Achieving School Readiness & Success Using Tablets and Content:

iStartSmart® Mobile by Hatch® Research Basis Whitepaper

The purpose of this whitepaper is to present the research basis for the iStartSmart Mobile through a connected discussion of the most current literature on mobile devices and content for early learners.

Lilla Dale McManis, Ph.D.

Research Director, Hatch Early Childhood

The Early Learning Experts

Table of Contents

The Current State of Mobile Learning

The presence of mobile devices in educational settings is rising rapidly.

Mobile devices are among six technologies named in the most recent *NMC Horizon Report* as having a substantial impact on education in teaching and learning. Further, they are poised to become mainstream in the immediate future (Johnson, Adams & Haywood 2011). According to Informa Telecoms & Media (Püschel 2012), the number of mobile devices produced yearly is now more than 1.2 billion. Tablets are foremost among the type of mobile technology driving this immense growth. The tablet/slate market is expected to grow from fewer than 20 million units in 2010 to over 230 million in 2015, with 87 million Android devices approaching the number of iPads at 90 million.

Trends indicate that much of the use of such mobile technology will be by early learners. A recent analysis by the Joan Ganz Cooney Center found that over 500,000 apps are now available on the Apple App Store and an additional 300,000 on the Android Market. The vast majority (80%) of the selections in the Education category of iTunes are for children, and 72% of these are meant for preschool and elementary age children. However, fewer than 20% of all education apps are designed for elementary-age children (Shuler 2012).

Why is mobile technology such an appropriate and well-liked educational tool?

One of the key reasons that mobile devices are so appealing to educators is their natural fit into the learning environment (Shuler 2009). This fit results from the usability of the technology and the flexible options for learning at an individual or collaborative level. The fact that mobile technology is portable makes it a compelling choice for use in the classroom. When a device moves with the child, the flow of learning continues less interrupted than it is when children must move to a desk or more so to a computer lab outside of their classroom. Learning is supported on a multitude of levels as children can make a smooth transition from their individual activities to collaboration by sharing their work with teachers and one another. Just as importantly, studies show that children like using touch-driven, highly interactive technology (Michael Cohen Group & USDOE 2011; Shuler 2009).

New technologies are being developed to provide customization and differentiated instruction to meet children's unique needs. Such development has been spurred by a growing realization that methods designed to meet "everyone's" needs at once actually neglect the learning and school-readiness needs of many children. As Johnson and colleagues note, "Technology can and should support individual choices about access to materials and expertise, amount and type of educational content, and methods of teaching" (Johnson, Adams & Haywood 2011). The revised Position Statement *Technology Tools and Interactive Media in Early Childhood Programs Serving Children from Birth through Age 8* from the National Association for the Education of Young

Children (2012) discusses at length why educational technology must be able to provide a learning experience that meets individual children's needs in a developmentally-appropriate manner. The statement also discusses the need for teachers to have the skills to select and use the technology in an integrated fashion within their programs/classrooms.

Can young children successfully use and learn from mobile technology?

Tablet usability studies find that preschool children learn to use tablets quickly, independently, and confidently, showing freedom of exploration (Couse & Chen 2010; Michael Cohen Group & USDOE 2011). Findings are emerging related to outcomes for learning from educational content on mobile devices. For example, a recent study with iPod Touch devices with learning content found that young children gained in vocabulary and phonological awareness (Chiong & Shuler 2010). The potential of mobile devices to support learning may be particularly relevant to under-resourced children because handheld mobile devices typically are often more accessible both at school and at home which supports efforts to address digital equality. For example, a study with low-income children showed they gained in essential literacy skills using mobile technologies to deliver robust educational content and to support interactions in which parents learned to scaffold their children's learning (Horowitz, Sosenko & Hoffman 2006). A just-released report describes the findings of a study in which half of the kindergarten classrooms in a school district were randomly assigned to use an iPad to focus on literacy. Both target and control children were administered standardized literacy assessments before and after using the iPad. Gain scores were consistently greater for the children in the iPad condition than for children in the comparison group. Notably strong effects were found in particular around the iPad users' level of phonemic awareness and ability to represent sounds with letters (Bebell, Dorris & Muir 2012).

