Findings on the Development and Use of Technology-Infused Curricula in Preschool Classrooms

Mobile tablets are becoming more prevalent in educational settings, but little is known about the impact of using technology-infused curricula in preschool classrooms. The research summarized in this brief suggests that well-designed tablet-based activities can indeed improve student learning outcomes at the preschool level. These positive outcomes are more likely when digital activities target clear learning goals; are collaborative and social experiences; are accompanied by hands-on activities; and are used in classrooms where teachers receive support for their integration.

WHY IT MATTERS TO YOU

Research suggests that in order to maximize the benefits of technology-infused curricula, **teachers** must integrate digital tools purposefully and strategically within a diverse array of learning activities, while **administrators** and **professional development providers** must work together to ensure that teachers have the support they need to do so. In addition, designing technology-infused curricula may be most effective when **researchers** and **developers** work in collaboration with practitioners and students.

Context

Beginning in 2011, learning scientists and researchers from EDC and SRI International, public media producers from WGBH, and content-expert advisors worked in collaboration to develop Early Math with *Gracie & Friends*™, a free technology-infused mathematics curriculum supplement comprised of units on subitizing and equipartitioning[1] (Orr, Flannery, Lewis Presser, Vahey, & Latimore, 2015). *Gracie & Friends*™ was developed through the National Science Foundation-funded project *Next Generation Preschool Math* (NGPM). In partnership with preschool teachers, administrators, and children, the NGPM team developed the learning materials for *Gracie & Friends*™ over a period of four years and conducted a study in 2013 to determine whether implementing the NGPM program in preschool settings improves mastery of subitizing, equipartitioning, and early mathematics knowledge more generally (First 8 Studios, 2016).

Research Approach

The NGPM team used an evidence-based curriculum design approach to create a blueprint that mapped out the learning trajectories for subitizing and equipartitioning, which are foundational mathematics concepts not usually taught at the preschool level. App and curriculum designers used the blueprint to develop tablet app prototypes and non-digital, hands-on classroom activities that were created and tested with children and teachers. The team developed two curriculum units, one on subitizing and one on equipartitioning. Units include four digital games, non-digital classroom activities, and a teacher's guide; take approximately 2-3 weeks to complete; and are designed specifically for preschool classrooms.

Researchers conducted a randomized controlled trial (RCT) of the implementation of these units in 16 preschool classrooms in two metropolitan areas. The classrooms were randomized into the business-as-usual group or the treatment group. Teachers in the treatment group completed a one-day professional development session to support curriculum implementation, and treatment classrooms were given iPads and non-digital materials (First 8 Studios, 2016). Teachers completed pre- and post-surveys, and the NGPM team

[1] Subitizing - quickly identifying the quantity of objects in a set, which is key to understanding the notions of quantity and cardinality
Equipartitioning - creating equal-sized groups from a collection or equal-sized pieces from a continuous whole; a precursor to proportional reasoning

administered a pre- and post-standardized assessment to the sample of 170 children (Lewis Presser, Vahey, & Dominguez, 2015).The study investigated two main research questions:

- Does experiencing NGPM impact young children's mastery of subitizing and equipartioning?
- Can the NGPM units feasibly be implemented in preschool classrooms? (First 8 Studios, 2016).

Key Findings

Although children in the two groups had similar mathematics knowledge at the beginning of the study, the treatment group outperformed the business-as-usual group on the NGPM content during the post-test, suggesting that the use of *Gracie & Friends*™ led to gains in children's learning of subitizing and equipartitioning.[2] Both teachers and students found the apps to be "engaging and mathematically challenging," and teachers considered materials and activities useful and were able to successfully integrate them in the classroom (Vahey, Lewis Presser, & Rosenfeld, 2015).

Based on the research findings, NGPM researchers offer recommendations for effectively integrating tablet technology in preschool classrooms:

- Early learning with technology can and should be a social and collaborative experience.
- Hands-on activities and manipulatives are important for a child's development and cannot be replaced by technology. For each digital activity, there should be a complementary set of hands-on activities so that knowledge can be transferred into real-world applications.
- Games for [early] learning need to have gentle pacing and allow for thinking, reflecting, and learning.
- Partnerships with researchers, advisors, teachers, and children are integral in the development of high-quality learning digital resources.
- Teachers need support, especially in integrating new technologies (Orr, Kamdar, Lewis Presser, & Vahey, 2015).

Findings from this study lend support for models of curriculum development that target clear learning goals, integrate new technologies using best practices, and attend to teachers' own learning and development. The study also highlights the potential for technology to support student engagement and learning (Orr, Flannery, Lewis Presser, Vahey, & Latimore, 2015).

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ATTENDING TO EQUITY

The Research + Practice Collaboratory (RPC) was funded by the National Science Foundation to study ways to bridge the gap between research and practice in STEM learning. Through its work, the RPC aims to promote equity in STEM learning opportunities and outcomes. The research summarized in this brief was conducted in urban early childhood education centers that serve primarily low-income children. Teachers report that according to parents, children who used the NGPM curriculum were better prepared in math than their peers upon entering kindergarten (First 8 Studios, 2016). These results provide an example of how close collaboration among researchers, developers, and educators can produce educational innovations that support more equitable STEM learning outcomes.

[2] The treatment group's post-test scores (M=59.69) on subitizing and equipartitioning were statistically different than the control group's (M=53.53) after statistically controlling initial math knowledge (p=.026, effect size=.51).

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