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Influences of Block Play on Academic Learning in Preschool

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Influences of Block Play on Academic Learning in Preschool

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Abstract

Preschool classrooms often include free play time during the school day. Many studies have been conducted on the common sociodramatic play center, yet less research has observed the importance of block play. However, the block play center can be used to foster literacy and mathematics skills. Similar to other play centers, block play is a social phenomenon where students can develop language skills and vocabulary. Early math skills are supported as students count, sort, classify, and identify blocks. Students must also use spatial awareness and language to place blocks. Furthermore, preschoolers must problem solve and use logical and creative thinking to strengthen block structures. Finally, blocks are representational in that they serve as symbols. By understanding symbolic representation, students are learning that an object or idea can stand for something else, similar to written words. It is important for preschool teachers to develop a strong block play center where students can participate in sustained block play in order to foster reading literacy and mathematics skills.

Keywords: block play, literacy, mathematics, play centers, symbolic representation

Influences of Block Play on Academic Learning in Preschool

Chapter One: Introduction

Students attended preschool in order to prepare for the rigor and demand of elementary school. Preschool was a social setting that was developmentally appropriate to the growth of student learning. In these settings, children often learned through play, which was a developmentally appropriate practice. One area of play frequently found in preschools was block play, which might have contained a variety of blocks in various sizes such as unit, wooden, or hollow blocks, and even Legos®. Sometimes, block play areas also contained other toys called replica toys, which could be figurines of people, animals, or cars. Through block construction and deconstruction, students were developing fine and gross motor skills (Robertson-Eletto, Guha, & Marinelli, 2017; Tepylo, Moss, & Stephenson, 2015), spatial awareness, which lead to later math success (Robertson-Eletto et al., 2017; Schmitt, Korucu, Napoli, Bryant, & Purpura, 2018; Tepylo et al., 2015), and symbolic play, the ability to use objects or actions to represent a different object or action (Cohen & Uhry, 2011). Thus, block play was an extremely important time of the school day for young students to build foundational academic skills. The purpose of this paper was to explore the question, “In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading and mathematics skills?” To answer this question, the researcher reviewed peer-reviewed studies on the benefits of block play in preschool classrooms that focused on the effects of block play on academic learning. Academics were defined as skill building in reading literacy and early mathematics. Foundational academic skills were the skills developed in preschool to support later learning.

Block play fostered growth in reading literacy. As students played, the ability to use symbolic representation grew. Symbolic, or representational play, was the ability for an object or idea to represent a different object or idea. Blocks represented other objects. For example, imagining a block was a cell phone during playtime (Prairie, 2013). Additionally, symbolism was also important to understand before learning to write because letters were representations of spoken words. By introducing books to the block area, teachers were encouraging emergent literacy skills such as print awareness. Teachers also provided writing utensils and paper to promote emergent writing skills. Both print awareness and emergent writing were necessary skills for students to master before kindergarten. Furthermore, block play encouraged students to use “more sophisticated language and vocabulary” (Ashbrook, 2017, p. 18). Teachers encouraged vocabulary growth by teaching targeted vocabulary before play time or during students’ exploration (Ashbrook, 2017).

Not only did block play promote literacy, block play also fostered growth in mathematics skills. For one, symbolic play helped children develop abstract thinking, which was necessary for math success. Furthermore, as children grew and aged, block complexity increased. For example, children first made stacks and towers of blocks and eventually created three-dimensional castles or cities. Researchers have identified four developmental stages of block construction: patterns and symmetry, symbolic representation, architectural features, and composition and decomposition (Tepyllo et al., 2015). Throughout all of these stages, children participated in problem solving (Lindeman & Anderson, 2015). As a child was learning to build a tower, it may have continually toppled over but, through trial and error, the child learned that the base needed to be stronger in order to support the tower. Problem solving was an important mathematics skill

that helped children process and solve complicated math problems. Students were also developing numeracy as blocks were counted or stacked. In order to attain higher level math skills, students must first master numeracy (Edens & Potter, 2012). Numeracy referred to the ability to count and manipulate numbers, such as in simple addition problems. Furthermore, block play helped develop spatial awareness, which was a critical skill that helped students describe shape, orientation, and movement (Tepyo et al., 2015). Foundational skills, such as described, were necessary to develop in preschool in order for students to succeed in elementary and middle school.

With the implementation of Common Core State Standards in many elementary schools, developmentally appropriate practice had been ignored in favor of more academically rigorous curriculum. The National Association for the Education of Young Children (NAEYC) was an advocacy organization that supported best practices in early childhood education. In order to provide educators with best practices, NAEYC created position statements on a variety of topics. In the developmentally appropriate practice position statement, NAEYC (2009) stated, “Play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence” (p. 14). Block play could be used as a vehicle to support these developmentally appropriate skills. As children engaged in block play, they were developing decision-making skills and self-discipline as structures toppled over and rebuilt (Prairie, 2013). Since block play was a stress-free area, children felt confident to use new vocabulary and ways of communicating (Ashbrook, 2017). It was necessary for students to problem-solve and work together to create block structures. As structures were built, students negotiated story lines and rules of building together. The developmentally appropriate skills were necessary for

preschoolers to develop before entering kindergarten. Additionally, developmentally appropriate skills supported ongoing growth in literacy and mathematics.

Conclusion

The researcher found that block play was often a play center in many classrooms, yet there was limited research of the benefits of block play. Research that had been conducted on block play had found positive influences on student learning such as developing fine motor skills, vocabulary, problem solving abilities, and math concepts (Pankratz, 2015). In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading and mathematics skills? The researcher, although it was limited, found academic benefits for foster reading and mathematics skills. Chapter Two reviewed the research in the areas of literacy and mathematics. Block play was beneficial to emergent literacy skills such as symbolic representation, oral language, and by incorporating literature materials in the block play area. Furthermore, block play influences mathematics skills specifically in the areas of spatial awareness, problem solving, and complexity.

