Technology and the Future of Preschool: Developmentally Appropriate and Evidence-Based Approaches to Integrating Technology in the Classroom

Background
Next Generation Preschool Math (NGPM) is an NSF-funded collaboration between researchers, media developers, and teachers that aims to develop preschool classroom activities and innovative tablet-based games to help preschool children learn sophisticated mathematics concepts crucial to early school success. As part of this effort, the NGPM team is addressing one of the most salient controversies facing preschool educators today: What, if any, are the most appropriate roles for technology in the preschool classroom and how can technology, if used appropriately, provide unique affordances for teaching and early learning?

NGPM is based on research that shows that (1) early mathematics learning is one of the most important predictors of school success broadly across the curriculum in later years; (2) very young children are capable of learning sophisticated mathematics; (3) technology can be used to help young children learn sophisticated mathematics; and (4) most preschool children are only exposed to simplistic mathematics, such as counting and simple shape recognition. Currently, NGPM has developed and pilot tested a 10-week preschool math curriculum supplement, consisting of two modules, that supports young children's learning of key ideas in mathematics: subitizing (key to understanding the notion of quantity and cardinality) and equipartitioning (key to understanding rational number reasoning).

NGPM's evidence-based design begins with the notion of a Curricular Activity System, which considers teachers' professional development needs, children's developmental abilities, available curriculum resources, typical classroom routines and requirements, and learning goals—all as elements in an interrelated system that must be considered in its entirety. Therefore, key features of NGPM include:

- A combination of classroom activities and tablet-based games that complement and support each other to promote children's learning.
  - Classroom activities include a host of common formats/materials that preschool teachers and children are familiar and comfortable with, such as:
    - Children's books and literature, as well as the use of non-digital games, to introduce, reinforce and extend the math and science topics.
    - Whole- and small-group activities that reinforce concepts and use manipulatives and tangible materials.
  - Tablet-based games are designed to both:
    - Allow children to individually explore and practice key ideas and concepts in a fun, "low-stakes" environment that is engaging and provides encouraging feedback.
    - Be inherently collaborative and foster children's social skills by inviting children to engage each other in rich interactions and talk about sophisticated math and science topics.
- Teacher professional development that meets teachers where they are, and demonstrates to teachers via interactive activities and resources (e.g., video) how to infuse their existing classroom routines (circle time, choice time, snack time, playground time) with important math and science.

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- A digital Teachers' Guide that provides teachers with supports as they prepare to teach the unit, just-in-time scaffolds as they prepare for a particular activity, and reports on children's progress in the online activities.

Documented Results

NGPM was piloted in three classrooms (one each in New York City, the San Francisco Bay area, and the Boston area), all of which primarily serve children from low-income families. The regular preschool teachers implemented the modules. The research team conducted observations of classroom practices throughout implementation and also assessed children's learning before and after implementation. Findings from the child assessment suggest that children improved their understanding of target skills: scores at post-assessment were significantly higher than at pre-assessment ($F(1, 18) = 24.338$, $p < .001$). Analysis of observations and teacher interview data suggests that teachers were comfortable with the use of technology in their classrooms, the use of technology was developmentally and socially appropriate, and the teacher professional development and the Teachers' Guide were helpful. NGPM is currently being evaluated in a larger experimental study, and the results will be available by summer 2014.

Potential Applications

NGPM expects its materials to be made widely available in summer 2014, after the current experimental study is completed and revisions are made that can strengthen future implementation. The NGPM design and development model can also inform future development efforts in other areas. For example, the NGPM team is currently working on a similar effort: Next Generation Preschool Science (NGPS), an NSF-funded project to promote young children's learning of science practices and concepts. NGPS is also based on a Curricular Activity System framework. The science curriculum program will include classroom activities (e.g., children's books, hands-on science investigations) and will integrate technology to innovatively support inquiry (e.g., tablets will be used to record and analyze data, and simulations will be developed to reinforce the learning that occurs in the investigations). NGPM believes the Curricular Activity System framework can be of general applicability in designing (or adopting/adapting) effective and appropriate interventions to promote STEM readiness and integrate technology in meaningful ways.

For More Information

Contact: philip.vahey@sri.com, ximena.dominguez@sri.com, alewis@edc.org.

Next Generation Preschool Math websites: http://nextgenmath.org/ and
http://cct.edc.org/projects/next-generation-preschool-math and
http://www.sri.com/work/projects/next-generation-preschool-math

Read: http://www.nytimes.com/2013/09/03/science/field-testing-the-math-apps.html

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