Water Play

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Abstract

The inclusion of activities to develop sensory awareness, spatial thinking, and physical dexterity, operationalized through hands-on science lessons such as water play, have long been part of early childhood education. This practical article addresses Next Generation Science Standards K-2 ETS1-3 and K-2 ETS1-2 by having four-year-old prekindergarten students direct the path of water on a vertical pegboard water table with strategically-placed, attached plastic cups with holes drilled into them that leak streams of water into each other. Students enhanced their retelling of the story of the Billy Goats Gruff by placing student-made watercolor artwork along the path of the water, which represented the stream in the story. Students devised a variety of working solutions to guide the path of the water from the upper right to the lower left of the vertical water table. Students grew in confidence and skill as they voiced and tested their solutions. They also enjoyed retelling the story of the Billy Goats Gruff from the beginning of the water stream to the end, using the illustrations they had made. Later, students created their own challenges on the water table. Through play and exploration, students were able to test their spatial designs, incorporate literacy and art, and work on social-emotional skills while being actively engaged in their endeavors.

Key Words

Arts-integration, STEM education, STEAM education, literacy, preschool, water play, spatial thinking

Introduction

Fredrich Frobel established a basic philosophy of early childhood education that continues to resonate in the field (Moore, 2002). Frobel believed children developed their ideas and concepts through exploration in sensory awareness, physical dexterity, and creative expression (Early Childhood Today, 2000). Froebel felt "the child would know himself why he loves the thing; he would know all its properties, its innermost nature that he may learn to understand himself in his attachment" (Froebel, 1826/ 1887, p. 73). The articulated knowledge Frobel provided continues to be the solid foundation of early childhood education.

This solid understanding is coupled with the strong belief early childhood educators hold in the critical role of play for whole child development in the early childhood classroom (Lawson, 1996, Bergen, 2007). Early childhood educators give heavy consideration to how curriculum and pedagogy can be delivered in the form of play (Cutter-Mackenzie & Edwards, 2013). Although the exact method of play-based curricula

may vary from classroom to classroom, the vitality of hands-on experiences through play is natural in most early childhood settings. However, the current rigor of the Common Core and standardized testing that are making their way into the preschool classrooms suggest "play is losing to rigor in American classrooms as more and more structured reading and math replaces" (Wohlwend & Peppler, 2015, p. 22). The challenge for early childhood teachers is to ensure children receive authentic play experiences, but uphold the academic rigor being required of them.

Early childhood educators have found a variety of ways to find a balance between rigor and play, with one of the most noted delivery methods being through hands-on curricular experiences. Because of a tendency towards hands-on activities, science curricula lend themselves particularly well to supporting both play and rigor. In teaching the sciences, educators can find balance between children's self-exploration and structured pedagogical activities (Chalufour & Worth, 2005). The Next Generation Science Standards (NGSS; 2013) follow core disciplinary ideas that strike this balance; one such idea specifically asks that students' interests and experiences tie into the lesson plans. Another NGSS idea suggests students be provided with learning tools so they can become independent investigators and problem solvers. The continued call for science-based activities has also appeared in the National Health and Safety Performance Standards (2011) that suggest students be provided with an understanding of the world around them and their environment.

One hands-on science topic that provides rigor with hands-on learning is water play for young children. Water and sand play are often coupled in early childhood literature and seen as necessary activities in early childhood classrooms (West & Cox, 2001). The manipulation of sand or water was so important to early childhood education that early childhood specialists suggested sand or water play be accessible for children at least 25 minutes a day during children's activity time (Harms, Clifford, & Cryer, 2015). Children naturally understand what to do during sand and water play, as it enhances the promotion in all development and learning areas for children, including cooperation in social-emotional development, spatial thinking skills, motor skills for physical development, and "observations classification, comparison, measurement, and problem-solving" for cognitive development (Dodge, Colker, & Heroman, 2010, p. 403).

In addition to impacting the science content learning domain, the water play on which this lesson focuses, formed a strong foundation for learning through art, while addressing engineering standards of the Next Generation Science Standards (Achieve, Inc., 2013), as explained in the next section. Art integration has been shown to heighten children's interest, motivation, and engagement (Nevanen, Juvonen & Ruismaki, 2014; Poldberg, Tranin, & Andrezejczak, 2013). Although a strong foundation of water play already exists in early childhood classrooms, the authors believe this lesson has a strong component of originality as water play and art standards are rarely considered in combination in the early childhood classroom.

Methods

During this lesson, preschool students investigated ways water could move using a vertical water table. In the first part of the lesson, students were given the constraint of getting the water to flow from point A to point B. Then, adding in art through retelling a story, students used the water flow to retell a familiar story, The Three Billy Goats Gruff with the water representing the stream in the story. Students made hand drawn sketches of the different characters and settings, using watercolors to bring them to life.

Setting

This lesson was conducted with children enrolled in a public preschool class for four-year-olds at an elementary school in the Midwestern United States.

Materials and Equipment

Materials needed were a vertical water table made of pegboard anchored with a wooden base in a rectangular plastic tub (see Figure 1), pegboard rings, and clear solo cups with holes drilled in them. The teacher drilled the holes in the cups using a standard electric drill at home. The metal rings that supported the water cups were purchased at a hardware

store. The rings had prongs that fit into the pegboard holes for attachment.

The rectangular plastic tub used in this classroom was an under-the-bed plastic container and the pegboard rectangle was cut to match the inside length of the plastic tub. The wooden feet for the pegboard were cut to fit into the plastic tub. The pegboard itself was supported by a wooden frame attached to these feet. After construction, the pegboard and supports were painted white.

Students wore waterproof smocks and used drawing paper, paint brushes, and water colors to make the illustrations. The illustrations were cut apart and laminated to increase stiffness and to make them waterproof.