Chapter Two: Literature Review

In preschool classrooms, students often participated in various types of play that were developmentally appropriate. Sociodramatic play had been the center of many previous research studies and was shown to have positive effects on student academic growth (Hanline, Milton, & Phelps, 2010). However, block play had been studied less often (Hanline et al., 2010; Cohen & Uhry, 2011; Trawick-Smith et al., 2017; Schmitt et al., 2018). Only recently had researchers focused specifically on block play. Even though many classrooms contained a block play area, teachers may not have used this area's full potential to foster student growth in literacy and mathematics. Block play enhanced students' cognitive development in all domain areas—physical, cognitive, social, and emotional (Pankratz, 2015). More specifically, block play built cognitive skills such as memory, communication, and symbolic representation (Cohen 2010). Furthermore, students developed problem solving abilities and understanding of math concepts such as numbers, spatial relationships, ordering and comparing, and classifying and sorting (Pankratz, 2015). With some the benefits of block play already uncovered, preschool teachers should have a block play center in the classroom in order to foster reading and mathematics skills.

In order to construct world knowledge, Piaget (1962) believed that children must play with the objects around them (as cited by Ramani, Zippert, Schweitzer, & Pan, 2014). In addition Pankratz (2015) concurred, “academic success and play are often viewed as different entities..., but one propels the other” (p. 67). Play was children's work, yet many children did not participate in play prior to preschool. In a study of a 29-student kindergarten class, only seven students had access to blocks at home (Pankratz, 2015). As a result, a majority of the students in

the kindergarten class were at a disadvantage to gain the academic benefits from block play. Thus, it was important to offer a block play area at school.

During block play, students progressed through four developmental stages that supported academic growth (Tepyllo et al., 2015). At a young age, children began block play by constructing patterns and symmetrical objects. Then, students used symbolic representation, (i.e. an object standing for something else, such as a block structure being a castle). Next, children added architectural features like doors or windows. Finally, students entered the composition and decomposition stage where building increased in complexity. Teachers should be cognizant that typically developing students worked through the four developmental stages of block play by six years old (Tepyllo et al., 2015). Although typically developing students moved through these four developmental stages, teachers must remember that students from low socio-economic status developed academic skills more slowly than students from higher socio-economic classes (Pankratz, 2015). Often, this inequality was due to various home life factors. For example, parents from low socioeconomic households used less higher-level vocabulary at home. Also, students with special needs normally developed at a slower rate than typically developing peers (Hanline et al., 2010). However, on occasion, students may have used blocks in a manner that did not reflect current capabilities (Hanline, Milton, & Phelps, 2001). Teachers used the four developmental stages of block play in order to assess students. The block play stages were an important part of the process. Essentially, block play is in the process, not the end result of construction time.

In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading

and mathematics skills? Researchers found influences of block play on literacy and mathematics development. Block play was beneficial to emergent literacy skills such as symbolic representation, oral language, and through incorporation of literature materials in the block play area. Furthermore, block play influenced mathematics skills in the areas of problem solving, spatial awareness, and complexity. Block play fostered foundational literacy and mathematics skills.

Literacy

During preschool, children must build foundational literacy skills in order to succeed in elementary school. In order to create foundation skills, children must understand that reading is intertwined with symbols and representation (Cohen & Uhry, 2011). Hundreds of studies on successful reading pedagogy were reviewed by the National Reading Panel (Armbruster, Lehr, & Osborn, 2000). The panel found five similar domains of reading instruction in the reviewed studies: phonemic awareness, phonics, fluency, vocabulary, and comprehension. When students develop in one domain, literacy skills are support in the other domains (Snow, Eslami, & Park 2018). Foundational literacy skills that support the five domains could be built in preschool. Furthermore, foundational skill development was beneficial for students through future schooling. In accordance to the five domains, block play fostered growth in phonics, vocabulary, and comprehension. Phonics was supported through symbolic representation skills. Furthermore, vocabulary building was fostered as oral language developed during block play. Additionally, teachers incorporated literacy materials, such as books and writing materials, in the block play area to advance student comprehension.

Symbolic Representation

Block play was an open-ended activity meaning there was no official end to the game (Snow et al., 2018). Therefore, block play continued for a sustained period of time without interruption. Since block play was open-ended, blocks represented many different objects for young children. Therefore, blocks were a representational tool (Pirrone, Tienken, Pagano, & Di Nuovo, 2018). For example, blocks portrayed other objects or ideas (i.e. a single block represented a cell phone, or a mound of blocks represented a house). During play, children used symbolic representation to create and imagine. Students needed to develop symbolic representational skills prior to reading. Symbolic representation was an important prereading skill because students must understand that an object can stand for something else. For instance, words in a book stand for the words people say. Words form a sentence, which stood for a idea. Block play helped children develop the understanding as blocks stood for objects and ideas in play (Hanline et al., 2010). Blocks represented other objects, while letters represented the words people say.

In a mixed-method study conducted by Cohen and Uhry (2011), 19 four-year-old students created block structures that were named at the end of the interval. Researchers found connections between block representation and cognitive levels. During this time, students' conversations flowed between real and imaginary worlds. Structures were influenced by peers and often blended real world objects with imaginary objects. Through block play, students were able to communicate meaning through block structures that were built. Structures included castles, cities, and WebKinz homes. In this study, block play served as an introduction to symbolic representation, which is the foundation of emergent literacy (Hanline, 2009).

Another mixed-method study (Snow, Eslami, & Park, 2015) observed the correlation of block play and symbolic representation. In a classroom of 20 kindergarten students, six focus students were observed using writing skills with block play. In this study, piles of blocks became parking garages marked with signs, while open block pens held sick animals. Students integrated drawings and symbols on sticky notes to communicate the symbolic representation of the block structures. Through written drawings and symbols, students were able to communicate the significance of the block structures. Similar to letters and words representing objects and ideas in print, block structures represented objects and ideas during play (Snow et al., 2018).

