Assistive Technology and Emergent Literacy for Preschoolers: A Literature Review

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Abstract: Despite the legislative mandate for assistive technology (AT) consideration and the tenacity of researchers, educators, and practitioners to develop more proficient readers at younger ages, cohesive and comprehensive emergent literacy technology planning has not been sufficiently developed for preschool children with disabilities. The purpose of this review is to synthesize information and research on available AT used with young children to promote the development of emergent literacy skills. Following the background discussion, key articles will be summarized, synthesized, and critiqued. Discussion focuses on the lack of empirical research in the combined areas of emergent literacy, AT, and preschool children; the need for conceptualized definitions of AT and emergent literacy across disciplines; existing barriers; and gaps in the research.

Keywords: Assistive technology, Emergent literacy, Preschool, Early childhood

Literacy skills are critical for every person in the U.S. Legislation such as the Goals 2000: Educate America Act and No Child Left Behind Act of 2001 (NCLB) stress the importance of reading at every entry level-- from early childhood through adulthood. They have emphasized that creating a literate society is considered of paramount importance. Given this expectation for children entering Kindergarten, the push for effective, early, literacy instruction must become a curricular concern and emphasis for early childhood educators. Additionally, the prominence of providing students with disabilities access to the general curriculum only strengthens the significance of literacy skill development in early childhood environments given that access to the general curriculum for preschool children occurs within the daily, instructional, early childhood curricula.

Developing the skills necessary to become literate and perform competently in a literate society begins very early in a child's life. From birth, children begin to interact with the world around them, and some of the most naturalistic behaviors of children can influence the beginnings of literacy development. For the purpose of this article, emergent literacy is conceptualized as global early experiences that create a foundation of life-long literacy and academic and personal success (Lankshear & Knobel, 2003). The early experiences that children engage in from birth through the time when they adopt conventional literacy skills bring "meaning to reading and writing" (Koenig & Holbrook, 2000, p. 265). These early experiences include: (a) learning to listen and respond to oral

communication; (b) interacting with written text (e.g. holding books, 'reading' books by using the pictures); and (c) exploring the written and verbal world (e.g. scribbling with a crayon, turning pages, talking with others, and pretending to read; Justice & Pullen, 2003; Koenig, 1992). In short, emergent literacy is the cornerstone of future literacy functioning.

NCLB created the Early Reading First (ERF) program to improve teacher practices, instructional content, and classroom environments in preschool settings. The anticipation was to assist in ensuring that young children start school with the skills needed for academic success. Whether educators and researchers agree on the means government is using to promote literacy and institute lofty literacy goals for all children, there is no disagreement that literacy is one of the most important areas of learning for all individuals. There is a stronger emergent literacy skill development research base for children ages five to eight, K-3rd grade, and older elementary and middle grade students than for children who are three to five years of age. In general, the research base is slowly but steadily validating best practices for early literacy education of children (Erickson & Koppenhaver, 1995).

Assistive Technology

Just as the definition of early literacy has expanded, so have the parameters of assistive technology (AT). Technology can take many forms such as (a) no-tech, (b) low-tech, and (c) high-tech. No tech is simply that: no technology is involved; instead, strategies are used to provide an opportunity for learner success (e.g. extended time, colored folders, index cards, chunking materials, and/or pairing pictures with print). Low-tech solutions involve use of straightforward tools such as simple voice output devices, adapted scissors, raised-lined paper, step-by-step picture schedules, and /or printed labels with

essential vocabulary. High-tech solutions typically involve the computer or have computer components, such as specialized software and advanced hardware devices. AT encompasses both low- and high-tech options with the federal definition culminating and addressing all aspects:

AT has been defined in the Individuals with Disabilities Education Improvement Act of 2004 (IDEIA) as "any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability" [20 U.S.C. § 1401(a)(25)]. This legislation echoed the benefit of AT by emphasizing that both Individualized Education Plan (IEP) and Individualized Family Services Plan (IFSP) teams consider the use of AT within the child's learning environment (Mandlawitz, 2006). Addressing AT considerations is not a mere luxury, but rather a federally mandated requirement.