The iStartSmart Mobile

Hatch has developed the iStartSmart Mobile, a tablet-based learning system with progress monitoring, based on research showing that children with literacy and math competence are more successful in school, and based on the aptness of mobile technologies for early-learning settings.

What Skills Should Young Children Learn in Literacy/Language and Mathematics?

Literacy/Language

The formation of reading and writing concepts and skills is a dynamic process in the earliest stages of children's literacy development. Research shows a strong and lasting relationship between the early development (birth-5) of reading and writing skills and later conventional literacy skills (Neuman *&* Dickinson 2006; National Early Literacy Panel 2008). The National Early Literacy Panel (NELP) conducted an extensive, rigorous meta-analysis drawn from multiple studies with large numbers of children. The Panel identified the critical areas representing

early/precursor literacy skills that have the strongest predictive relationships with later development of literacy. These skills also kept their power to predict even after accounting for the role of other variables, such as IQ or socioeconomic status (SES).

Skills identified as important for later reading and writing success are:
- Alphabet knowledge
- Phonological awareness and memory
- Rapid naming tasks (such as naming of letters, digits, objects, colors)
- Writing/writing name

Mathematics

Supported by a decade of success in improving early literacy, the National Research Council recognized the increasing importance of mathematics and established the Committee on Early Childhood Mathematics (NRC-Math 2009). Following an extensive review of the research and teaching literature, the Committee published their findings that virtually all young children have the capability to learn and become competent in mathematics. In fact, well before first grade, children can learn the ideas and skills that support later, more complex mathematics understanding. However, the Committee identified two main concerns. One is that mathematics is taught to young children for only a minuscule part of the day and secondly, many widely-used early childhood curricula do not provide sufficient guidance on mathematics pedagogy or content.

When early childhood classrooms do have mathematics activities, they are often presented as part of an integrated or embedded curriculum in which the teaching of mathematics is secondary to other learning goals. Research indicates, however, that learning experiences in which mathematics is a supplementary activity rather than the primary focus are less effective in promoting children's mathematics learning than experiences in which learning mathematics is the primary goal. There is expert consensus from the Committee that two areas of mathematics are particularly crucial for young children to learn: (1) number, which includes whole number, operations, and relations; and (2) geometry, spatial thinking, and measurement.

Underserved Children

Such preparation is especially urgent for low-income children who consistently perform below higher-income children in overall cognitive functioning, oral language, emergent literacy, and mathematics. For example, the report *Inequality at the Starting Gate* found that the cognitive scores of preschool-aged children in the highest socioeconomic group were 60 percent above those of children in the lowest group (Lee & Burkam 2002). Compared to their middle-income peers, young, low-income children are less likely to develop into mature readers (Arnold & Doctoroff 2003; Burkam, Ready, Lee & LoGerfo 2004). The contribution to these differences can be illustrated by the seminal work of Hart and Risley (1995), who found that by age four, the average

child from a family on welfare had 13 million fewer words of language experience than did a child in a working-class family.

The pattern is similar in mathematics. For example, Jordan and colleagues found that low-income children enter kindergarten far behind their middle-income peers on tasks assessing counting skills, knowledge of number relations, and operations. Moreover, longitudinal assessment reveals that low-income children are four times more likely than their middle-income peers to show flat growth in these mathematics areas throughout kindergarten and early first grade (Jordan, Kaplan, Nabors Oláh & Locuniak 2006; Jordan, Kaplan, Locuniak & Ramineni 2007).

What are best practices for using mobile technologies in early education settings?

An emerging group of well-designed projects has studied the usability and learning potential of mobile devices and of accompanying content for young children. From these projects, best practices are being identified (Chiong & Shuler 2010; Shuler 2012). These practices informed the creation of the iStartSmart Mobile.

Best Mobile Educational Technology Practice: Deliver learning content that is of high quality, relevant and appropriate.

Educational technology has the power to teach directly and to support and extend what children learn. These are the hallmarks of integration. When the standard curriculum and educational technology present appropriate learning content with guidance from teachers, children begin to see and make connections between concepts. This can result in deeper, more sustained mastery of concepts and skills, mastery that helps children more successfully apply what they have learned across many settings.