The studies found that block play served as a bridge for symbolic representation and reading (Pankratz, 2015). Through block play, children produced a final product in order to communicate meaning (Cohen & Uhry, 2011). Much like the writing process, block play involved creating multiple drafts and rearranging blocks to make a stronger structure. In this process, students learned how one object can stand for another. According to philosopher, Lev Vygotsky (1978), symbolic representation is an important step to using, processing, and producing written language (as cited in Hanline et al., 2010). Students must have foundational knowledge before progressing to higher level skills. As students develop through the stages of block play, symbolic representation led to more complex structures. Well-developed foundational skills supported faster growth in reading as students progressed through school.

In a study conducted by Hanline et al. (2010), researchers found that a higher-level representation in block play led to higher reading abilities in elementary school. The quantitative study used assessments to track the growth of reading and math scores in 51 preschool students. Students participated in a 90 minute guided block play session led by the teacher once a week.

The researchers collected longitudinal data over the course of the students' preschool year by taking photographs of complete block structures. At the beginning of kindergarten, the students were assessed in reading and math skills. Students who participated in the block play intervention had higher reading abilities, math scores were not influenced. Therefore, the symbolic representation used during block play supported reading growth. Not only can block play develop symbolic representation, also oral language abilities.

Oral Language

During preschool, students continually acquired oral vocabulary and understanding of language structure. Teachers provided students with opportunities to use new language skills, including language structure and vocabulary. New language skills were often used and explored during play time. Play is highly social and takes place in a low-stress environment (Trawick-Smith et al., 2017). Block play provided a natural setting to experiment with complex language.

During block play, students engaged in a variety of conversational strategies (Cohen & Uhry, 2011). While playing, children used varying voice and speech patterns to portray characters. In a qualitative study conducted by Cohen (2015), 19 preschool students were observed using stylized voice patterns of adults to fit an identity in the play scenario. For example, students in the study used block play to act out bad children being sent to jail. Researchers observed the children using adult-like phrases during play time. Another set of children built a farm and incorporated appropriate noises and sounds for the animals and machinery. Students' conversational styles were a mirror to what was heard in real life experiences. In order to see growth in vocabulary, teachers supported complex language

development by teaching new vocabulary prior to block play (Ashbrook, 2017). By utilizing complex language, teachers modeled vocabulary usage so that students used complex language during block play.

In a qualitative study conducted by Pate (2009), 15 preschool students from six different countries were observed in the block play area. Randomly assigned groups of students were given the task to create dinosaur parks out of blocks. Despite not having a common language, students were able to communicate through gestures. To support oral language, Pate (2009) taught related vocabulary before the students began block play by reading relevant books or teaching useful vocabulary words explicitly. The books and vocabulary taught related to dinosaurs or spatial language. Over the multi-day project, students' creativity and imagination were evident in the built structures. Throughout the process, student groups found ways to exchange ideas, negotiate, and problem solve despite the language barrier. At the end of the interval, Pate (2009) noticed more camaraderie amongst her students and better communication.

As students participated in block play, communication was necessary in order to plan structures and negotiate turn taking (Cohen, 2015). Students were found to model speech patterns from the adults in the environment. During play, children acquired new language skills and developed social skills by mimicking each other (Pate, 2009). Teachers supported student collaboration in order to develop stronger verbal, social, and complex language skills (Schmitt et al., 2018). By collaborating, students had a safe environment to utilize new vocabulary and experiment with complex language.

Collaborative Block Play

When students built with a partner, oral language growth was supported. Play was a social performance where children interacted with one another (Cohen, 2015). It was inevitable that children worked together while in the block play area. Students built stories off of another's ideas and incorporated new vocabulary and speech patterns. By collaboratively building, children developed oral vocabulary. In a qualitative study conducted by Ramani et al. (2014), 76 middle-class preschool students were observed for numerous eight-minute sessions in the block play area. Researchers examined how students' communication and collaboration affected block structures. During the interval, students were asked to build a house with a partner of the same age and gender. Student talk revolved largely around symbolic representations and design features of the house. In order to have the required features, such as a door, partners communicated specifically about the spatial relations of blocks. Although girls' final structures were more complex, boys communicated more throughout the building process. It is necessary to note that prior to the study, the preschool promoted block and partner play, which could have led to greater outcomes. When students worked collaboratively, groups were able to create more complex structures and used more intricate oral language. By communicating with a partner, students' oral language skills benefited.

As students developed from toddlers to preschool age, children were able to coordinate behavior with a peer to meet a goal (Ramani et al., 2014). Often this goal was a symbolic representation of a real life or imaginary object or thing. Through interactions, students communicated by planning, negotiating, and problem solving (Hanline et al., 2001). Joint play also allowed children to develop skills to navigate relationships such as cooperation and sharing

(Pankratz, 2015). Relationship skills were often a center point of preschool curriculum because students must develop relationship skills in order to cooperate in school succeed in life.

Students also practiced advanced social and cognitive skills through block play (Ramani et al., 2014). Play was a stress-free environment where students felt at ease as new social skills were practiced or new vocabulary words used. Trawick-Smith et al. (2017) found that building with partners led to more sustained block play, which allowed for more complex block structures. During joint block play, students needed greater cognitive flexibility in order to plan with a partner (Trawick-Smith et al., 2017). Developing cognitive flexibility can help students cope and adapt in all content areas of school as well as throughout life. Thinking aloud not only developed oral language, but also helped students to internalize the process of thinking (Edens & Potter, 2013). Indeed, later literacy achievement was directly related to students' ability to state the intent for an activity and describe the next step (Edens & Potter, 2013). Students practiced thinking aloud by following teacher modeling. Through play, students were immersed in a safe environment to practice thinking aloud and develop thinking skills.

