Perspectives on Early Childhood Psychology and Education

Volume 5 | Issue 1 Article 2

January 2023

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Abstract

Education professionals and researchers have underscored the importance of mathematics education for young children and the awareness that young children can learn early mathematics concepts that serve as a foundation for later years. The need for teachers to support individual needs for some children to build their conceptual understanding is clear as many children show deficits during kindergarten while others are ready to advance to the next areas of instruction. One way to meet the needs of children who need more work in foundational areas of mathematics is to utilize technology within filling stations in the classroom. To this end, this article discusses ways to expose children to more work in basic concepts and skills in mathematics through the use of a filling station with technology supports for children to work on foundational skills.

Keywords: *Kindergarten Readiness, Early Math Concepts, Technology*

Allison Hernandez looks around her kindergarten classroom buzzing with learning. She has just finished a whole group math lesson and is waiting on a small group of students to join her at a table for some more individualized practice. Ms. Hernandez wondered how she was going to meet the needs of all 20 students? At times meeting the learning needs of all the students in her classroom seemed overwhelming. The school bought the class some iPads to use, but Allison didn't know where to begin with incorporating them into daily instruction. Shannon, a bubbly child, came bounding to the table eager to start work with her group. Shannon loves math, science and technology but struggles to illustrate or talk about her thinking. Ms. Hernandez wondered how if she could use the two class iPads to help Allison practice math in an engaging way when she was meeting with other students. This problem is one that many teachers face, meeting the needs of all of the learners, especially in mathematics, and leveraging technological resources that teachers already have access to in ways that aid student learning.

For many years, experts in the areas of teaching, young children, and mathematics education have stressed the importance of mathematics for young children, emphasizing that 3- to 6-year-olds can learn early mathematics concepts that can be built upon in later years (National Association for the Education of Young Children, 2002; National Council of Teachers of Mathematics [NCTM], 2007; National Mathematics Advisory Panel, 2008). In addition, research has found that early math concepts such as knowledge of numbers and quantity were the most powerful predictors of later learning. Research indicates that mathematical teaching is under emphasized when compared to reading. This is unfortunate when considering that most young children are developmentally ready to build on their math knowledge. Therefore, the purpose of this article is to address the need to provide instruction in early mathematics and to outline some simple ways to support children with skill deficits. The following sections will review literature on children's early mathematics abilities and foundational skill deficits.

In most cases, children learn to discriminate between and among quantities of numbers as early as age 4 (Griffin, 2002, 2004). For example, given two piles of objects, they can tell which pile has more or less. By 6 years of age, most children use this knowledge combined with their counting knowledge to form a mental number line (Siegler & Booth, 2004). In time, they understand that numbers later in the count list have larger quantities than earlier quantities (LeCorre & Carey, 2006); for example, one is smaller than two. Many different factors influence children's early mathematics knowledge (Bodovski & Farkas, 2007; Crosnoe et al., 2010; Magnuson, Ruhm, & Waldfogel, 2007; Palardy & Rumberger, 2008) including whether teachers provide instruction in math. In many classrooms around the country kindergarten teachers report teaching mathematic far less than reading (Bargaglioti et al., 2009; Morton & Dalton, 2007).

In addition to mathematics content receiving less time than reading, the curriculum used for instruction may be misaligned with many students' abilities. Research using nationally representative data found that children received instruction in topics in which the majority of students entering kindergarten have already mastered (Engel et al., 2013). Skills such as counting and knowledge of basic shapes were highly emphasized, yet 95% of students were seen as proficient on these skills based on their kindergarten entry screening assessments. While most students do not need instruction on these core skills, it is imperative to quickly and efficiently remediate these skills with children who are lacking them. This remediation may place them on a math trajectory that is far more favorable than if the skills are not remediated. Accordingly, teachers should consider conducting more targeted mathematics skill assessments in kindergarten to determine children's conceptual levels and then make decisions regarding instructional needs.

Among the skills and concepts important to assess, children with early math difficulties, including children with and at risk for learning disabilities, often have weak number sense. Weak number sense is displayed by weak counting procedures, slow fact retrieval, and inaccurate computation (Geary, Hamson, & Hoard, 2000; Jordan, Hanich, & Kaplan, 2003a, 2003b). It can be challenging for teachers to determine how to remediate skill differences in some children when the vast majority of peers have mastered skills and need to move forward in the curriculum. Teachers can use criterion referenced assessments or teacher made skill assessments to determine children's current mathematics knowledge and skills in order to target skills for instruction.

Importantly, teachers can provide experiences that meet the needs of children with early math difficulties by using technological tools to provide learning experiences and meaningful feedback to children and teachers. To this end, in this article we provide two strategies for incorporating technology into early math skills instruction including video self-modeling and exit slips with technology. Creative ways to utilize existing technology features are also discussed. According to the Division of Early Childhood's (DEC) 2014 recommended practices, the supports outlined in this article can be matched to the assessment and instructional practice guidelines. For example, DEC recommended Instruction Practices include practices that: Identify skills for instruction and promote the development of skills in natural, inclusive environments (INS2); Use data for decision making and inclusion (INS3); provide appropriate level of support for learning (INS4); and Embed such instruction within environments to support authentic learning opportunities within a meaningful context (INS 5). These recommended practices could begin as an extension of daily instruction by using filling stations as a place children and go and build foundational skills.