For mastery to occur, effective presentation of the content is absolutely critical. Selecting from hundreds of thousands of 'apps' in a way that brings children effective content is extremely difficult. Combining applications to form a cohesive, meaningful, and appropriate learning experience for children may be impossible. As mentioned earlier, over 500,000 apps are available in the Apple App Store, and an additional 300,000 on the Android Market. Ratings by reputable sources such as Common Sense Media and Children's Technology Review are rare. These groups had together rated only about 100 apps for preschool- and elementary-age children at the time of the Cooney Center Report (Shuler 2012).

Studies involving parents highlight further app adoption problems. Chiong & Shuler (2010) found that many parents restrict their children's use of mobile devices because they do not view them as potential learning tools — especially as compared to other technologies such as surfing the Internet and playing video games. Interestingly however, without knowing the pre- and posttest results, all the parents thought that using the featured educational apps in the study reinforced

concepts and words which they felt their child already knew, or that as a result of using the content that their child learned new words and concepts.

One wonders whether this belief that mobile devices do not support learning is related to the purchasing patterns of parents. In a survey conducted by the NPD Group (2010), parents reported that 82% of all apps downloaded for children were free. Apps that are free may have a greater likelihood of being less educationally appropriate depending on the resources available to the developers. For example, one might see that free apps developed by PBS such as in the study described above could be of higher educational quality than apps developed by non-educators with little to no training and experience in education and/or early childhood. However, parents also responded that they were open to spending more for apps, perhaps realizing this issue.

Ensuring that children's content is high-quality, relevant and appropriate is also vitally important to addressing inequality. Gutnick, Robb, Takeuchi et al. (2010) report a measurable difference among children's use of technology. With regard to almost all platforms, low-income families in general 'consume' higher amounts of media, but in these families the children spend more of that time on media of lower quality. The report raises the concern that these media will not help children develop school-based skills. For instance, Neuman & Celano (2006) found that low-income children accessed websites at libraries featuring less text-based and more image-based content, resulting in lost opportunities for the development of reading skills.

How iStartSmart Mobile Addresses Delivering High Quality, Relevant and Appropriate Learning Content.

It is for these reasons that the iStartSmart Mobile includes research-based literacy and mathematics activities and games. They are modeled after activities within the TeachSmart Learning System, our interactive whiteboard content, also based on the NELP and NRC Math findings, in which an effectiveness study showed significant gains for children in literacy and math as measured by standardized assessments (McManis, Gunnewig & McManis 2010). The iStartSmart Mobile is not a random set of 'apps,' but a coordinated, connected learning system that provides content for children over the course of a school year.

The learning system includes games scaffolded within 5 skill families and 18 skill-development areas (emerging, developing, developed, and completed [skill maintenance]) in literacy and mathematics. *Scaffolding is discussed in detail below. The 18 skills are sentence segmenting, initial sounds, blending compound words, segmenting compound words, onset rime, letter recognition, language vocabulary, counting foundations, numeral recognition, sequence counting, objects in a set, addition, subtraction, measurement, spatial skills, common shapes, patterning, and sorting. Real time progress monitoring is provided for these areas. The learning system also has several free-play options for children to do individually and in groups.

Best Mobile Educational Technology Practice: Focus content within an appropriate developmental age range.

Children in the early childhood period naturally make momentous learning gains in a short span. The knowledge and skills of a typical three-year-old are substantially less than a typical six-year-old, for example. If content attempts to cover too wide a developmental range without matching a child's level and progress, the resulting software program may be either too difficult or not challenging enough for many children using it (Chiong & Shuler 2010). Individualizing and customizing the learning experience for children to help them meet their goals is another responsibility of educational technology (Johnson, Adams & Haywood 2011; NAEYC 2012).

Scaffolding. One of the most powerful ways to individualize education is by scaffolding learning through the use of technology. Scaffolding has been found to help children more often meet their learning goals; as they exhibit more effective task completion and use higher-order thinking strategies (Yelland & Masters 2007; Barbuto, Swaminathan, Trawick-Smith et al. 2003). Yelland and Masters (2007) discuss three types of scaffolding when teaching children using technology.

Technical scaffolding supports learning by using the features of the technology itself. This can occur through using the technology to bring content to children, such as through customization for individualization and interactivity. Technical scaffolding might involve a learning path based on a child's individual responses when reading print or moving geometric shapes, supported with customized tutorials.