Teachers helped students develop oral vocabulary by encouraging children to play together (Trawick-Smith et al., 2017). Furthermore, teachers could create a classroom environment where students were expected to play together and with a variety of peers. By having this classroom expectation, students may have built more elaborate block structures over a longer, uninterrupted time period (Trawick-Smith et al., 2017). Additionally, teachers modeled think-alouds in order to help students develop the skill (Edens & Potter, 2013). Teachers acknowledged that block play attitude is transmitted to students verbally and nonverbally (Pate, 2009). Therefore, teachers were cognizant of how the block play area was discussed in the

classroom. Teachers created an environment of support and encouragement for block play in order to foster student growth in oral language. Finally, teachers had replica toys available as props after a complex structure is built. The use of replica toys increased complex language use as block play turned into sociodramatic play (Hanline et al., 2010). Teachers further supported the development of literacy by incorporating literacy materials in the block play area.

Incorporating Literacy Materials in Block Play

Many teachers incorporated literacy materials in the block play area with good intentions. Some teachers believed having literacy materials available helped children develop emergent literacy skills or, at the least, encouraged real world use of literacy skills. However, Snow et al. (2015) found that students often forgot about the available literacy materials in the block play center. Teachers needed to encourage and support students' attempts of using literacy materials during block play (Snow et al., 2015). With teacher encouragement and modeling, literacy-rich block play centers supported oral language and literacy learning (Robertson-Ellette et al., 2017). Two literacy materials often included in block play were writing materials and books.

Writing

Writing was used to interact and communicate with the world (Snow et al., 2018). Even if students could only draw marks on paper, writing materials were still useful to incorporate in the block play center. For instance, drawings showed the understanding of symbolic representation (Snow et al., 2018). Without teacher modeling of writing materials in the block play center, students still engaged in writing as they mimicked one another (Snow et al., 2015). Teachers included plenty of environmental print in the classroom to model how writing was used in the

real world (Snow et al., 2018). Students were often encouraged by the social style of writing and the need to communicate with others.

In a mixed-method study, three preschool English language learners from a high socio-economic status were observed in the block play area (Snow et al., 2018). Literacy materials, such as writing tools and paper and high-interest books, were incorporated to the center. Despite having low writing proficiency, the English language learners still engaged in emergent literacy behaviors by drawing pictures and symbols to incorporate with block play. Students became more aware of print encountered in everyday life. More engagement with writing helped students learn visual discrimination, an important reading skill (Hanline et al., 2001). Visual discrimination helped students differentiate words that look similar, such as hat and cat, and can aid in reading development.

Books

Books were one literacy material often found in block play areas. Books that were related to student interests inspired more complex structures to be built. Additionally, books encouraged vocabulary usage during block play (Hanline et al., 2010). Books also helped promote narrative competence (Snow et al., 2018). Since blocks were open-ended materials, students created and developed new stories. Developing narrative competence was important in aiding comprehension skills. In a qualitative study, Pankratz (2015) modeled how to include books in the block play center during building. At first, the 29-kindergarten students merely retold the stories with block structures of the story settings. Pankratz (2015) then emphasized the freedom in block play to change or extend the story beyond the confines of the book. Students incorporated these skills in

block play. By the end of the interval, students used more imagination and participated in longer sustained block play.

In another qualitative study conducted by Robertson-Eletto et al. (2017), a preschool class engaged in a thematic, medieval unit centered around block play. Researchers found connections between story structures and block construction. At the end of the interval, students created more complex structures, and dictated longer, more focused stories. It was possible to incorporate literacy materials in the block play area. In order to foster literacy growth, teachers modeled how to use literacy materials during block play. Furthermore, teachers supported and encouraged the use of literacy materials during block play.

Summary Findings

Block play was correlated with the development of literacy skills. Students developed the understanding that written words and block play both contained representational meaning. Additionally, block play developed oral language as students used new vocabulary and mimicked adult speech patterns. As students built collaboratively, the environment became a safe space to practice new vocabulary and complex language. Teachers encouraged literacy development in the block play area by incorporating literacy materials. It was necessary for teachers to model the use of the writing materials and books. Teachers also needed to encourage and support the use of literacy materials as students often forgot the materials. By modeling, teachers encouraged students to use new vocabulary and literacy materials in the block play area. Researchers found that not only did block play foster growth in literacy, but block play also supported mathematics development.

Mathematics

Mathematics was another area that was supported through block play. Although Hanline et al. (2010) found no correlation between block play and foundational math skills, it is possible that block play's influence was not evident until students worked with more abstract content. Abstract content was introduced much later on in school with mathematics subjects such as geometry, trigonometry, and calculus. However, some abstract thinking was necessary for building the foundation for mathematical reasoning (Robertson-Eletto et al., 2017). During block play, students used mental manipulation, which was a skill necessary for algebra and geometry success (Pirrone et al., 2018). Previous studies found that students with higher block play abilities had higher math achievement in middle and high school (Hanline et al., 2010). Trawick-Smith et al. (2017) concurred that block play and math were closely intertwined when students' math ability predicted the complexity of block structures. Ramani et al. (2014) also found a correlation between later math achievement and block play. Block play developed a variety of math skills while small motor activities, such as water or sand play, were negatively correlated to math skill development (Edens, 2017). Therefore, teachers should strive to use the block play area to support mathematical achievement.

Pirrone et al. (2018) conducted a mixed-method study of 33 six-year-old students of similar socioeconomic backgrounds. This age was critical for the study's findings because students transitioned from concrete to abstract thinking. In the study, the experimental group of 17 students participated in a block play intervention that aligned with the mathematics curriculum twice a week throughout the school year. The intervention included two sections. The first section was to build a structure following a verbal prompt. The next section followed the

math curriculum where students used blocks as a prop. After the intervention, students were assessed on a similar mathematics exam as at the beginning of the interval. The students who received the block play intervention scored higher on the post-assessment than those who did not receive intervention. The intervention students showed growth in problem solving skills, creative thinking, and conceptual knowledge. Other studies have found correlation between block play and mathematical skills.