In addition to the federal mandates, a position statement generated by the Division on Mental Retardation and Developmental Disabilities of the Council of Exceptional Children stated that persons with developmental disabilities do, in fact, benefit from the use of AT (Parette, 1997). More specifically for young children, the National Association for the Education of Young Children (NAEYC, 1996) has supported the developmentally appropriate integration of technology in preschool settings.

AT can benefit children with increased opportunities for socialization, communication attempts and interaction, increased self-esteem and confidence, as well as developing language and communication skills (Erickson & Koppenhaver, 1995; Hutinger & Clark, 2000). This parallels the Social Learning Theory first presented by

Vygotsky (1996) in which children learn through interaction, communication, and play, thus strengthening the importance of AT and its critical link to increased communicative attempts, more engaged play, and increased socialization. Children vary greatly on how they access, use, and engage learning materials (Strangman & Dalton, 2005). AT provides tools for young children to become active versus passive learners.

Preschoolers with special needs have many options at their disposal with the advances in technology, availability of AT, as well as the growing array of AT devices. However, it should be noted, having a repertoire of devices is not enough to ensure that the needs of a student are compensated with appropriate technology tools. The challenge has been taking the next step, such as matching appropriate AT to the needs of preschoolers with disabilities. A key factor to successful integration is to match learner needs with appropriate technology needed for the instructional task, while simultaneously evaluating the teacher's knowledge and experience to implement the AT (Judge, 2006).

AT, Emergent Literacy, and Preschool Aged Children

AT may hold promise for helping aid children's development in many areas; however, even with the recognition of the benefits of technology there has been little information about the effect technology use has on preschool-aged children's development (Skeele & Stefankiewicz, 2002). It is very possible that AT could enhance the developmental skills targeted by emergent literacy activities (e.g., cognitive development, language development), but there is a dearth of empirical studies which address the acquisition of emergent literacy skills and the use of AT.

Earlier works of Kamil and Intraror (1998) and Lankshear and Knobel (2003) exposed the fact that the area of literacy and the use of technology were radically under-researched. Kamil and Intraror reviewed the literature for empirical based research articles from the years 1986 to 1995 that pertained to school–aged children and literacy and technology use in a broad sense. Lankshear and Knobel built on Kamil and Intrator's review by surveying professional journals for research studies published from 1996 through 2002, and which encompassed new technologies (computer-based applications) and early childhood literacy (ages 0-8 years). Building on these earlier works we examined current literature that addressed assistive technology, emergent literacy and early childhood (ages 3 to 5).

The purpose of this review is three-fold: to (a) conduct a literature review of scholarly publications in the area of AT that focus on emergent literacy for preschoolers, (b) discuss the outcomes and benefits of AT, and (c) describe implications for future research. This review closely follows a research synthesis model developed by Edyburn (2000). Within such a model, the examination of the literature was conducted by applying four procedures. These included: (a) search procedures, (b) inclusion criteria, (c) relevance, and (d) completion of article analysis form per each article reviewed. The following section provides greater detail regarding each procedure.

Method

Procedures

Search procedures. Article search procedures were conducted using the following components: (a) electronic-based searches in the Library Information Access System through the Educational Resources Information Center (ERIC), ProQuest, and

Infotrac® using AT with key descriptors or truncation (i.e., 'technology,' 'disabilities,' 'alternate and augmentative communication [AAC],' 'emergent literacy,' 'early literacy,' 'preschool'); (b) a manual search of refereed journals publishing articles on disabilities, early childhood education, literacy, AAC, and

AT; and (c) a traditional search using the reference section of articles obtained through the above two methods.

