EXECUTIVE SUMMARY

Uses of Technology to Support Early Childhood Practice

Use of Technology to Support Head Start Practice

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Executive Summary

Over the past two decades, technology has become increasingly prevalent in early care and education settings, growing out of the recognition that technology may be used to improve program practice and, ultimately, children's learning and development (Barron, Kemker, Harmes, & Kalaydjian, 2003; Diamond, Justice, Siegler, & Snyder, 2013; NAEYC, 2012). Unfortunately, little is known about the effectiveness, function, and requirements for technologies that are available to early childhood programs. Prompted by this gap in knowledge and the increasing prevalence of technology in early childhood settings the Administration for Children and Families (ACF) Office of Planning Research and Evaluation (OPRE) contracted with NORC at the University of Chicago to conduct a literature review and expert consultations to better understand how technology can be used to support and improve the quality of practice of early childhood practitioners.

The goal of the project was to review the knowledge base related to the use of technology to support the practice of early childhood professionals who work directly with children and families. To accomplish this goal, the review answers seven specific research inquiries within four Topic Areas of interest to ACF/OPRE (see Table 1). The first three Topic Areas describe early childhood practitioners' use of technology while the fourth Topic Area outlines barriers and facilitators of practitioners' effective use of technology to support early childhood practice.

Table 1.1 Specific Research Inquiries by Topic Area

Topic Area and Research Inquiry
Topic Area 1. Instruction and Assessment
1.1 What technologies are commonly used in early childhood settings with children to support instruction and assessment?
1.2 How do practitioners use technology with children for instruction and assessment?
1.3. How is technology used to track progress and individualize instruction/services to children?
Topic Area 2. Parent, Family, and Community Engagement (PFCE)
2.1 What technologies are commonly used to support parent, family and community engagement (PFCE)?
Topic Area 3. Professional Development and Informal Learning
3.1. In what ways has technology been used effectively to provide professional development and training for early childhood practitioners (e.g., product-specific training, prescribed coaching and mentoring)?
3.2. How do early childhood practitioners use technology to support informal learning (e.g., independent learning, peer collaboration)?
Topic Area 4. Facilitators and Barriers
4.1. How did early childhood programs (Head Start in particular) that successfully implement technology overcome barriers to implementation?
4.2. Is staff development a factor limiting the fidelity of implementation of technology in early childhood settings?

Methodology

The review team employed three methods to address these research inquiries. First, the team conducted a web search to obtain a comprehensive sampling of both common and cutting-edge uses of technology that support early childhood practice. Second, the team conducted a search of academic databases, establishing an evidence base through the identification of literature that evaluated the impact of the technologies and/or technology using programs on child, family, or practitioner outcomes. Finally, the team interviewed sixteen early-childhood and technology experts (i.e., researchers and developers) who have built, used, or evaluated these technologies and associated technology-mediated programs. These experts provided first-hand descriptions of the facilitators and barriers to effective technology use by early childhood practitioners.

Findings and Conclusions

Below, the evaluation team offers our conclusions from our review of the knowledge base on the use of technology to support the practice of early childhood professionals who work directly with children and families. The results are intended to fill a knowledge gap regarding what technologies are currently available to early childhood programs; how practitioners are using these technologies on a regular basis; the effectiveness of these technologies to improve practitioner, child and family outcomes; and the requirements necessary for practitioners to use these tools effectively. As such, the search was guided by seven research inquiries focused on four primary areas of interest to ACF/OPRE: 1) Topic Area 1: Instruction and Assessment, 2) Topic Area 2: Parent, Family and Community Engagement (PFCE), 3) Topic Area 3: Professional Development and Informal Learning; and 4) Topic Area 4: Facilitators and Barriers to Technology Use. A brief summary of the results for each Research Inquiry within Topic Area is provided below.

Topic Area 1 – Instruction and Assessment

Topic Area 1 explored the potential of current and emerging technologies to support practitioners' instruction and assessment of young children.