In a quantitative study conducted by Schmitt et al. (2018), 59 students in nine different preschools were given gradually more complex prompts at the beginning of block play. Researchers compared pre and post-assessments and found that block play had the potential to improve math skills in numeracy, shapes, and language. Not all domains of mathematics were assessed in this study, such as measurement skills and patterning, even so, other researchers have found positive correlations between block play and mathematics. For example, Hanline et al. (2010) found mathematical growth in counting, sorting, classifying, and identifying shapes after students engaged in block play. Meanwhile Bagiati and Evangelou (2016) identified growth in academic skills, motor skills, creativity, and problem solving. Furthermore, Ramani et al. (2014) found that block play influenced math development in the areas of spatial reasoning, geometry, classifying, sorting, problem solving, and number sense. Overall, block play was found to have an especially positive influence on problem solving, spatial awareness, and complexity.

Problem Solving

One domain of mathematics was problem solving. Block play supported the development of problem solving through logical thinking (Hanline et al., 2010). Bagiati and Evangelou (2016) studied how block play is related to engineering with 18 three to five-year-old children. In the

qualitative study, the researchers observed spontaneously occurring play activities to look for engineering-related behaviors. Bagiati and Evangelou (2015) examined students in the block play area using problem solving skills. During building, the children identified a problem, attempted to solve the problem, and continuously tested solutions until the goal was attained. For instance, students attempted to build a house, but the walls were too wide so the roof kept falling down. To solve the problem, students moved the walls closer together in order to support the roof. Similarly, professional engineers partook in the problem solving process as well. Engineers transformed the world by using observation and exploration to improve lives. Children at play naturally used similar engineering skills.

Not only was problem solving a skill necessary for engineers, but problem solving was useful in other areas as well. Problem solving was a cognitive process used in mathematics (Pirrone et al., 2018). In order for peers to problem solve together, children must have understood each other's point of view, which can be difficult for the egocentric mind of young children (Ramani et al., 2014). Teachers encouraged the development of problem solving skills by asking open-ended questions and posing problems during or after construction (Cohen & Uhry, 2011). By working together in block play, students developed problem solving skills.

Spatial Awareness

Through block play, it was possible to teach spatial skills. Spatial skills are the ability to mentally manipulate objects in the environment (i.e. using mental rotation to find the direction that a puzzle piece will fit into a puzzle, or rotating blocks to create symmetry) (Verdine, Golinkoff, Hirsh-Pasek, & Newcombe, 2014; Jirout & Newcombe, 2015). Additionally, spatial skills related to the ability of noticing and describing shape, location, orientation, and movement

of objects (Tepylo et al., 2015). Spatial skills were closely linked to success in math and science (Barton et al., 2018). Edens and Potter (2013) found a correlation between strong spatial sense and higher math achievement. Block play was an appropriate method for spatial interventions (Schmitt et al., 2018).

In a mixed-method study conducted by Edens and Potter (2012), researchers tested 14 preschool students on basic math skills before and after the interval. Researchers observed if play choices over a three-week period would affect math skills on a post-assessment. At the end of the interval, students in the block play area engaged the most with mathematical skills. Also, block play required the highest cognitive demand. However, the girls observed were less likely to engage in block play. The students who played the most in the small motor activities center, such as water play, had lower post-assessment scores. Researchers found the small motor activities had low cognitive demands. Meanwhile, the students who engaged most in block play showed more growth in the post-assessment. Block play was found to require more perseverance, cognitive ability, concentration, and higher spatial skills.

Jirout and Newcombe (2015) examined if the amount of play time with spatial toys was related to spatial performance. Quantitative researchers analyzed home-mailed surveys of 847 families with children between the ages of four and seven years old. The families were chosen by Pearson Education and were comprised of 51% female students, 52.5% Caucasian families, and 247 families with a low socioeconomic status. Parents were asked about the home environment while children completed spatial ability tests by recreating two-dimensional color designs. Results of the survey indicated that frequency of block play had a positive effect on spatial ability. Furthermore, boys engaged more frequently in spatial play at home. Although children

from high socioeconomic backgrounds performed better overall, there was no difference in spatial play for students of varying socioeconomic status. Students from low socioeconomic backgrounds reported more engagement in number skills, shapes, and math games at home. However, it is necessary to note that the survey combined a variety of categories of play, so it is difficult to differentiate if block play was solely correlated to spatial awareness.

Block play was found to develop spatial concepts that were necessary for mathematics success (Robertson-Elletto et al., 2017). Spatial concepts were important for navigating and using diagrams in planning, often part of the problem solving process (Jirout & Newcombe, 2015). Furthermore, mastery of spatial concepts was related to higher achievement in geography, technology, science, engineering, and math (Tepyllo et al., 2015; Verdine et al., 2014). In order to foster spatial skills, teachers should consider that spatial play and spatial skills are positively correlated (Jirout & Newcombe, 2015). Guided block play was one way to foster spatial skills in children (Tepyllo et al., 2015). During guided block play, teachers focused on problem solving and spatial language, which included relational language (i.e., in, under, on, over, etc.) (Verdine et al., 2014). Ramani et al. (2014) found that discussions of spatial placement during block play built spatial skills in 76 preschool students. Teachers encouraged students to use spatial language while in the block play center in order to build spatial skills.

Complexity

Complexity and mathematics were also intertwined. Mathematical success influenced block play complexity. Many studies used the four developmental stages of block play to assess complexity (Tepyllo et al., 2015). Children first play with blocks by creating patterns and symmetry. Next, students use symbolic representation in block play. After that, students began

adding architectural features such as doors. Finally, children began the composition and decomposition stage where structures became more complex. Therefore, teachers strived for complex structures to be built in the block play center.

