruction *and* (2) a code for mathematical concepts (i.e. algebra).

The frequency of coding for each theme varied substantially (Table II). A total of 55% of articles related to the two most common themes, which were 'mathematics concepts' and 'instruction'. Thus, over half of all the papers identified were concerned with what to teach and how to teach early childhood mathematics.

The most common theme of the articles was 'mathematics concepts', with over a third (n = 112) of the 311 codings (Table II). Although this theme incorporated a range of mathematical concepts, including number and operations, algebra, geometry, measurement, and data analysis and probability, the predominant topic was number. Within the category of mathematical concepts, 36.6 % (41) articles were specifically related to number concepts such as counting, one-to-one correspondence, numeracy and number operations. Over a hundred years ago Dewey (1898), and later Thorndike (1922), concluded that children's initial training in mathematics should focus on counting. This traditional importance bestowed on counting and number concepts has remained constant over the past century. The topic of number holds a particularly important place in the mathematics curriculum, with number and operations identified as one of the three grade-level curriculum focal points from pre-kindergarten through to Grade 7 (NCTM, 2006).

ERIC Descriptor	Frequency of theme	Percentage of theme
Mathematics Concepts	112	36%
Instruction	59	19%
Mathematical Development	35	11.25%
Social and Cultural Issues	25	8%
Assessment	21	6.75%
Special Needs	21	6.75%
Mathematics Curriculum	20	6.45%
Technology	14	4.5%
Problem Solving	4	1.3%

Table II. Themes and frequency of occurrence.

A total of 19% of articles focused on the broad theme of 'instruction' (n = 59). This theme included articles grouped around the focus of teaching and instructional techniques. The broad ERIC descriptor defines instruction as a process by which knowledge, attitudes or skills are deliberately conveyed, including the total instructional process and teaching strategies employed. Research on instruction is of particular importance because teachers of young children are typically uncomfortable with teaching mathematics and lack confidence in their own knowledge of mathematical content and pedagogy (e.g. Copley, 1999). Additionally, there is a dearth of research on mathematics teaching in the early years of schooling (e.g. Ginsburg et al, 2007).

Articles relating to 'mathematical development' made up 11.25% of the codings (n = 35). Articles in this category provide research details or discussion about the progression from earlier to

later stages of mathematical growth in the early years. Earlier nineteenth-century views about mathematical development were pessimistic about the capacity of young children for mathematical thought (e.g. James, 1890; Piaget, 1965). However, in the last quarter of the twentieth century, researchers and educational practitioners have adopted a highly optimistic view of children's capability and focused on what they *can do* (e.g. Gelman, 1979). Research findings indicate that foundational mathematical knowledge begins during infancy and undergoes extensive development over the first five years of life. Clements & Sarama (2007) suggest that 'it is just as natural for young children to think pre-mathematically and then mathematically as it is for them to use language' (p. 5). Contemporary research has confirmed that children are capable of mathematical insights and inventions that exceed our expectations (e.g. Ferrini-Mundy et al, 1999) and challenge the adequacy of the intellectual demands of most programs (Geary, 1994; Griffin & Case, 1997; Klein & Starkey, 2004).

Social and cultural issues that impact on young children's mathematics featured in 8% of the articles ($n = 25$). It has long been recognised that social and/or cultural circumstances may affect or alter learning outcomes (Arnold & Doctoroff, 2003). Several factors have been reported to contribute to the relationship between young children's socioeconomic status and educational outcomes – for example, birth weight, nutrition, access to housing and health care (Bradley & Corwyn, 2002). The National Research Council (1997) identified that factors such as these have repercussions on children's cognitive functioning or parenting and, as a result, educational achievement can be impeded. Quality investigations and discussion of the type that appear in peer-reviewed journals are becoming more salient as child poverty reaches epidemic proportions throughout the world. Approximately 47 million children in OECD nations live below their national poverty lines – that is, one in every six of the rich world's children is living in poverty (United Nations Children's Fund, 2000). Research and discussion is needed to ascertain the contribution that mathematical proficiency can make to improving young children's life outcomes.

Three further themes each accounted for between 6 and 7% of the codings: assessment and special needs (both 6.75%, $n = 21$), and early childhood mathematics curriculum (6.45%, $n = 20$). The assessment theme was assigned to articles which researched or discussed assessment strategies or tools in early years' mathematics. Appropriate assessment tools and practices are essential to monitor mathematical capability and evaluation tools are essential to assess the effectiveness of programs and curricula (Ginsburg & Golbeck, 2004). However, Ginsburg et al. (2007) also warn that overly narrow evaluation may inhibit efforts to create an effective, enjoyable and age-appropriate early childhood mathematics education.

The special needs theme (6.75%, $n = 21$) included articles relating to children who are deaf, who suffer from ADHD, or those who have learning disabilities. Although Nunes & Moreno (1998) and Jordan et al (2003) have conducted investigations that address children who need extra help or have disabilities, this area of early childhood mathematics has received scant attention. Johnson (1999) attests that children with special needs are a particular challenge for early childhood education, as developmental milestones are attained on a different timeframe and in divergent ways. Thus, if all children are to develop to the fullest extent of their capabilities, the needs of every child irrespective of ability or disability should be addressed in educational policy and curriculum. The inclusivity of these policies and curricula will depend on the adequacy of the literature base.