1.1 What technologies are commonly used in early childhood settings with children to support instruction and assessment?

Our web-search identified 12 technologies (i.e., hardware, software and video) that early childhood practitioners are currently using to support instruction and assessment. Hardware includes: computers, interactive books, interactive whiteboards, mobile devices, movement sensors, multi-touch tables, and proprietary computers. Software includes: apps for mobile devices, eBooks, software as a service (SaaS), in which software is delivered via the Internet and a service provider hosts, maintains, and provides technical support remotely, and traditional software.

Because the instruction and assessment Topic Area is so broad, we present the use of these technologies within three more focused categories: 1) curricula and instructional tools; 2) assessments; and 3) integrated curricula and assessments. Curricula frequently use computers and traditional software to deliver content to children. More cutting edge curricula feature web-based materials in the form of SaaS. Instructional tools are intended to assist practitioners with direct instruction, often with the ability to engage multiple children at once. Instructional tools and technologies are generally one in the same. That is, an instructional tool is a technology; it

does not use a technology to perform another task. Examples of instructional tools include interactive whiteboards and multi-touch tables. Assessments use computers and SaaS, typically to enter data and report results. Newer technology is allowing practitioners to collect assessment data directly on mobile devices and upload the data directly to the SaaS via the Internet. Integrated curricula and assessments also commonly use computers and software (particularly SaaS). The software for these products/programs requires immediate access to assessment data so it can make accurate instructional suggestions. Given this interdependence, integrated curricula and assessments often require the use of technology (i.e., it is not optional). As with standalone assessments, developers of integrated curricula and assessments are actively adapting their products/programs for use on mobile devices.

1.2 How do practitioners use technology with children for instruction and assessment?

In order to learn how practitioners use technology to support instruction and assessment, we searched for products/programs that use the 12 technologies described in 1.1. The 53 resulting products/programs are concrete examples of how practitioners use technology to instruct and assess children. Technology was an integral component of two-thirds of the products/programs (i.e., technology-first), meaning that the product/program could not function properly without the use of technology. Of the 53 products/programs, 20 used technology with a curriculum or as an instructional tool, 11 with an assessment, and 22 with an integrated curriculum and assessment. The 22 integrated curricula and assessments enable practitioners to simultaneously track progress and individualize instruction and are therefore discussed in more detail under Inquiry 1.3.

The search identified 20 curricula and instructional tools. In regard to curricula, practitioners frequently use computers and traditional software to deliver curricular content to children. More cutting edge curricula feature web-based content, often as SaaS. The advantage of a web-based curriculum is that it can be made available to both practitioners and families (e.g., *ABCMouse.com).* It can also be updated more frequently than paper-based curricula. Whereas practitioners use technologies to convey information within a specific curriculum to children, they also use instructional tool technologies to facilitate general instruction. For example, practitioners can use interactive whiteboards to involve children in interactive lessons provided by curriculum developers. They can also use whiteboard software to develop their own lessons. The touch-activated nature of interactive whiteboards and multi-touch tables are particularly engaging for young children.

With respect to the 11 assessments, practitioners typically use computers and SaaS to enter data and obtain outcome reports. In the absence of technology, practitioners must conduct an assessment with paper and pencil, and then score the results on the paper record form. Some assessments may have a paper report template that the practitioner must also complete. With technology, practitioners enter data into the assessment's software package. The software then scores the assessment data and produces a report. Computerized scoring and reporting reduces potential for error. Newer technology is allowing practitioners to collect assessment data directly on mobile devices, eliminating the need to transfer data from a paper form. Some cutting edge assessments are eliminating data entry altogether by having children respond to assessment items directly, typically on a mobile device's touchscreen (e.g., *mCLASS:CIRCLE*).

1.3 How is technology used to track progress and individualize instruction/services to children?

Integrated curriculum and assessment packages are designed specifically to track student progress and individualize instruction to children. Integrated curricula and assessments are typically powered by traditional software or SaaS, and operate on non-proprietary hardware (e.g., a computer, a mobile device). Practitioners collect assessment data on a mobile device (e.g., tablet computer) or desktop computer, which is then saved to a web-based SaaS. The software automatically scores the assessment and offers the practitioners instructional suggestions based on assessment results.