Inclusion criteria. Using the selection criteria procedures described above, more than 500 articles were found. The selection

Table 1
Coverage and Scope of Articles Selected for Review

Study	Purpose	Critique
Beck (2002)	Case study examining how AT affected emergent literacy in a preschool classroom for students with multiple disabilities	Variations were noted in how technology components were used which may call into question the fidelity, reliability and validity Case study methodology. Noted a teacher-made checklist to collect data on progression of both student receptive and expressive knowledge of symbols though it was not specifically described. Technologies used: picture communication symbols, adapted books, Big Mack switch, Intellikeys/Intellitools.
Hutinger et al. (2006)	Longitudinal Study *Dependent variable:* Computer use; teacher perception *Independent variables:* Use or non use of the model Length of time the teachers received replication training and follow up	Strong reliability, validity, and fidelity measures *Primary findings:* Teachers need significant training and support when implementing an innovation Children did make gains in literacy measures *Secondary findings:* Data analysis is ongoing Technologies used: computer-based activities/software
Lankshear & Knobel (2003)	Intent was to map recent research pertaining to new technologies and early childhood literacy in ways that may be useful to early childhood educators and researchers	Teachers' attitudes and perceptions did impact technology use and were related to lack of understanding software, narrow definition of literacy, lack of time, and expertise. Similar search and procedure as this review.
Marsh (2004)	Family surveys: Avg age of children in the families was 2 yrs 8 mo. Families were targeted from disadvantaged environments in home. 26 families of the 44 volunteered to be interviewed and they were the parents of 13 boys and 13 girls	The authors make a case for techno-literacy to actually be considered a form of emergent literacy in itself; in essence, it is not how technology can enhance literacy but the fact that technology has become a part of emergent literacy as much as the experience. Different cultural perspective than the dominant culture in the U.S. Technology used: television, film, computer games, and mobile phones.

criterion was further refined by limiting the inclusion to AT with the following categories: emergent or early literacy (*n* = 23), then further refinement of early childhood literacy (*n* = 6). Articles published between the years 2002 to 2007 were reviewed to establish the relevance to the special topic of the emergent literacy and the use of AT. Only peer-reviewed articles published in journals were used in this review. See Table 1 for a brief purpose and content analysis of articles selected for review.

Relevance. An article was determined relevant and was included if it was peer-reviewed and published between 2002 and 2007 and the primary focus of the article was related to AT in the areas of preschool, early literacy, or emergent literacy. Articles were excluded if (a) AT was only mentioned as a consideration or a recommendation; (b) AT was demonstrated as a tool, but not one specifically targeting early or emergent literacy; or (c) emergent literacy research was conducted on children older than five years.

Article analysis. A content analysis was generated to provide a summary of selected articles. The analysis was divided into examining six categories (a) background information (i.e., full citation, purpose of study); (b) participant characteristics (i.e., background characteristics of study participants, number not completing study and why); (c) research design (i.e., design of the study, description of theory or model); (d) practice characteristics (i.e., independent variables; characteristics of the intervention measures; treatment fidelity); (e) outcomes (i.e., outcome measures; how were they measured; measurement of reliability or validity); and (f) synthesis findings (i.e., how are characteristics of the practice related to the outcome; positive or negative outcomes; level of measurement used to describe the practice and outcome). Results from the analysis are summarized in Table 1.

Limitations

This review was a focused examination of current articles (within the last five years) specifically addressing AT, emergent literacy, and early childhood. Because of the specific nature of this review, there are limitations that should be noted. One possible limitation may be the omission of important articles written prior to 2002, or work not published in peer-reviewed journals (e.g., reports, conference papers, etc.). Another possible limitation may be the exclusion of articles outside the parameters of all three descriptors (i.e., AT, emergent literacy, and early childhood). An attempt to conduct an exhaustive search of literature was the ultimate goal; however, there may have been additional search techniques not explored. Only journal articles published in English were examined in this review. This resulted in a pool of only five articles meeting the specific criteria for this review.