Cognitive scaffolding refers to teacher-facilitated learning around technology use. It might include additional learning and concept building while children use technology through questioning, modeling, or encouraging collaborations with peers. Talking with children about what they are learning and connecting the learning to concepts taught using other curricula are also examples.

Affective scaffolding is essential for task-orientation and to support higher higher-level thinking in young children in particular. In addition to teacher encouragement, the software/content program itself should motivate children in a meaningful way. Engagement and positive feedback may take the form of characters present throughout the learning experience. The child may help the characters, or the characters provide direction to the child, affirming the child's responses and interactions. Successful scaffolding prompts the child to assume responsibility for learning as the next set of new skills enters the scaffolding cycle.

How iStartSmart Mobile Addresses Focusing Content within an Appropriate Developmental Age Range.

iStartSmart Mobile is built in response to the findings that scaffolded methods of delivering content to children is appropriate and effective. iStartSmart Mobile includes four levels: emerging, developing, developed, and completed/maintenance. After log in by a child, the learning system begins all children at a basic level within the skill families. Automated progression rules determine each child's movement through the skill-development areas. The games include tutorials that automatically launch and that the child can access at any time. The system provides automatic intervention and instruction based on each response the child provides. The skill development areas build such that children do not encounter advanced concepts before they show success at the foundational levels.

To ensure that children do not spend time playing without learning the concept, the system automatically locks skills after a certain number of incorrect responses. The teacher must unlock the skill in order for the system to present that skill again. This alerts the teacher to provide additional instruction to the child prior to unlocking. Additional resources in the form of *Beyond the Tablet* provide a large number of activity ideas for teachers to connect the literacy and math concepts within iStartSmart Mobile's Shell Squad Games to their own curriculum.

To further support the approach of scaffolding, iStartSmart also offers two additional features, Teacher Mode and Refocus. In Teacher Mode, the teacher can temporarily suspend the responses of an emerging-level child from entering the progress monitoring component. The teacher can then work directly with the child on the games until the child has demonstrated understanding of the underlying concept and can resume learning through the games. The second feature is Refocus, with which the teacher can block a certain skill family of activities from showing to the child for a specified time in order to pre-teach or re-teach. These features support using scaffolding as a teaching method and a tool for customization and individualization.

Best Mobile Educational Technology Practice: Offer the familiar and the novel.

Cognitive learning theory proposes that like adults, children too show increased attention to new situations and information. This attention mechanism is one of the foundations for how people learn new things. However, there is also the tendency to gravitate to what is familiar and known as being safe and trustworthy (Miller 2011). Therefore a balance is important between the novel and the familiar so that children do not experience cognitive overload. Familiar characters or settings may provide this safety for children as they interact with the exciting novelty of activities and games (Chiong & Shuler 2010).

How iStartSmart Mobile Addresses Offering the Familiar and the Novel.

iStartSmart Mobile includes over 650 research-based activities and games within the 18 skill areas of literacy and math. The games expose children to many novel experiences. However, in order to provide balance with familiarity, real photographs appear in the vast majority of the visuals, and many of these images form the basis for a number of games. The literacy and math content is delivered using a foundation of familiar and ever present themes and characters.

Each of the three main characters that make up the 'Shell Squad' shares the commonality of being hatched from an egg. There is Henry (a chick), Cami (a chameleon), and Platty (a platypus). These characters accompany the child the entire time he or she is engaged with the iStartSmart System. They instruct, guide, encourage, and affirm the child's efforts. Further, three main themes provide both novelty and familiarity: Garden, Travel, and Safari. For each session, the child selects a theme of his or her liking. Then games and response-connected rewards (for example, a vegetable growing) occur within the theme.

Best Mobile Educational Technology Practice: Consider children's evolving motor skills.

Observing that young children had some difficulty using mobile, touchscreen devices such as the iPod Touch, the Cooney Center report recommends that developers should consider the following when designing for early learners (Chiong & Shuler 2010).
• Power buttons should be obvious.
• Necessity of the swiping motion should be minimized.
• Icons should be made large for tapping that is easy and accurate.
• Menu options should be more intuitive, particularly exiting methods, so that information is not lost.
• Sound quality should be high to allow children to hear instructions clearly.
• Awareness of optimal portrait or landscape orientation/settings is important.
• The smaller hand sizes of children should be taken into account when choosing the motions needed to operate the device and games/activities.