Advances in technology have allowed these packages to provide practitioners with timely and accurate information that supports effective data-based decision making. These packages often have the ability to track progress and provide instructional suggestions for a single child or for multiple children. Aggregating data across multiple children allows the program to suggest small groups based on objective data. The algorithms that make these suggestions, either for groups of children or for a single child, are typically based on scientific research. Overall, the intentional integration of an assessment and curriculum via technology allows the practitioner to not only instantaneously assess, score, and obtain reports on child outcomes, but also receive immediate, evidence-based instructional suggestions. Fully-integrated technology-first curricula and assessments are becoming widely available to early childhood practitioners. Given that these potential advantages afforded by this cutting-edge technology, many developers, researchers and companies are currently working to create new or integrate existing curricula and assessments.

Topic Area 2 – Parent, Family, and Community Engagement

Topic Area 2 focused on technologies practitioners use to support parent, family, and community engagement (PFCE). Given the broad range of activities that constitute PFCE, we focused our review on those technology-enhanced products/programs that support parent learning, parent engagement with their children, and parent engagement with early childhood programs and practitioners. In keeping with the scope of this review, we examined only those technology-enhanced PFCE products/programs that require the direct involvement of an early childhood practitioner. As such, PFCE products/programs that do not require direct practitioner involvement were not reviewed.

2.1 What technologies are commonly used to support parent, family and community engagement (PFCE) for children?

The web search identified seven technologies that early childhood practitioners use to support PFCE. Hardware included: computers, mobile devices, and the Language ENvironment Analysis (LENA) system, which consists of a digital audio recorder and analytic software package that objectively measures a child's home language environment. Software included: traditional software, SaaS, and apps. An additional technology used to support PFCE was video. Of the 13 PFCE products/programs identified through the web search, the majority required technology for proper use (i.e., 70% technology-first). The most frequently utilized technologies included video and traditional software, which were designed to operate on existing hardware (i.e., computer or mobile device, not proprietary hardware). The prevalence of these two technologies is in keeping with the two primary objectives for PFCE technology use – to build and maintain positive social relationships through more regular communication, and to share

facts, ideas, and exemplars or build skills with parents or families. Almost 40% of the PFCE products/programs used video technology to 1) model ideal parent behaviors (pre-recorded video), and/or 2) serve as an objective measure for self-critiquing a parent's behavior or a source for coaching. Another 40% used software to enhance PFCE activities, particularly to present parent educational materials (e.g., power point presentations).

While the goals and therefore outcomes of the two PFCE exemplars (i.e., *Play and Learning Strategies* and *Thirty Million Words Initiative*) differed, they both shared the same theory of change – home visitors educated parents in an effort to change parent behavior so as to improve child outcomes. The empirical evidence from their evaluative studies suggests that high quality PFCE interventions, particularly those that use video exemplars and video feedback, have a positive impact on a variety of both parent outcomes (e.g., parental responsiveness, emotional well-being) and child outcomes (e.g., language, cognitive function, attachment).

Topic Area 3 – Professional Development and Informal Learning

Topic Area 3 focused on technologies practitioners use to support their own professional development (e.g., in-service programs for pedagogical strategies and subject areas; training on product-specific implementation and enrichment) or engagement in informal learning (e.g., independent learning and peer collaboration).

3.1 In what ways has technology been used effectively to provide professional development and training to early childhood practitioners (e.g., product-specific training, prescribed coaching and mentoring)?

The web-search uncovered 21 technologies that early childhood practitioners use to support formal professional development. These technologies were classified into four main categories: video-enabled professional development, online coursework, social media networking, and other. Video-enabled professional development technologies included: video exemplars, multi-media or email feedback from a coach or trainer based on video review, case-based hypermedia resources, which include web-links to and/or digital copies of articles and video exemplars written for an early childhood audience, web-mediated coaching, video self-reflection, product training and implementation videos. Practitioners used video-centered professional development technologies for learning and communication. Social media networking technologies included common commercial social networking sites, community specific social networking sites, blogs, forums and photo/video sharing technologies. Practitioners used social media networking technologies to connect with other early childhood professionals. Practitioners used other technologies for formal professional development including: audio self-reflection, online document libraries and user guides, online reliability exercises/tests, user resource exchanges, audio recordings, teleconferences, online peer-to-peer interaction, and webinars (live and/or archived).