In a mixed-method study conducted by Trawick-Smith et al. (2017), 41 preschool students in four classrooms were observed in the block play center. The children's mathematical growth was assessed with a pre and post mathematics assessment. At the end of the interval, Trawick-Smith et al. (2017) found that math ability predicted structure complexity. However, if replica toys were available, children's block play complexity diminished. Students were found to focus more on sociodramatic play with the replica toys than block construction (Hanline et al., 2010; Pankratz, 2015). Therefore, teachers evaluated the purpose of the block play center. If complexity was the goal, a block play center without other toys had the greatest impact. On the other hand, block play retained complexity if replica toys were provided after structures were complete (Hanline et al., 2001). Trawick-Smith et al. (2017) suggested occasionally removing replica toys from the block play area.

Other factors affected complexity. For instance, it was necessary to note that Trawick-Smith et al. (2017) found no differences in complexity based on children's ages. Other researchers found that structure complexity increased by age (Hanline et al., 2001). Additionally, Ramani et al. (2014) observed block structures begin as rows or towers and develop into multi-block structures with enclosures, symmetry, and patterns as children aged through the study. Another factor to influence block play complexity was prior experience with blocks. Children who had more experience in the block play center created more complex structures (Hanline et al., 2001). Block play with a peer also encouraged more complex structures (Ramani

et al., 2014). Joint block play increased complexity as students worked together to problem solve (Barton et al., 2018). Trawick-Smith et al. (2018) found that students built more complex structures when cooperation was more frequent. Therefore, teachers encouraged partner block play and gave adequate time for students to build experience in the block play center.

Summary Findings

Research findings contradicted one another in relation to block play's influence on mathematics skills. Some researchers found a positive correlation, while others did not. It was possible that block play influence was not evident on mathematics skills until more abstract thinking was introduced in later grades, such as that in geometry, trigonometry, or calculus. However, researchers agreed on the link between block play and problem solving. Problem solving skills in block play mirrored the problem solving process used by professional engineers. Furthermore, students developed spatial skills through block play. Spatial skills, or mental manipulation, were linked to math and science success. Finally, block play complexity and math were intertwined. Complexity of block structures directly correlated with mathematical skills in that more complex structures indicated higher math abilities. Block play fostered mathematical skills.

Conclusion

A variety of studies have been conducted on block play in the last few decades. In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading and mathematics skills? Researchers found connections between block play and foundational skills in literacy, and mathematics. In fact, block play was found to build cognitive abilities. Furthermore, block play

facilitated social skills. Moreover, block play was beneficial to developing students' foundational academic skills in literacy and mathematics.

During block play, students developed literacy skills. Symbolic representation, the ability for an object to stand for another object or idea is developed during block play. Children built structures that became castles and animal pens (Robertson-Eletto et al., 2017). Symbolic representation was important for understanding that words represent ideas as well (Hanline et al., 2010). Additionally, oral language progressed as students used complex language and vocabulary while building and describing structures. When children built with a peer, oral language was also supported. Joint block play created an environment where children felt safe to utilize new vocabulary. Furthermore, incorporating literacy materials encouraged writing skills to develop for children. Students created signs using symbols and letters to communicate the symbolic representation of structures. Moreover, books aided children's creative thinking and comprehension skills.

Block play not only fostered literacy skills, but also mathematical abilities as well. Although block play was not correlated with early mathematics success, children developed abstract thinking, which was a skill necessary for later mathematics such as calculus, geometry, and trigonometry. Block play also encouraged problem solving skills, similar to the process used by engineers, as students identified a problem and tried multiple solutions until success was found. During problem solving, students often discussed the spatial awareness of blocks which led to development of spatial skills. Finally, researchers observed complexity of structures, which was related to early math success. More complex structures indicated higher math abilities. Indeed, block play fostered foundational skills in literacy and mathematics.

Chapter Three: Research Summary and Conclusions

The preschool classrooms in the reviewed research all had a block play area. Block play was sometimes seen merely as a construction activity. However, block play was beneficial for growth in literacy and mathematics for preschool children. To answer the question, “In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading and mathematics skills?” Teachers must consider research conducted specifically on block play. Substantial research has been conducted on the benefits of sociodramatic play. However, less research observed block play specifically in the light of benefiting foundational academic skills. Therefore, it was important for educators to review the existing literature in order to reap maximum benefits in the block play area. The research findings presented in Chapter Two of this paper show that block play can be used to foster growth in literacy and mathematics.

Literacy

During preschool, it is important for students to master foundational literacy skills. The National Reading Panel (Armbruster, Lehr, & Osborn, 2000) reviewed hundreds of studies about reading research. The findings described five domains of reading instruction: phonemic awareness, phonics, fluency, vocabulary, and comprehension. Block play can be used to support the development of phonics, vocabulary, and comprehension. Phonics skills are developed through the understanding of symbolic representation. Vocabulary can be supported as students use oral language skills and work collaboratively. Finally, comprehension is supported when teachers incorporate literacy materials in the block play area.

Symbolic Representation

Block play supported the development of early literacy skills such as symbolic representation. Symbolic representation is the ability to imagine that an object can stand for something else. The skill is important for reading and writing in that letters and words represent ideas and objects. Block play is one way students can communicate meaning. A student's level of symbolic representation can influence block play. Hanline et al. (2010) found that a higher level of symbolic representation in block play equated to higher reading abilities and faster growth. However, Hanline et al. (2010) also discovered that there was no relationship between symbolic representation in block play and mathematics skills. Moreover, Cohen and Uhry (2010) observed students blending real-world and imaginary objects during block play in order to communicate meaning with peers and create new storylines. Snow et al. (2015) also observed symbolic representation through the use of symbols in writing. In the study, students wrote symbols and words on sticky notes to convey meaning. Therefore, evidence shows that preschool teachers used block play to foster symbolic representation skills. The way in which students use block play for representation increases early communication, comprehension, and writing skills.