Another theme was 'mathematical curriculum' (6.45%, $n = 20$). This theme relates to the structured learning outcomes and associated learning experiences identified within curriculum documents. Early childhood mathematics curriculum is a growing area. As Ginsburg & Golbeck (2004) acknowledge, we are just starting to see the emergence of systematic early childhood mathematics curricula. In response to the need for sound and effective early childhood mathematics education, several researchers have become involved in creating early mathematics programs (Casey et al, 2004; Griffin, 2004; Sarama & Clements, 2004; Sophian, 2004; Starkey et al, 2004). The rise in early childhood curricula and a recognition of the increased importance of early childhood mathematics in the western world (Kilpatrick et al, 2001) needs to be mirrored by an increase in the literature.

The lowest two themes were technology (4.5%, $n = 14$) and problem solving (1.3%, $n = 4$). This result is surprising given the importance of these two areas in twenty-first-century mathematics. The twenty-first century is an era marked by extraordinary and accelerating change.

In particular the influence of technology on human life has created a world characterised by diverse and energetic communication, vast amounts of information, and rapid change. The need to understand and be able to use mathematics and technology in everyday life has never been greater and will continue to increase. Mathematical achievement in a technological and global society will have a major impact on students' career aspirations, their role in society, and even their sense of personal fulfillment (Malcom, 1999). Each of the technology articles analysed related to young children's use of computers and information technology and communications during mathematical experiences. No articles referred to the mathematical component of other technological tools or devices. For example, most video games draw heavily on spatial ability. Considering the significance of technology in the twenty-first century and the learning potential of the early years, technology and mathematics needs further emphasis.

Problem-solving was the theme that received the least attention. The lack of literature in this area is a serious concern for early childhood educators. Problem solving has received particular attention in curricula documents over the past two decades. For example, the NCTM (2000) emphasises problem solving as the 'hallmark of mathematical activity and a major means of developing mathematical knowledge' (116). It recommends that in the early years children should have frequent opportunities to 'formulate, grapple with, and solve complex problems that require a significant amount of effort' (NCTM, 2000, p. 52). Such tasks have no prescribed rules or standard algorithms. However, only 1.3% of the articles (n = 4) within a six-year period addressed young children's ability to problem solve, reason and converse mathematically. In our increasingly technological and information-based society, students need to develop abilities to function in a world that demands flexible and creative mathematical thinkers and problem solvers. Many professionals in mathematics foresee a society where children are required to have a broader range of skills and knowledge that prepares them to solve new and more complex problems in mathematics (Bowman, 1999). Considering the significant attention that problem solving receives in policy and curriculum documents (e.g. NCTM, 2000), the paucity of the literature base poses a severe limitation to the effective implementation of policy and curriculum in the early childhood years and substantial efforts should be directed towards increasing the literature base.

How Representative was the Early Childhood Mathematical Research of Different Age Groups within the Birth-to-Eight-Years Age Range?

The time span from birth to eight years has been internationally identified as the early childhood years (Bredekamp & Copple, 1997). Four age groups were identified within the birth-to-eight-year span to represent established early childhood care and education groupings: (1) infants (birth to 18 months); (2) toddlers (18 months to 3 years); (3) preschool/kindergarten children (3 to 6 years); and (4) primary/elementary children (6 to 8 years). These age bands vary according to specific entry regulations of individual states, regions and countries and are therefore approximate. For example, in some individual states or countries children may not start preschool till three and a half years of age yet they are classified in the preschool/kindergarten group. Similarly to the coding of topic themes, if articles addressed more than one age group, they were assigned more than one code. One code was assigned to 175 articles of the 208 articles and two codes were assigned to the remaining 33 articles. Hence, overall there were a total of 241 age-related codes.

The frequency of codings was split approximately evenly between the prior-to-school years and the early school years. A total of 51% of the codings (n = 123) discussed infants, toddlers and preschool/kindergarten children (birth to six years), whilst 49 percent (n = 118) related to primary/elementary-aged children (6 to 8 years) (Table III). This split is disproportionate, however, because the prior-to-school years cover the first *six* years of the child's life, while the early school years cover only *two* years.

Age band	Frequency of Cohort	Percentage of Cohort
Infants: birth-18 months	17	7%
Toddlers: 18 months-3 years	7	3%
Preschool/kindergarten: 3-6 years	99	41%
Primary/elementary: 6-8 years	118	49%

Table III. Representative age cohorts and frequency of occurrence.