Findings and Discussion

This section of the review includes a synthesis of the findings from five articles satisfying the selection criteria. Specifically, this section will provide an assessment of available research in the field of AT and preschool children's emergent literacy development. This review investigated the following themes present in the body of research: (a) lack of clear or poorly communicated conceptualizations of key terminology, (b) implementation barriers, and (c) limited research base.

Conceptualization Problems

As stated previously, the intent of this review was to find articles that specifically addressed emergent literacy and AT within the context of preschool aged children's development. When examining the selected articles, there appeared to be a lack of or poorly communicated delineation of the terms

'emergent literacy' and 'AT.' Differences in orientations with regard to these two key terms could lead to a convoluted conceptualization.

In all of the articles reviewed the authors noted that there was considerable work in the area of emergent literacy; however, authors of three articles did suggest that the term emergent literacy had been limited only to print-based materials. Marsh (2004) stated that the view of current definitions of emergent literacy were too restrictive and needed to be reconceptualized. Lankshear and Knobel (2003) concurred with Marsh's evaluation and assertion that the acquisition of literacy is too narrowly defined. All of these researchers agree that literacy experiences should be viewed in a monolithic way by examining emergent literacy with a broader approach and within a variety of contexts. These researchers made a point to explain that they were examining 'techno-literacy,' but did not clearly define the dimensions of such a term. Further, when these researchers introduced the term techno-literacy they may inadvertently generated a distinction between techno-literacy and emergent literacy where the terms had been perceived as two different entities.

Hutinger, Bell, Daytner, and Johanson (2006) broadly conceptualized the term to encompass a wide array of skills and behaviors. They demonstrated their broader conceptualization by the scope of their outcome measures through examination of emergent literacy behaviors beyond simple print awareness and interactions with text. In their three year longitudinal study, Hutinger et al. examined the emergent literacy growth of preschool children at risk for or having disabilities (e.g., orientation to book, assessing early writing development, child's communicative attempts); student behavioral changes with regard to literacy (e.g. attending skills, interactivity, response to pictures); and teacher outcomes (e.g. increased comfort with

technology, resources and technical assistance needed). These researchers reflected a marriage between emergent literacy and technology with AT providing an avenue for interaction and engagement with literacy.

Interestingly, Beck (2002), in an article published more for early childhood education practitioners, narrowly defined emergent literacy in both scope and validation of AT: "Emergent literacy is concerned with the early phases of literacy development, the period between birth and the time when children read and write conventionally" (p. 44). Unlike the other articles reviewed, there was no clear assertion that technology should be considered in the conceptualization of emergent literacy.

Another interesting finding related to the conceptualization of emergent literacy was that the articles in research journals seemed to stress the need for incorporating technology literacy within the construct of emergent literacy. In contrast, the article in a practitioner friendly journal presented a very traditional definition of emergent literacy and AT, with AT not being considered as an integral part of an emergent literacy program. There was no clearly operationalized definition of emergent literacy across the articles reviewed. All of the ideas were related but there were slight, and possibly unintended, variations in the conceptualization of emergent literacy across studies. A universal definition of the term emergent literacy is needed to include behaviors for interacting with both print and technology-based materials. In light of these findings, it is evident that future research would benefit from a consistent and global description of what constitutes emergent literacy behaviors taking into account the advancements in technology and other learning tools, such as digital and virtual learning.

The problems with the conceptualization of AT is slightly different than the conceptualization of emergent literacy. Variations in the conceptualization of emergent literacy are often reflected across researchers in the field (c.f., Beck, 2002; Neuman & Dickenson, 2001). In contrast, the conceptualization of AT has benefited from a well-defined standard definition provided by federal mandates. However, in implementation, variations in the conceptualization of AT can occur from other professional, general educators, curriculum developers, and families. For example, the impetus for expanding access and educational opportunities for all learners has resulted in a stronger examination of universal design for learning (UDL) principles and its integration into classrooms. The concept of UDL has blurred the once clean definition of AT. Consequently, many persons both in and outside the field of AT and special education view AT and UDL as synonymous entities.