Oral Language

Play was a natural and safe environment where students can utilize new vocabulary and complex language. Block play fostered oral language development. It was important for preschool teachers to stress complex oral language because many children were lacking experience. Children from low socioeconomic classes had lower vocabulary than those from higher socioeconomic classes, which may have been due to parent education level or the amount of time parents spend with children. Therefore, it was important for children to have a safe space

to practice new vocabulary and complex language structures. For example, Cohen (2015) observed students using varying speech patterns that mimicked adults during block play. Furthermore, despite language barriers, Pate's (2009) multilingual students were able to communicate as structures were created together. Students used communication in a variety of ways during block play in order to plan structures and work collaboratively. During block play, students' vocabulary grows through continued use and experimentation.

Collaborative Block Play

During block play, it was inevitable that children worked together. Social skills that centered around communication were necessary to develop in preschool students. Collaborative block play also fostered oral language development. Ramani et al. (2014) observed students using spatial language, creating symbolic representation, and speaking about design features as structures were built. Furthermore, students were observed thinking aloud during collaborative block play (Edens & Potter, 2013). Being able to think aloud helps students internalize and develop an inner voice. Through collaborative block play, oral language and social skills were supported.

Incorporating Literacy Materials in Block Play

Often, teachers incorporate literacy materials, such as writing materials and books, in the block play area. Although teachers have the best intentions, sometimes literacy materials were not used to their full potential. In order for literacy materials to have the most benefit for students, teachers encouraged use. Snow et al. (2015) found that students often forgot about the literacy materials in the block play center. Literacy materials supported learning as demonstrated by Robertson-Eletto et al. (2017). During a medieval thematic unit, students created more

complex narrative stories when engaged in block play when using the reading materials. Students created signs using words and symbols in order to communicate the meaning of structures (Snow et al., 2018). Books inspired structures to be built as children retold and elaborated the stories (Pankratz, 2015). Literacy materials supported student growth when teachers encouraged and supported the utilization of such materials.

Summary Findings

Block play was not only a construction center. Through block play, teachers fostered literacy skills in preschool students. The skills included the domains of phonics, vocabulary, and comprehension. Symbolic representation developed as students created castles from piles of blocks. Narrative competence grew as storylines progressed using the block play area. Students' vocabulary growth was supported with pre-teaching and interacting with peers. Additionally, student vocabulary also expanded through discussions and creating during building. As students engaged in collaborative block play, social skills developed. Furthermore, incorporating literacy materials helped students find real-world ways to use literacy, with teacher encouragement.

Mathematics

Besides supporting literacy development, block play also fostered growth in mathematics. However, more research was needed on block play's influence on mathematics. Hanline et al. (2010) found no correlation between block play and foundational math skills. Robertson-Eletto et al. (2017) hypothesized that, since block play develops abstract thinking, block construction has a positive influence on later math achievement in algebra and geometry. Although Pirrone et al. (2018) agree, further research was necessary. Nevertheless, block play was found to develop mathematics skills such as problem solving, spatial awareness, and complexity.

Problem Solving

Block play can help students develop problem solving skills. During block construction, it was necessary for students to identify problems of a structure, attempt to solve the problems, and test solutions (Bagiati and Evangelou, 2016). The same method was used by professional engineers and was a necessary skill for future academic success. Problem solving also influenced social skills as it was necessary for students to understand each other's point of view as peers persisted in the problem solving process. Teachers encouraged the development of problem solving skills by asking open-ended questions during block play (Cohen & Uhry, 2011). Supporting students in developing problem solving skills was beneficial not only in mathematics, but also in other content areas in preschool and in later schooling.

Spatial Awareness

Spatial awareness was the ability to mentally manipulate objects in the environment, which was important for success in abstract mathematics such as geometry. Through block play, children had an organic approach for practicing spatial language with relational words such as in, under, on, or behind. Strong spatial skills were related to higher math achievement (Edens & Potter, 2013). Furthermore, Jirout and Newcombe (2015) found a positive effect between the frequency of block play and spatial abilities. Spatial awareness was also related to problem solving as students mentally planned a new solution to solve a dilemma. By developing strong spatial skills, students built skills to succeed in future content areas such as geography, science, and math.

Complexity

As students aged, block structures gained complexity, although this finding is disputed by Trawick-Smith et al. (2017) who found no differences in complexity based on student age. Structure complexity was correlated with mathematics success. When replica toys were available, complexity decreased as students focused more on sociodramatic play than block play (Hanline et al., 2010; Pankratz, 2015). However, sociodramatic play was beneficial in developing cooperation and oral language. Therefore, teachers added replica toys to the block play area after structures were complete. Complexity also increased when students built with a peer, although complexity was not always consistent (Barton et al., 2018). Overall, complexity that was consistent related to mathematics success.

Summary Findings

The correlation between block play and mathematics was not as strong as that of block play and literacy. Therefore, more research needed to be conducted on block play's influence on mathematics. The research findings presented showed positive correlations between block play and problem solving, spatial awareness, and complexity. It was necessary for students to engage in the same problem solving methods as engineers during block play. Spatial awareness was a part of abstract thinking that was necessary for success in higher mathematics courses. In order to support the development of foundational academic skills, teachers encouraged the creation of complex structures. Complexity of structures was found to have a positive correlation with math success. However, it was necessary for teachers to remove replica toys from the block play area until after structures were built.

