All Hands on Tech: Math and Media in the Preschool Classroom

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Abstract: Technology and digital media, used in conjunction with more traditional preschool learning activities in the early childhood classroom, have demonstrated positive outcomes in increasing early literacy skills in preschoolers with limited exposure to pre-academic activities (Penuel et al., 2009). Building on these findings, Educational Development Center, Inc., and SRI International are implementing a study that focuses on early mathematics learning through integrating transmedia and hands-on activities. We propose strategies to build on these two important teaching mediums in the most developmentally appropriate and meaningful way to promote the best practices possible.

1. Introduction

The introduction of technology and digital media into early childhood classrooms is a recent initiative that has yet to be fully explored and researched. However, when used in conjunction with more traditional preschool learning activities, the integration of digital media into the classroom has demonstrated positive outcomes in increasing early literacy skills in preschoolers with limited exposure to pre-academic activities (Penuel et al., 2009). Building on these findings, Educational Development Center, Inc., and SRI International are implementing a randomized control trial study that focuses on early mathematics learning for preschoolers through the integration of digital media. This paper will outline the goals of the study and report on findings from our 2012 pre-kindergarten pilot study, highlighting our approach to integrating educational transmedia and hands-on math materials and activities.

2. Background

Following research on early mathematics learning for low-income children (Balfanz, Ginsburg, & Greenes, 2003; Ginsberg, Klein, & Starkey, 1997), we are drawing on the theory that young children, including those in low-income communities, already use mathematical thinking and are able to develop new mathematical skills and knowledge. In fact, children's latent mathematical skills, theories, and knowledge can be a useful foundation for formal instruction in mathematics. In designing our current study, we take into account that well-trained teachers, who are able to guide children's mathematics experiences, provide the best support for such learning. We believe this support is particularly important for children in traditionally under-resourced communities, which often do not have access to a stimulating and challenging pre-kindergarten mathematics learning environment to support their early mathematics learning (Ginsburg, Lee, & Boyd, 2008).

To support teachers' use of digital media during our study, we have constructed a transmedia-rich (digital videos and interactive games) curriculum supplement that draws on the work of Herb Ginsberg, Doug Clements, and Julie Sarama. In particular, the Sarama and Clements Building Blocks curriculum (Sarama & Clements, 2004) provided strong examples of how to introduce and sequence mathematics skills that early-childhood teachers are comfortable addressing and with which they tend to be less experienced. Ginsberg's Big Math for Little Kids (Balfanz et al., 2003) provides evidence-based examples of mathematics topics, skills, and activities.

Findings from the 2009 *Ready To Learn* randomized controlled trial—where we conducted a large-scale evaluation of a media-rich literacy curriculum supplement (Penuel et al., 2009)—provided the theoretical grounding for the approach used in creating the transmedia-rich curriculum supplement for the 2013 pre-kindergarten randomized

control trial: anchoring activities around weekly video-co-viewing and including a mix of transmedia-rich and hands-on traditional pre-kindergarten activities throughout the curriculum supplement. The curriculum begins from the understanding that media and technology resources have particular strengths and affordances for learning and are powerful tools for teaching, but are most valuable when thoughtfully sequenced to complement and enrich established routines and activities. Additionally, McManis and Gunnewig (2012) reaffirmed our approach with their conclusions that making technology educational in early childhood classroom settings often means that adults are present nearby, interacting with children and facilitating peer-to-peer interaction. They also noted that, akin to our approach, research suggests that technology use has positive outcomes for children if (1) it is developmentally appropriate, (2) it includes tools to help teachers implement the technology successfully, and (3) it is integrated into the classroom and the curriculum.

3. Methods

Several logistical and practical factors, in addition to the theoretical frameworks mentioned above, contributed to our approach in developing the transmedia-rich supplement for this study. First and foremost, we strove to develop a 10-week curriculum supplement that would augment what early childhood educators typically do when supporting mathematics learning.

We began construction of the transmedia-rich curriculum supplement by identifying four mathematics topics from the Ready To Learn mathematics framework; we identified topics by using a number of parameters including topics for which a variety of transmedia already existed and topics likely to be most developmentally appropriate for our sample of children at the midyear point (when the supplement is being implemented), as well as a combination of topics that made pedagogical sense to teach together. Using prior research (e.g., Balfanz et al., 2003; Clements & Sarama, 2009a), we decided upon four areas—counting, recognizing numbers and subitizing, recognizing and composing shapes, and patterning—as the focus of our curriculum supplement.

In developing the transmedia-rich curriculum supplement guide, we used a spiral curriculum design model (Bruner, 1960) to introduce content and skills in order to provide repeated and sophisticated activities for children to understand, practice, refine, and master previously introduced material. Allowing children time, space, and a variety of different opportunities to learn and practice skills is crucial for their early knowledge and deepening understanding of mathematics skills (Wiggins & McTighe, 1998). The supplement teacher's guide supports educators in how to introduce important math skills, model play, and engage children in using educational media in ways that encourage learning and skill practice.

We designed the supplement so that each week's activities are anchored by a video that illustrates a specific skill, such as making and identifying patterns or forward and reverse counting, and then we extend that skill through the use of hands-on games and other activities, such as journal writing or drawing and computer gameplay. For example, a teacher starts the week co-viewing a video that identifies different types of patterns. The next day, the teacher leads an activity to provide an opportunity for children's independent practice of copying and extending patterns using different actions such as clapping, stomping, and so on. In addition to co-viewing videos on the interactive whiteboard, we offer suggestions for integrating activities on laptop computers for individual or paired gameplay. These transmedia activities are interspersed with center-time activities, book reading, and large-group and small-group gameplay.