To expound, many researchers in the field of AT conceptualize AT as a continuum of devices and strategies (Mistrett, Lane, & Ruffino, 2005). Other educators and professionals tend to equate AT with more expensive high-tech devices often overlooking low-tech options; that is, sometimes individuals of influence in a child's education may overlook effective low-tech devices and may be dissuaded from investigating AT because of a perceived expense and training requirements (Ashton, 2000). This incorrect conceptualization may be inadvertently reinforced because many AT research articles seem to focus more on high-tech options. This was true for articles in this review: three articles dealt exclusively with high-tech (Hutinger et al., 2006; Lankshear & Knobel, 2003; Marsh, 2004); one focused on both high- and low-tech (Beck, 2002); and only one article investigated low-tech resources (Weikle & Hadadian, 2003). AT can be incorrectly conceptualized when the focus is placed on the technology itself rather than technology as a tool for learning.

Barriers to Implementation

A majority of articles reviewed discussed possible barriers to using technology with young children (Hutinger et al., 2006; Lankshear & Knobel, 2003; Marsh, 2004; Weikle & Hadadian, 2003). The most common barrier identified in this review dealt with teacher perceptions, attitudes, and practices. Teachers play a significant role in the implementation of technology in the classroom while parents were viewed as the gatekeepers and implementers in the home environment (Hutinger et al.). Studies reveal that teachers need training and technical support to infuse AT into their classrooms. Given that technology seldom is implemented with young children in isolation, there is no doubt that the teacher's ability, confidence, as well as perceived usefulness of the technology greatly influence the frequency and duration of technology use (Hutinger et al.). As a result, teachers with greater levels of perceived comfort with technology were also more likely to implement technology-enhanced activities versus only viewing the computer as the only source of technology (Hutinger et al.).

Weikle and Hadadian (2003) provided practical recommendations for parents and professionals to enhance literacy by using AT. The authors emphasized that both parents and professionals are hesitant and resistive to acknowledge the importance of technology in the enhancement of emergent literacy skill development. It was also revealed that the lack of society's acceptance of AT with the youngest of learners does create a barrier to implementation of possible successful intervention strategies.

Interestingly, the identified barriers revolved around socio cultural issues rather than practical concerns. For example, none of the

studies in this review suggested that funding, either positively or negatively, influenced AT and emergent literacy instruction. Likewise, technology itself was not identified as a barrier.

Limited Research Base

This examination identified a recurring theme that there is a limited amount of research addressing AT, emergent literacy, and preschool children simultaneously. This paucity of research was addressed in some manner within all articles reviewed. Lankshear and Knobel (2003) examined 'new technology' as it relates to emergent literacy and characterized the research in this area as 'piecemeal' and 'hopelessly inconclusive.'

For this review, a concerted effort was made to locate scholarly articles in the areas of AT, emergent literacy, and preschool children concomitantly. Given the criterion, the review only yielded five peer reviewed articles in the past 5 years. One of the articles selected for analysis in this review was a review of research from 1996 to 2002 (Lankshear & Knobel, 2003). These researchers used similar procedures implemented in this review and located only five articles. Therefore, over an 11-year period, only 11 articles were located which addressed the search descriptors. As previously discussed, much work continues to address emergent literacy skill acquisition as well as the use of AT, though not in conjunction with each other at the preschool level.

Outcomes and Benefits of AT

The premise of this literature review was that meaningful integration of technology could enhance emergent literacy for preschool children. This review generated the following: a need for (a) more empirical research in the area of AT, emergent literacy, and early childhood; (b) shared professional perspectives regarding the conceptualization of emergent literacy, technology, and AT in early childhood education; (c) increased collaboration, communication, and investment of time and resources among key stake holders regarding AT and its role in emergent literacy for young children; and (d) heightened recognition of the socio cultural influences affecting technology and AT integration in early childhood emergent literacy programs and activities. Each of these is discussed in the following section.