In addition to identifying technologies, a broad but not exhaustive web-search identified 50 unique products/programs that use one or more of the technologies to support professional development. The most common technologies among professional development products/programs were: webinars, online document libraries and user guides, online courses, product training and implementation videos, and video exemplars. To understand which technologies have been used *effectively* to support professional development, we examined the evaluative literature for all 50 products/program. Despite the prevalence of webinars within

professional development, we found no evaluative literature describing the effects of webinars on practitioner or child outcomes. Instead, the vast majority of literature examined video-enabled professional development technologies; specifically video exemplars and video feedback provided by a coach or trainer. The results of these evaluations suggest that video-enabled professional development can have a positive impact on both practitioner and child outcomes.

3.2 How do early childhood practitioners use technology to support informal learning (e.g., independent learning, peer collaboration)?

Our web search identified 15 technologies that early childhood practitioners use to support informal learning. These technologies were classified into four main categories: video-enabled professional development, online coursework, social media networking, and other. Video-enabled informal learning technologies included: video conferences, video exemplars, and product training and implementation videos. Online-coursework included both online courses and online learning modules. Social media networking technologies included: alternative social media networking sites, blogs, forums and photo/video sharing technologies. Practitioners used other technologies for informal learning including: online document libraries and user guides, user resource exchanges, audio recordings, teleconferences, online peer-to-peer interaction, and webinars (live and/or archived).

To better understand how practitioners use these technologies to support informal learning, we conducted an additional search to identify products/program that use these technologies. We found only eight sample products/programs. Among the eight, the most common technologies used for informal learning were: online peer-to-peer networks, alternative social media sites, blogs, forums, and photo or video sharing tools. We also conducted an academic search that failed to find any evaluative articles for early childhood practitioner's use of technology to support informal peer professional learning.

Topic Area 4 – Facilitators and Barriers to Technology Use

Topic Area 4 examined the facilitators and barriers to practitioners' effective use of technology to support early childhood practice. It differed from the other Topic Areas in that 1) the primary data source was the 15 expert interviews rather than web searches or academic searches, and 2) the scope of the inquiry area encompassed all three other topic areas.

4.1 How have early childhood programs (Head Start in particular) that have successfully implemented technology into their programs overcome barriers to implementation?

To answer inquiry 4.1, it was first necessary to identify the barriers that programs needed to overcome when trying to implement technology with early childhood practitioners. Based on our findings from the expert interviews, early childhood programs face many common obstacles to effective uses of technologies to support instruction and assessment, PFCE or professional development and informal learning. The most common barrier to successful implementation was staff technological literacy. Providing adequate professional development/training and technology support services were two of the most commonly mentioned facilitators for successful implementation and thus solutions to this challenge. An expanded discussion of this barrier is provided in 4.2 below.

Other common barriers included lack of access to technology resources, lack of support from administrators for the use of technology, and lack of time to learn and use the technology.

Experts continually highlighted the critical role early childhood administrators play in either encouraging or hindering practitioners' use of technology. When administrators support practitioners' use of technology by providing adequate funding, technological infrastructure, hardware, software, training and professional development, technical support, and explicit encouragement, they are best able to affect positive practitioner outcomes in regard to technology use. If, however administrators are indifferent or hostile towards their practitioners' use of technology, even the most self-motivated practitioners find it difficult to use technology with fidelity. Building upon early childhood practitioners' intrinsic desires for self-improvement and to produce the best outcomes for their children, leading by example, and providing adequate resources and recognition for high performing staff are among the most effective strategies that proactive administrators can engage in to encourage successful practitioner use of technology for instruction and assessment, PFCE, and professional development and informal learning.