Any classic version of the Billy Goats Gruff (e.g., Galdon, 1973, Asbjørnsen & Moe, 1957) will work for this activity. Reading several versions of the story and comparing the way the story unfolds and its illustrations may allow children to explore different approaches to the story. A version with large and detailed illustrations will assist students in understanding the story and gaining ideas for their own sketches and paintings.

Figure 1. The vertical water table

Standards Addressed by the Lessons

The Science standard that was addressed in this lesson during the exploration phase was K-2 ETS1-3: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs by giving the students the constraint of getting water from point A to point B. Another standard, K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem, was addressed during the elaboration phase of the lesson when students used art to retell and model the familiar Norwegian folktale, The Three Billy Goats Gruff.

The Lesson

Engagement Activity

The preschool classroom visited through this lesson devotes much of the day for play. There are seven different centers for students to learn various skills through playing with each other and materials. Simply bringing in the water table to the classroom was enough to pique students' interests. Before center time started, the teacher showed students how to use the rings and how to place cups in them. The class quickly looked at the different holes in the cups. At center time, students choose this sensory table immediately and a waiting list was set up so that all interested children could have a turn with this equipment. Incorporating this structured play center allowed for play based learning directly tied to engineering and problem solving.

Exploration Phase

During the exploration part of the lesson, the teacher quickly revisited how to use the rings to hold the cups for the water table and gave students the first constraint. Students were given two rings already placed on the table and were not allowed to move them (see Figure 2). Next, students were given the task of using cups and more rings to get water to flow from the top ring to the bottom ring at the far right near the base of the board in Figure 2. Questions the teacher asked were: How would you catch the water in the next cup? Which

direction will the water flow? Can water flow up, down, or in a straight line? If you place the cup/ring there, where will the water go? What happens when the cup gets too full or becomes empty? Should any cup be higher than the first cup?

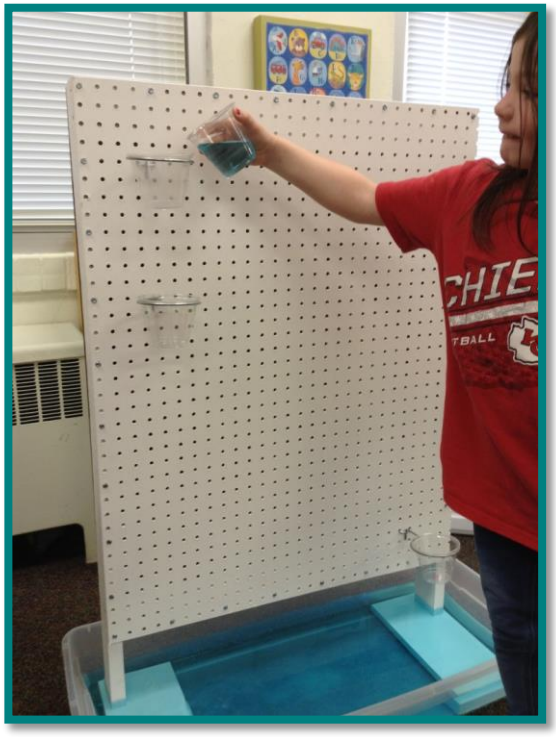

Figure 2. The two fixed rings on the water table with the goal to make water reach the cup at lower right.

Explanation Phase

While students were working, the teacher asked them questions. Many student observations came to the surface while they worked as well. One group had a very proactive approach and believed they would "get it" and just needed to keep working. As they were working and moving cups around they discovered that the end result looked very similar to a waterfall. The second group believed that if they made their cups look like a set of steps they would accomplish their goal. The third group did no talking to each other. Their misconception was if they used all the rings and cups it would work. They also started in the middle and after testing with water to check their placements generated the result shown in Figure 4. Students discovered that using all the cups and rings available did not necessarily result in getting the water from point A to B. The last group discovered that to achieve a waterfall effect they needed to be constantly pouring water in the top cup, taking turns so they would be able to achieve this effect.

Figure 3. Clear plastic cups with holes punched in them near the bottom have been placed on the pegboard to guide the path of the water.

Figure 4. Two girls with a solution that worked.

Expansion Phase

In the literacy lesson part of the day, the class read various versions of the familiar Norwegian folktale, The Three Billy Goats Gruff. For the next part of the lesson, a story retelling activity was added. Students choose characters and settings to illustrate and add to the water table. Students did a quick sketch of the character or setting and then added watercolors to make the characters come to life. See Figure 5 for student pictures of the troll, Figure 6 for illustrations of the goats, and Figure 7 for paintings of the setting.

Students planned the story and taped the illustrations to the board in the correct order, adding the water cups. Then, they added the water to the top cup and retold the story as the water (the stream in the story) flowed past the different scenes.

The story, The Three Billy Goats Gruff, has three distinct settings which led to having three constraints. In solving this problem, students were much more successful, faster, and used more communication with each other. They were more confident that things would or would not work. Students also voiced their thinking and then tested their structures to prove their solutions to each other. Figure 8 shows children using the illustrations in retelling the story.

Figure 5. Student watercolor paintings of trolls

Figure 6. Student illustrations of the goats

Figure 7. Student paintings of parts of the setting.

Figure 8. Students using the water table and illustrations to retell the story

Conclusion

After the described lessons were over, students still were very interested in the water table and chose to go to that center during center time. During this time, students had a constraint-free table with which to work and generated many different challenges on their own. One group used two rings at the top of the table opposite each other and then tried to get water to flow to one central cup at the bottom, quite a spatial thinking challenge! Through play and exploration, students were able to test their designs, incorporate literacy and art, and work on social-emotional skills while being actively engaged in their play.

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