Filling Stations

One way to structure classroom environments is to create "filling stations" for remediating prior knowledge needs. Filling stations are a metaphor for a place (e.g., centers) where children can be exposed to knowledge they currently lack. These centers provide support to students who may be lacking in understanding a place to practice

a skill while still other students in the class work on other tasks. The remainder of the article will give educators examples of filling stations infused with technology to remediate skills essential to future success. For example, a teacher like Ms. Hernandez (case example from beginning) would likely find the idea of filling stations valuable.

Video self-modeling. Video modeling is an evidence based practice often used to help teach behaviors to students with disabilities, particularly individuals with autism (Franzone & Collet-Klingenberg, 2008). However, video modeling could easily be adapted to demonstrate academic skills for students who may need a little extra practice. Modeling with guided and independent practice opportunities are evidence based practices that are effective for children at risk for failure in school (Stormont, Reinke, Herman, & Lembke, 2012). Types of video modeling include basic video modeling, video self-modeling, and point-of-view video modeling. Basic video modeling involves recording someone besides the learner engaging in the target behavior or skill (i.e., models). The video is then viewed by the learner at a later time. Video self-modeling is used to record the learner displaying the target skill or behavior and is reviewed later. Point- of-view video modeling is when the target behavior or skill is recorded from the perspective of the learner. Any of these types of modeling would be an effective way to teach or record a student performing a mathematical task.

To implement this strategy in the classroom teachers could use a device of their choosing. IPads, Chromebooks, laptops, and many cell phones all come equipped with a program to record. Teachers would decide which type of video modeling they would want to record. The teacher would then record either themselves, or their students modeling the expected task and save the recording. Students needing extra practice could later access the recording and perform the task with the model or watch the model and then independently practice the task.

Another option would be to have the student record themselves performing the mathematical task. The would allow the teachers to have a copy to assess the student and check for growth. Students could go back and watch themselves. This can be an engaging task for many students and it allows teachers to go back at a time of their choosing to assess and make educational decisions.

Ms. Hernandez determined that in group work Shannon needed more practice with counting and one to one correspondence. At a quiet time of the day she set up an iPad to record herself with the built-in camera on the iPad. Using the counters that she used with her groups, she laid out a group and clearly touched each one and counted it. She did this each time, slowly counting the group 2 times so that the student had time to count along with the video later. She saved this video in the photos and taught Shannon how to get to it. With little instruction, Shannon navigated to the video with ease and had a little much needed practice on this essential skill.

Snap a Picture: Exit slips. Snap a picture is a flexible way to help students, especially those with limited verbal ability, show their understanding. In this filling station, students use technology to take a picture of their knowledge to explain what they know. Teachers could collect outdated technology such as older digital cameras or older cell phones, that still functionally take a digital picture, but may not be in use. The student is then given a task such as find or make groups of 4. The student would then find things related to the task and photograph them. In addition to allowing students to practice mathematical concepts, this allows teachers to have a record of performance. Many tasks or concepts could be addressed using this technology including size (snap a picture of something bigger than a counter or smaller than you), shapes (snap a picture of things that look like circles), or visual numbers (snap a picture of the number 4). This task allows documentation of student growth while assessing for understanding. It would be important that the teacher reviews the photographs and confers with the student about their pictures to give essential feedback.

Ms. Hernandez decided to have Allison and Shannon try snapping a picture with different groups of numbers. Ms. Hernandez made

note cards with numbers on them. She then taught them both how to use the built in camera, and gave them a box of manipulatives. They were excited to use this filling station; they worked with the manipulatives to represent number groupings, carefully counting and recounting before they snapped a picture.

Utilizing existing technology applications for skill building. Every device comes with built in features that could reinforce ideas children are learning in the classroom. Students could use the calendar and weather feature to create their own physical calendar. Writing down the expected temperature to determine patterns, such as recording cloudy days in the form of graphs, are all ways to possibly encourage students to utilize their resources as well and build on routines that exist in many classrooms.

One feature that is on many devices is the calculator. Groves and Stacey (1998) found that when given the opportunity to use a calculator many students used it as a "scratch pad." When given a question (How many feet do you have? How many legs does a spider have?) students would record their answer with the numbers on the calculator. This encouraged students to connect words with numbers and quantities while taking the barrier of physically writing the numerals away. This is important because counting is fundamental to mathematical growth (NCTM, 2009). Teachers could use the automatic-constant feature that is programed to most devices to practice counting, skip counting and counting backwards. The calculator can help a student learn counting as they practice counting out loud with it. If this task is too difficult for students, talking calculator, and talking calculator apps are available for free. When the buttons are pushed, the calculator "speaks" the number, which is helpful language support for young children as well.

Finally, on iPads, old cell phones or iPods students could use a texting feature that is already built in. Using the building Wi-Fi, where available, students could text the teacher mathematical representations. For example, students may want to show the quantity 8. They could type the number 8 and represent that number with the appropriate amount of emojis. This engaging activity allows students to creatively engage in mathematics, while again allowing the teacher to collect student work samples and provide necessary feedback. This representation is more challenging for most children and should come after demonstrated fluency with manipulatives. These products can also be used as exit slips to document student performance.

Conclusion

Math education is an important but often under emphasized subject in kindergarten classrooms; many teachers struggle to meet the needs of all learners. Technology is one way to allow students to explore math related ideas in structured ways such as through filling stations. This article outlined in detail how teachers can both utilize filling stations in meaningful ways and take advantage of technology to support meeting more children's needs for support in kindergarten classrooms.

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