The importance of the prior-to-school years for mathematical development (Clements & Sarama, 2007) should not be underestimated. Researchers have suggested that some mathematical concepts seem to develop very early in infancy. For example, Wynn (1992) noted that 'infants are sensitive to number' (p. 5) and Geary (1996) found that all children, regardless of culture or surroundings, possess 'biologically primary' abilities including not only number, but also basic geometry. Other researchers have reported that toddlers also develop a variety of mathematical competencies (e.g. Ginsburg, 1977; Gelman & Gallistel, 1978; Hughes, 1986). Additionally, preschool/kindergarten children possess relatively powerful mathematical knowledge, skills and dispositions in number sense (Bobis, 1999), problem solving (Cobb et al, 1991), subtraction (Hughes, 1986), data sense (Jones et al, 2002), analogical reasoning (English, 2004) and spatial thinking (Feeney & Stiles, 1996). Although our review of early childhood mathematics education identified substantial literature on learning in the preschool/kindergarten years (41%), there was scant literature on the learning of infants (7%) and toddlers (3%) (Table III). Additions to the existing literature base would improve our understanding of the development of foundational knowledge in mathematics.

Concluding Comments

This review revealed three particular points of interest for early childhood mathematics education. First, there is a general lack of peer-reviewed articles that discuss, investigate, examine or debate early childhood mathematics. Second, more emphasis is needed on research in the prior-to-school years. Finally, there is a paucity of literature that explores the salient role that technology and problem solving occupies in early childhood mathematics education.

The dearth of research on early childhood mathematics education literature is apparent from the process of identifying the data set for this study. Initially, 12,850 articles were identified relating to the broad descriptors of young children/early childhood/kindergarten/elementary education. Once the mathematical descriptors were incorporated into the search the data pool was reduced to 369 articles, which is only 2.87% of the initial data pool. The data set was further reduced when a manual search detected articles that did not comply with the search requisites. The total of 208 early childhood mathematics articles published in peer-reviewed journals between 2000 and 2005 was only 1.6% of the early childhood literature base. This paucity of literature including evidence-based articles is a concern. An adequate evidence base is essential to inform policy and practice. Slavin (2002) argues that 'research in education should ultimately have something to do with improving outcomes for children' (p. 21). A more extensive evidence base would address the void of knowledge in early childhood mathematics education and provide the means to validate and improve contemporary early childhood mathematics programs, policies and curricula.

The prior-to-school age years are a particularly important but under-researched time period in early childhood mathematics education. Before many children reach compulsory schooling they have developed a foundation of mathematical understandings on which formal learning can be built. Additionally, the mathematical competencies of these very young children can be extensive and impressive (Baroody, 1987; Clements, 2000). Thus, a major question is not whether to teach mathematics in the years prior to formal schooling but how to do so effectively. Ginsburg et al. (2007) attest that 'everyday mathematical knowledge is so fundamental a feature of the child's cognition that it is hard to see how children could function without it' (p. 1). Thus, the literature needs to provide adequate guidance for ways to support mathematical learning in the years prior to formal schooling and to inform practices in formal schooling about building on children's entry knowledge.

A particularly serious issue emerging from this study is the lack of attention to technology and problem solving in the early childhood mathematics literature. When considering the mathematical proficiency to be developed by young children to function effectively in everyday life, we need to consider the technologically oriented time in which they live. Today's children are fundamentally different from those of the past. Prensky (2001) argues that they 'are native speakers of technology, fluent in the digital language of computers, video games, and the internet'. Each of these tools and technologies requires various mathematical know-how and so as the technologies develop the mathematical demands increase and change. Hence, today's children need not only to know about the time-codes of video recorders – a technology that was new in the latter part of the last century – but also the cost of iTunes© and the speed and cost of Internet connectivity for online games. The scope of technology and its impact on the lives of twenty-first-century children is enormous. For example, before American children reach university they have spent over 10,000 hours playing videogames, sent or received over 20,000 emails, and talked on digital mobile phones for over 10,000 hours (Prensky, 2004). In our increasingly technological and information-based society, *mathematical proficiency* is just as important a gatekeeper to effective participation in life and life outcomes as literacy. Hence, research needs to provide adequate guidance on early childhood mathematics education in order to increase the likelihood of children's success. This goal begins with the development of an adequate literature base for early childhood mathematics education. The literature from 2000 to 2005 is a step in the right direction; however, research in strategic areas is needed to adequately address mathematical topics of importance across all age groups in the early childhood years.

Throughout the world various stakeholders have demonstrated their commitment to a quality education for young children. Clearly, the development of mathematical proficiency is integral to young children's everyday lives and future success. However, the effectiveness of young children's participation in everyday mathematical situations and their achievement of mathematical proficiency are dependent on the extent to which the triumvirate of research, policy and practice are aligned and mutually informing. For example, the NAEYC (2002) argues that 'In every early childhood setting, children should experience effective, research-based curriculum and teaching practices.' Thus, more substantial and representative early childhood mathematics literature would be a valuable information source for guiding policy and practice.

> Our children are the latest model of human being. Looking at the world of children is not looking backward at our own past – it is looking ahead. They are our revolutionary future. (Rushkoff, 1999)

Acknowledgement

Special thanks to Joanna Logan, a senior librarian, who provided guidance and assistance in the identification of the data set.

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