How the iStartSmart Mobile Addresses Children's Evolving Motor Skills

• The power button is easily accessed on the tablet through a clear opening on the protective bumper.
• The system uses the Hatch KidSpace interface, a controlled and safe environment for play.
• The interface is designed for early learners with developing fine motor skills to launch, use, and stop/exit programs independently. The interface:
  • allows independent access to all the learning games on the iStartSmart System.
  • does not require any swiping to access any of the games.

- has enlarged game icons that are activated with a single touch.
- has clear and simple navigation for movement from game to game.
- has an enlarged Stop Sign button as well as a Continue button with arrows and clear audio cues spoken by a speech pathologist.
- The software is designed and optimized with the appropriate landscape orientation so children can easily view and interact with all features.
- Data recording /progress monitoring information is maintained and saved as each activity is completed without intervention from the child or teacher.

The Vital Role of Progress Monitoring in Informing Instruction

Technology that meets the needs of individual learners is often called Computer Assisted Learning (CAL). CAL has a long history of connection to positive learning outcomes in the school readiness skills of language/literacy and mathematics (see reviews by McCarrick & Xiaoming 2007; Clements & Sarama 2003; Heft & Swaminathan 2002). Customized educational software allows children to progress at their own pace. This process means that current levels of performance are determined, instruction is adjusted, and children are appropriately and successfully supported throughout the process.

Interactivity is a design component central to most technology-based learning that enables a child to engage with the content. Interactivity and customization play a pivotal role in the acquisition of knowledge, the development of cognitive skills, effective instructional practice, and discovery on the part of the child (Sims 2000). When educators are aware of and understand the basics of progress monitoring and interactivity, they are better prepared to harness the immense potential that customized, interactive software holds as part of a full and balanced early childhood educational experience.

Progress monitoring is a scientifically-based practice for assessing students' academic performance and evaluating the effectiveness of instruction. To implement progress monitoring, current levels of performance are determined and goals identified for learning that will take place over time. Performance is measured on a regular basis and progress toward meeting the goals for the child is measured by comparing expected and actual rates of learning. Instruction is then adjusted based on this information and to best meet the individual child's learning needs (Fuchs & Fuchs 2002).

Research has demonstrated that when teachers monitor the progress of their students, the children learn more, the teacher's decision making improves, and children become more aware of and reflective about their own performance. A large body of research carried out over the past three decades shows that progress monitoring validly and reliably predicts subsequent

performance on a number of outcome measures (Shapiro 2008). Progress monitoring is thus relevant and important for instructional decisions.

When progress monitoring is well implemented, the benefits can include:
- Appropriate child expectations
- Accelerated child learning
- Documentation of child progress
- More efficient communication with others

Technology can substantially support and facilitate progress monitoring. Studies report positive outcomes using technology in supporting teachers' use of data to inform instructional decisions. These systems strengthen the practice of making instructional decisions based on data and allow teachers to better meet the diverse needs of children (Hupert, Heinze, Gunn et al 2007). Monitoring functions are particularly relevant for those children experiencing difficulty in learning. However, research suggests teachers may not implement technology-based progress monitoring fully or regularly. This diminishes the teacher's power to help children reach their learning outcomes (Penuel & Yarnall 2005).

Progress monitoring through technology raises two issues. One is the role of the software program creating a learning path for the child as he/she interacts with the content. The second is making this path and how children are progressing toward goals more visible to teachers, parents, and others who have a vested interest in the children's success. The need to address these issues is based on the growing acknowledgement of the central role served by progress monitoring in guiding instruction so that children can attain positive outcomes (Shapiro 2008). When all of these practices come together, children will be much more likely to have a good learning experience.

However, without a way to accurately and consistently know how children are performing and moving toward their school readiness and school success goals, the teaching and learning cycle is incomplete. Without solid progress monitoring, teachers may not expose children to learning experiences outside of technology, and then may not attend to how and whether the children are learning. Technology without progress monitoring creates an incomplete cycle of learning. This progress monitoring cycle feature is typically absent from most narrow, single apps.

How does iStartSmart Mobile support best practices in progress monitoring?