4.2 Is staff development a factor limiting the fidelity of implementation of technology in early childhood settings?

As noted in 4.1 above, the experts consistently stated that staff development is one of the most common barriers to successful use of technology among early childhood practitioners. They noted that many practitioners often have low-levels of technological literacy. Lack of knowledge and experience leads to feelings of discomfort and unease, and hinders adoption and use of new technologies. Providing adequate professional development/training and technology support services were two of the most commonly mentioned solutions to this challenge. Experts also noted, however, that this obstacle is rapidly becoming less prevalent as new and more familiar technologies are being harnessed for use in early childhood instruction and assessment, PFCE and professional development and informal learning. Two common examples are the increasing use of mobile devices and social media in early childhood products/programs and services. The majority of early childhood practitioners are familiar with these technologies from their own personal uses (e.g., smartphones, iPads/tablets, and Facebook/LinkedIn). By incorporating technologies that practitioners are familiar with, that are designed to be intuitive to use and that are user friendly, early childhood product/program developers can best ensure that their technologies will be used with fidelity.

Recommendations for Research, Policy and Practice

This review has outlined both the opportunities and obstacles associated with increasing the use of technology among early childhood programs, with a particular focus on Head Start and Early Head Start programs. Given the ubiquity and integration of technology in modern society's every-day activities (e.g., internet, social media, and personal mobile devices), the proliferation of technology in practice at all levels of the education system will likely only accelerate. As such, the need for better access to technological advances is becoming increasingly important to the success of the Head Start program.

As noted by experts, a common site-level barrier among individual early childhood programs is an absence of agency/site-level leadership embracing and modeling the importance and necessity of technology to support practice. Faced with a limited research literature on the impact of technology-enhanced programs to support early child development practice, a lack of technological literacy among site staff, and dearth of financial resources to acquire and support technology, site and program directors are both conceptually and fiscally challenged to actively

work to incorporate technology into their daily practice. In order to overcome this barrier, the site's leadership must choose to transform itself into a high-performance system driven by the Digital-Age learning needs of all students and staff. Administrators need to prepare themselves to model the use of technology effectively and work with colleagues to guide their site towards more effective uses of technology in teaching, learning and management (Partnership For 21st Century Skills, n.d.).

It is important for administrators to recognize that technology is a tool – a means to more efficiently and effectively achieve the ultimate goal of improving child outcomes. As such, the success of any technological implementation will require prior thoughtful consideration of appropriate educational and/or engagement goals and approaches. These decisions will impact the choice of assessment, curriculum, instructional approaches, engagement strategies and finally technologies. Adopting a technology without thoughtful consideration of its relationship to educational goals will not likely produce hoped for outcomes.

Once a site's leadership has made the commitment to incorporate technology at a site, the next barrier to overcome is the lack of preparation to use technology with young children among individual practitioners. As noted above, a common individual barrier to practitioners becoming proficient users of the wide variety of technologies available today is their own knowledge and competency to use technology (i.e., technological literacy). Technological literacy among today's diverse community of early childhood practitioners varies greatly, often hindering the adoption and use of even the most effective technology. Some argue that young adults are best positioned to incorporate technology because they are "digital natives" and have the intuitive skills to use technology. However, that argument assumes that knowing how technology works is sufficient to make informed decisions about choosing and then applying technology to positively influence practice. Effective practice is the result of much trial and error. Learning how to use technology is a required first step in its implementation, followed by multiple iterations of trial and error. Whether an individual is a digital native or not, effective practice comes about because she is willing to try a new approach and learn what works and what does not.

As mentioned previously, practitioners not only need to learn to use technology, but they often lack the time, resources and expertise to identify effective technologies in the first place. Finding and sharing such resources can be a time consuming task for an individual practitioner working in her own classroom or conducting home-visits. Professional development is one mechanism through which practitioners can take the first step in learning how to use technology to improve their practice. Typical education technology professional development has been delivered in face-to-face classes where the technology skill is presented, but often without the context of how it fits into teaching and learning. As the results of our professional development inquiry demonstrated, current effective trends utilize blended-learning approaches, which combine some online content such as videos or webinars for at home review. Online videos have the advantages of being accessible at any time of day and available for later reference. They typically showcase model examples of technology in actual classroom use; something that is difficult to replicate in typical professional development settings. The Results Matter Video Library is an excellent example of just such an existing video collection.[1] Blended-learning approaches have the added

[1] http://www.cde.state.co.us/resultsmatter/RMVideoSeries_UsingTechnology.htm#top

benefit of providing practitioners with experience using technology and building valuable technology skills.