In the teacher's guide, we provide a sample, recommended math supplement schedule for educators to use while integrating the activities into their existing curriculum. The transmedia and hands-on activities were designed to fit existing preschool classroom structures (e.g., circle time, hands-on centers, or choice time) in order to support but not replace existing routines or math curricula.

Sample Schedule

Monday	Tuesday	Wednesday	Thursday
Video Co-Viewing (25 minutes)	Math Detective Journal (20 minutes)	Math Circle Routine (10 minutes)	Challenge Game Play (25 minutes)
	Easy Game Play (10 minutes)	Guided Reading (15 minutes)	
Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)
	Hands-On Centers (~10 minutes per pair of children)	Hands-On Centers (~10 minutes per pair of children)	Hands-On Centers (~10 minutes per pair of children)

Table 1: Recommended sample weekly schedule of the transmedia-rich curriculum supplement.

Many participating sites had limited technology prior to the study (usually a classroom desktop computer with Ethernet Internet access), so we provided all of the technology and support required for the transmedia-rich curriculum supplement to ensure full and smooth implementation. Teachers received the following:

- one interactive whiteboard (IWB) with a computer, projector, and wireless keyboard situated on the IWB cart specially designed for use with young children
- one mini PC computer to run the IWB
- three Chromebook laptop computers with three wireless mice and six headphones for use by the children in the laptop center-time area (headphone splitters were supplied so each laptop could accommodate two children using two sets of headphones)
- wireless routers (when needed)
- three Bluetooth adaptors for each of the laptops (to connect the wireless mice)
- access to all of the featured transmedia via a Drupal site

Figure 1: A *Ready To Learn* 2013 study interactive whiteboard cart in a preschool classroom.

By design, hands-on activities play an important role in the transmedia-rich supplement. In addition to technology tools, teachers also received hands-on materials, including the following:

- classroom materials (e.g., number lines, dry erase boards, construction paper)
- games (e.g., shape and pattern concentration cards, shape matching sticks)
- manipulatives (e.g., Unifix cubes, dominoes, foam dice, plastic fruit)
- children's books about mathematics
- Mathematics Detective Journals (notebooks) for each child in class

Additionally, teachers received professional development and a personal coach. The professional development introduced teachers to the technology and provided an overview of early childhood mathematics concepts. It also presented a detailed walk-through of the curriculum supplement, using the guide and accompanying hands-on materials. Throughout the implementation, coaches supported teachers one-on-one, providing regular feedback or targeted problem-solving support and assistance.

4. Conclusion

Digital media can be integrated into preschool mathematics instruction in ways that build on the successful implementation strategies regularly used as part of more traditional, hands-on teaching methods, and that extend these to further children's learning experiences and opportunities for practice. During the 2012 pilot study, members of our research team observed several positive examples of adult-child interactions during the enactment of transmedia-rich activities, especially in whole-class settings. The designated pause points during the video-based co-viewing activities and the interactions during the IWB games helped teachers draw children's attention to important math concepts, introduce mathematical vocabulary, ask questions to elicit children's mathematical thinking and check comprehension, and scaffold children's practice of a math skill. Supplement activities and materials that hewed to common and well-established preschool instructional formats were well-received by teachers. They appreciated how the supplement leveraged developmentally appropriate and engaging preschool practices, such as the use of manipulatives, play-based activities, book readings, and songs, to create opportunities for practicing target math skills.

When making the decision to incorporate technology and digital media into his or her teaching practice, a teacher should consider the best ways to weave these new and powerful teaching tools into more comfortable and established routines. A successful integration involves a willingness to incorporate familiar, everyday teaching strategies, such as modeling and thinking aloud while explaining a concept or a process, re-voicing a child's idea back to them, and fostering peer feedback into learning channels that are not typically associated with teaching preschoolers.

By blending these two important teaching mediums in the most developmentally appropriate and meaningful way, a teacher can invigorate the practice of teaching math to children while also using the best practices possible. As our 2009 literacy-focused study and our 2012 mathematics-focused pilot study have demonstrated, with teacher support and thoughtful integration, technology can be a useful addition to the early childhood classroom to support early learning.

References

Balfanz, R., Ginsburg, H. P., & Greenes, C. (2003). The Big Math for Little Kids early childhood mathematics program. *Teaching Children Mathematics, 9*(5), 264–268.

Bruner, J. (1960). *The process of education*. New York, NY: Vintage Books.

Clements, D. H., & Sarama, J. H. (2009a). Learning and teaching early math: The learning trajectories approach. New York, NY: Routledge.

Education Development Center & SRI International (2012). Prekindergarten Mathematics Pilot Study: A Report to the Ready To Learn Initiative. New York, NY: Education Development Center and Menlo Park, CA: SRI International.

Ginsburg, H. P., Klein, A., & Starkey, P. (1997). The development of children's mathematical thinking: Connecting research with practice. In I. Segel & A. Renninger (Eds.), *Handbook of child psychology: Child psychology and practice* (Vol. 4, 5th ed., pp. 401–476). New York, NY: Wiley.

Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report: Giving Child and Youth Development Knowledge Away, 22*(1), 3–22.

McManis, L. D. & Gunnewig, S. B. (2012). Finding the education in educational technology with early learners. *Young Children*, *67*(3), 14–24.

Penuel, W. R., Pasnik, S., Bates, L., Townsend, E., Gallagher, L. P., Llorente, C., & Hupert, N. (2009). *Preschool teachers can use a media rich curriculum to prepare low-income children for school success: Results of a randomized controlled trial*. New York, NY: Education Development Center and Menlo Park, CA: SRI International.

Sarama, J. H., & Clements D. H. (2004). Building Blocks for early childhood mathematics. *Early Childhood Research Quarterly, 19*(1), 181–189. doi: 10.1016/j.ecresq.2004.01.014

Wiggins, G., & McTighe, J. (1998) *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.