To strengthen the practice of making instructional decisions based on data to support teachers in better meeting the diverse needs of children, the iStartSmart Mobile includes a robust progress-monitoring component. To ensure that current levels of performance are being determined, instruction adjusted, and children appropriately and successfully supported throughout the process, the iStartSmart Mobile progress monitoring is built-in, automatic, and easy for teachers to

use. The progress monitoring occurs in a regular, real time, and active manner in order to support a relevant and complete learning cycle of instruction.

Each of the 18 skill areas is represented in the iStartSmart Mobile progress-monitoring feature by showing the current level of the child (emerging, developing, developed, and completed [maintenance]) and the amount of time a child has spent on each skill area. To provide information and data to teachers, various configurations of the levels of the children are represented through an array of reports including:

- Organization Device Overview
- Organization Overview – Skill Monitor
- Class Overview – Skill Monitor
- Individual Skill Monitor

The ultimate purpose of the iStartSmart Mobile progress monitoring is to support a tailored setting of appropriate and relevant expectations for children so that they can succeed in their educational settings and endeavors.

Summary

The iStartSmart Mobile Learning System is based on the most current, relevant, and evidence-based research to date. To recap:

- The presence of mobile devices in educational settings is rising rapidly.
- Mobile technology is appropriate and well-liked as an educational tool by both teachers and children.
- Young children can successfully use and learn from mobile technology.
- The core content areas in which children need to develop competency to be successful in school are literacy and mathematics.
- There are a number of key best practices for developing and using mobile technologies in early education settings:
  - Deliver learning content that is relevant, appropriate, and of high quality.
  - Focus content within an appropriate developmental age range.
  - Offer the familiar and the novel.
  - Consider children's evolving motor skills.
- To fully meet the goals of preparing children to be successful in school in the present and in the future, progress monitoring to inform instruction is essential.

References

Arnold, D. H., & Doctoroff, G. L. (2003). The early education of socioeconomically disadvantaged children. Annual Review of Psychology, 54, 517-545.

Barbuto, L., Swaminathan, S., Trawick-Smith, J., & Wright, J. (2003). The role of the teacher in scaffolding children's interactions in a technological environment: How a technology project is transforming preschool teacher practices in urban schools. In J. Wright, A.

McDougall, J. Murnane, & J. Lowe (Eds.), Conferences in research and practice in Information Technology (vol. 34). Young children and learning technologies: Selected papers from the International Federation for Information Processing Working Group 3.5 open conference, Melbourne, Australia. Retrieved from http://crpit.com/confpapers/CRPITV34Barbuto.pdf.

Bebell, D., Dorris, D., & Muir, M. (2012). Emerging results from the nation's first kindergarten implementation of iPads. Retrieved from https://s3.amazonaws.com/hackedu/Adv2014_ResearchSum120216.pdf

Burkam, D. T., Ready, D. D., Lee, V. E., & LoGerfo, L. F. (2004). Social-class differences in summer learning between kindergarten and first grade: Model specification and estimation. Sociology of Education, 77, 1-31.

Chiong, C., & Shuler, C. (2010). Learning: Is there an app for that? New York: The Joan Ganz Cooney Center at Sesame Workshop.

Clements, D.H., & Sarama, J. (2003). Strip mining for gold: Research and policy in educational technology: A response to "Fool's Gold". AACE Journal, 11 (1), 7-69.

Couse, L.J., & Chen, D.W. (2010). A tablet computer for young children? Exploring its viability for early childhood education. Journal of Research on Technology in Education, 43 (1), 75-98.

Cross, C.T., Woods, T.A., & Schweingruber, H. (Eds.) (2009). Mathematics learning in early childhood: Paths toward excellence and equity. Washington, DC: Committee on Early Childhood Mathematics; National Research Council and National Academy of Sciences.

Fuchs, L. S. and Fuchs, D. (2002). What is Scientifically-Based Research on Progress Monitoring? Retrieved from National Center on Student Progress Monitoring website http://www.ode.state.or.us/offices/slp/sld_ode_pm_scientific_research.pdf

Gutnick, A. L., Robb, M., Takeuchi, L., & Kotler, J. (2010). Always connected: The new digital media habits of young children. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Hart, B., & Risley, R. T. (1995). Meaningful differences in the everyday experience of young American children. Baltimore, MD: Paul H. Brookes Publishing Co., Inc.