Need for Empirical Research

Technology is indeed an undisputable presence in all aspects of life in contemporary society today. In 2003, 91% of children in nursery school through 12th grade ($n = \sim 53$ million) used computers and 59% ($n = \sim 35$ million persons) used the Internet. The high percentage of preschool-aged children in 2003 that actively interacted with computers and computer related technologies (66%; $n = \sim 3$ million preschoolers) further accentuates the presence of technology in the lives of individuals beginning at a very young age (National Center for Educational Statistics [NCES], 2005).

Further evidence of the trend toward increased technology integration on a very basic level is the continuing increase of computers and their use in American schools. In 1998 the average public school contained approximately 90 computers as compared to approximately 154 computers in 2005. Additionally, access to the Internet in instructional settings has increased from 51% to 94% from 1998 to 2005 (NCES, 2008).

To ensure full potential for students with disabilities from this increased access to computers and the Internet, AT is often an integral part of the instructional activity. As a result, researchers must decipher the effectiveness of AT isolated from other

educational interventions (Fennema-Jansen, Edyburn, Smith, Wilson, & Binion, 2007). Currently, initiatives are in place to gauge the outcomes of AT in school settings (e.g., Project OATS; Fennema-Jansen et al.). While there are similarities in preschool children's abilities, use, and needs a compared to older children's skill sets, an examination of appropriate AT tools and devices for preschoolers is underexamined (Judge, 2006; Lankshear & Knobel, 2003). More AT projects such as Let's Play (http://letsplay.buffalo.edu/index.html) and similar initiatives are needed to provide a foundation for future research.

Common Conceptual Framework

Research studies in the area of AT, emergent literacy, and preschool children that adhere to scientific rigor (e.g., replicable, empirically sound) and work in tandem with current programs and practices provide insightful information to chart new pathways for learning. The process of establishing a conceptual framework is currently reflected in the efforts of several states (e.g., Florida and Georgia) to establish emergent literacy curriculum standards for preschools. Another example is the National Educational Technology Standards for Students (NETS-S; International Society for Technology in Education, 2007) in grades PK-2 (ages 4-8). The next step in extending and refining the conceptualization of emergent literacy and AT with preschool children is to look across published standards to identify commonalities and interrelatedness. This conceptualization allows for the development of measurable indicators for technology and emergent literacy competence in young children. A common conceptual framework provides parameters for researchers, educators, and families.

Increased Collaboration, Communication, and Investment

Increased collaboration, communication and investment of time and resources among key stake holders regarding AT and its role in emergent literacy for young children is essential. Lankshear and Knobel (2003) asserted that few mainstream journals address technology in conjunction with emergent literacy. It is critical that successful practices be disseminated to those needing the information most (i.e., families and professionals). In order to provide key resources and proven approaches, stakeholders must align technology and strategies, while carefully documenting outcomes. Through collaboration, stakeholders bring about the best literacy experiences and opportunities for preschoolers with each lending their expertise and insight.

Recognize Socio Cultural Influences

Evidence-based practices and programs promoting effective integration of technology and AT with emergent literacy can be rendered ineffectual by extenuating socio cultural influences. For example, teachers who are not comfortable with technology and do not use technology in their personal lives may be resistant to integrating technology in emergent literacy programs. In this case, teachers' comfort levels determined the socio cultural environmental condition for the children they were serving. Additional socio cultural factors such as family beliefs, interaction patterns, gender, ethnicity, and socioeconomic status (SES), can be involved in determining effective integration practices. Further, it appears a catalyst for widespread implementation of AT with young children lies in addressing socio culture challenges present in early childhood environments.

Conclusion

Researchers and practitioners alike have advocated that working on developing emergent literacy skills among young children could help alleviate negative academic and personal outcomes. As technology continues to expand and grow, more AT, both low- and high-tech, will continue to be developed. Therefore, incorporating technological advances should be a key component in designing the most effective and innovative emergent literacy interventions.

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