Given the cost (i.e., time, money, effort) associated with adopting a new technology, support from administrators for the implementation of technology oftentimes requires strong empirical evidence demonstrating effectiveness. However, as is clear from the results of this review, the existing literature on the use of technology is sparse. Below, we briefly review the results and highlight promising areas for future research and evaluation.

In the Instruction and Assessment Topic Area, very little literature examines the effectiveness of instructional tools and very few studies were designed to explicitly isolate the impact of using a technology. As such, it is unclear whether and to what extent technology helps practitioners instruct and assess children. Yet, a number of technologies and technology-enhanced products/programs are currently in widespread use and/or growing in popularity.

For example, among Curricula and Instructional Tools, numerous free and downloadable apps are available for mobile devices and are widely utilized due to their convenience and ease of use. Many of these are based on software for traditional desktop computers. However, there is little or no evaluative literature on the effectiveness of either product in improving student or practitioner outcomes. Similarly, in the area of Integrated Curricula and Assessments, apps for mobile devices are being developed based on existing products, many of which have limited evaluative research.

In addition, among Curricula and Instructional Tools, multi-touch tables and whiteboards are growing in popularity. Multi-touch tables in particular are new and innovative technologies. However, no evaluative literature assesses their effectiveness as an instructional tool. A potential evaluation might examine whether the addition of a multi-touch table in a classroom leads to better outcomes for students compared to a traditional classroom setting.

In the area of Assessments, little evaluative literature exists to determine whether use of any of the Software as a Service (SaaS)-enhanced assessment products can affect practitioner or student outcomes. Ten of the eleven assessments highlighted in the report offer SaaS features, in which assessment software is delivered via the Internet and a service provider hosts, maintains, and provides technical support remotely.[2] Practitioners can use the SaaS features of these assessments to input assessment results into an online database for storage and scoring, and then often receive individual or aggregate reports of students' outcomes. Among these products, those that are available as both a paper-based assessment as well as a technology-enhanced SaaS would be suitable for an evaluative study isolating the effects of SaaS on practitioner and student outcomes. Such an evaluation would provide evidence of whether SaaS supported or dependent assessments increase practitioner assessment efficiency, quality and reliability, as well as instructional quality and effectiveness.

In order to rigorously assess the impact of stand-alone curricula, instructional tools, and assessments, as well as integrated curricula and assessments, on student and/or practitioner

[2] Because SaaS providers store student data, it is important for SaaS subscribers to know and understand providers' data use policies (e.g., for marketing, research) and data security protections (e.g., encryption, compliance with state or federal regulations).

outcomes, future research should first examine implementation and effectiveness of these curricula, instructional tools or assessments *independent* of the technology. Once established, an evaluation of the technology-enhanced product/program can be conducted to isolate the effect of the technology. Among the latest integrated curricula and assessment products/programs, it is often impossible to separate the technology from the product/program. The integrated nature of the technology may therefore preclude experimental manipulation of the technology to isolate its impact. In such instances, it may be necessary to identify comparable products/programs that have similar content in order to estimate the differential impact of the products/programs (e.g., two products that have an integrated emergent literacy curriculum and assessment; one with technology and one without).

Within the Professional Development and Informal Learning Topic Area, webinars were identified as the most common form of professional development among early childhood educators, yet we found no evidence base describing the effectiveness of webinars to support early childhood professional development. Likewise, despite the widespread use of social media in the general population, we found no evaluative literature on the use of peer collaboration technologies to support informal professional learning.

The rapid pace of technology development and evolution may be a key reason for the lack of literature. Many of these technologies are relatively new to the market, and especially to the field of early childhood education (e.g., multi-touch tables, tablet computers, SaaS, interactive whiteboards). The often protracted process of funding, developing, conducting, and publishing academic research studies typically takes a longer time than the products/technologies (in their current state) are in use. Considering the speed with which technology evolves, by the time a typical academic article is published the technology in question may be out of date and the findings of little value to users. A more rapid evaluation mechanism is likely needed to provide administrators, practitioners and policy makers with objective data to help them know which technology-enhanced products and programs are most effective.