Heft, T. M., & Swaminathan, S. (2002). The effects of computers on the social behavior of preschoolers. Journal of Research in Childhood Education, 16 (2), 162-174.

Horowitz, J., Sosenko, L., Hoffman, J., Ziobrowski, J., Tafoya, A., Haagenson, A., & Hahn, S. (2006). Evaluation of the PBS ready to learn cell phone study: Learning letters with Elmo. Los Alamitos, CA: WestEd.

Hupert, N., Heinze, J. Gunn, G. Stewart, J., & Honey, M. (2007). An Analysis of Technology-Assisted Progress Monitoring to Drive Improved Student Outcomes [White paper]. Retrieved from http://www.wirelessgeneration.com/pdf/white-papers/Prog_mon_White_Paper.pdf

Johnson, L., Adams, S., & Haywood, K. (2011). The NMC horizon report: 2011 K-12 edition. Austin, Texas: The New Media Consortium.

Jordan, N.C., Kaplan, D., Nabors Oláh, L., & Locuniak, M.N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematical difficulties. Child Development, 77, 153-175.

Jordan, N.C., Kaplan, D., Locuniak, M.N., & Ramineni, C. (2007). Predicting first grade math achievement from developmental number sense trajectories. Learning Disabilities Research and Practice, 22(1), 36-46.

Lee, V. E., & Burkam, D. T. (2002). Inequality at the starting gate: Social background differences in achievement as children begin school. Washington, DC: Economic Policy Institute.

McCarrick, K., & Xiaoming, L. (2007). Buried treasure: The impact of computer use on young children's social, cognitive, language development and motivation. AACE Journal, 15 (1), 73-95.

McManis, L.D., Gunnewig, S.B., & McManis, M. H. (2010). Exploring the contribution of a content-infused interactive whiteboard for school readiness. Winston-Salem, NC: Hatch Early Childhood. ED528703.

Michael Cohen Group & USDOE. (2011). Young Children, Apps & iPad. New York, NY: Michael Cohen Group.

Miller, P. H. (2011). Theories of developmental psychology. New York, NY; Worth.

National Association for the Education of Young Children (2012). Technology and Interactive Media as Tools in Early Childhood Programs Serving Children from Birth through Age 8 Retrieved from http://www.naeyc.org/files/naeyc/file/positions/PS_technology_WEB2.pdf

National Early Literacy Panel. (2008). Developing early literacy: Report of the National Early Literacy Panel. Washington, DC: National Institute for Literacy.

Neuman, S.B., & Dickinson, D.K. (2006). Handbook of early literacy research, Volume 1. New York, NY: Guilford Press.

Neuman, S. B., & Celano, D. (2006). The knowledge gap: Effects of leveling the playing field for low- and middle-income children. Reading Research Quarterly, 41(2), 176-201.

Penuel, W. R., & Yarnall, L. (2005). Designing handheld software to support classroom assessment: An analysis of conditions for teacher adoption. The Journal of Technology, Learning, and Assessment, 3, 50-70.

Püschel, J. (2012). Tablet market to generate over US$120 billion in retail revenue by 2016, but operators' share will be limited to 30% [Web log comment]. Retrieved from http://blogs.informatandm.com/3898/press-release-tablet-market-to-generate-over-us120-billion-in-retail-revenue-by-2016-but-operators%E2%80%99-share-will-be-limited-to-30/

Shapiro, E. (2008). Best practices in setting progress monitoring goals for academic skill improvement. In A. Thomas & J. Grimes (Eds.), Best practices in school psychology (5th ed., Vol. 2, pp. 141–158). Washington, DC: National Association of School Psychologists.

Sims, R. (2000). An interactive conundrum: Constructs of interactivity and learning theory. Australian Journal of Educational Technology, 16, 45-57.

Shuler, C. (2009). Pockets of potential: Using mobile technologies to promote children's learning. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Shuler, C. (2012). iLearnII: An Analysis of the Education Category of the iTunes App Store. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Yelland, N., & Masters, J. (2007). Rethinking scaffolding in the information age. Computers & Education, 48 (3), 362-382.