Conclusion

The research attempted to answer the question, “In light of early childhood theories, philosophies, and current research in the field regarding best practices, how can preschool teachers use sustained block play to foster reading and mathematics skills?” Block play was found to influence growth in both reading and mathematics. The academic benefit in block play was found during the construction of structures, not in the end result (Pate, 2009). Block play was found to strengthen symbolic representation skills and the use of complex oral language. When students participated in joint block play, new vocabulary was used and social skills were developed. By incorporating literacy materials in the block play area, students were able to communicate ideas and acquire social skills. Furthermore, block play positively influenced mathematic skills as well. During construction, students participated in the problem solving process to build complex structures. Structure complexity was correlated with math achievement in that more complex structures were built by students with higher math scores. Despite the proven benefits of block play, the reviewed research included gaps and limitations. Therefore, future studies may be needed to close the gaps in existing research.

Chapter Four: Discussion, Application, and Future Studies

The research findings of this study provided an overview of the current research conducted on the positive benefits of block play on foundational academic skills. However, one of the biggest challenges in the area of block play is how to ensure that students are getting the most benefits out of block play. Many preschool classrooms have block play areas, but teachers may not be using these areas to foster growth in literacy and mathematics. Researchers have proven that it is possible to develop foundational literacy and mathematics skills with block play. Teachers can make the most of the block play area with recommendations of best practices. The purpose of chapter four is to clarify the limitations of the research, offer suggestions for future studies, and suggest how the research can be used to inform instructional practices.

Limitations and Gaps of Research

It is important to be aware of the limitations of the research in the study. The studies presented, except for the study conducted by Jirout and Newcombe (2015), contained small sample sizes. Therefore, it may be difficult to understand how a large number of students would respond to the interventions. There were few longitudinal studies represented in the research. A few researchers claimed that mathematics skills may not be influenced until later grades when students participate in abstract domains, such as trigonometry, geometry, or calculus. Unfortunately, no studies have been conducted to prove the theory. Most of the studies were administered in one classroom of students. In spite of this, a few of the studies contained multiple classes of students. The findings of the studies could have different results based on a different teacher or class community. Furthermore, many of the classrooms were easily available to researchers. For example, Pankratz (2015) conducted a study on her own classroom of

kindergartners, while Edens and Potter (2013) observed students who attended the university daycare. Therefore, researchers may have had bias because the studies were conducted with familiar students. Additionally, some studies observed classrooms of students who were required to engage in block play, while other studies only followed students who chose to play in the block play area. Students who chose to participate may have engaged in more sustained block play and may have been more willing to participate in the interventions provided by researchers.

Suggestions for Future Studies

Future studies might attempt to fill the aforementioned limitations and gaps in research. For instance, a study could be conducted on a large sample size of students. Researchers could observe if socioeconomic level influences block play complexity or symbolic representation. Another study could explore how block play complexity and literacy are intertwined. Several studies discussed the connection between block play complexity and mathematics, but there were fewer connections between literacy and block play complexity. Furthermore, a study comparing sociodramatic play and block play could be useful for teachers. Many studies have already been conducted on sociodramatic play. Perhaps if more research is done on block play, then block play will be a more revered classroom center. Finally, further longitudinal research needs to be conducted on block play. Researchers claim that block play benefits abstract thinking such as that used in higher level mathematics classes like trigonometry, geometry, and calculus. However, there were no studies found on the connection. Block play research is relatively recent. More research needs to be conducted in order to have a better understanding of the benefits block play has on foundational academic skills.

Informing Instructional Practices

The findings of this study can inform instructional practices. Firstly, teachers should strive for block play to be a respected area of the classroom. Teachers should not dismiss the block play area as a place for construction purposes only, because the research has proven that block play can foster foundational academic skills. The classroom environment should value play, and teachers should encourage a variety of play in the classroom such as sociodramatic and block play. In order to foster growth in reading and mathematics, teachers should support and encourage block play. Support and encouragement can be given in a variety of ways including through modeling, guided play, and hands-on assessments.

Pankratz (2015) found it was necessary to model block play for her students. Similarly, teachers should model block play use for students. Many students do not have access to blocks at home. Therefore, students may begin preschool without prior knowledge or experience with blocks and may be developmentally behind in block play. Consequently, teachers must model how to use the block play area. Teachers may read a story and then model with blocks how to recreate the setting. Then, after the structure is built, teachers could add replica toys to model how to extend or change the story. Alternatively, teachers may model how to change the setting of a previously read story. After, teachers could use replica toys to show how the characters in a story may act differently in another setting, which increases comprehension skills. Through modeling, teachers are closing gaps based on experience of block play.

A second way teachers can be more intentional with block play is by using guided block play. Guided block play is a teacher-led method with loose parameters. First, teachers should pre-teach vocabulary that will be helpful in construction. By front-loading vocabulary, students

are prepared to use more complex language during the construction time. For instance, teachers could give directions for students to build a house out of blocks that include four walls, a way to get into the house, and at least two rooms (Ramani et al., 2014). As students are building, teachers could observe and ask thoughtful questions to students. Teachers can observe to see the developmental stage in which students are engaging in block play: patterns and symmetry, symbolic representation, architectural features, and composition and decomposition (Teplyo et al., 2015). The observed information should be used as a driving force for another block play interval. Perhaps students were unable to build an enclosed structure; teachers should instead encourage students to build an open pen. With teacher prodding and guidance, students will eventually be able to build enclosed and complex structures.

A third way that teachers can use block play in the classroom is to have hands-on assessments. Pate (2009) completed a thematic dinosaur unit with her preschool students with the goal of creating a dinosaur park. The students produced dinosaur parks using blocks that could be modified throughout the unit. Teachers could use this method as an authentic assessment of student knowledge. Assessments could be based on block structure complexity, the ability to collaborate, engaging in the problem solving process, or an explanation of the final structure using targeted vocabulary. Through block play, students are able to showcase knowledge of a subject.

Conclusion

Preschool classrooms often use play as a facet for learning. For young children, play is work through which students learn. Sociodramatic play is often found in preschool classrooms. A variety of research has been done on the benefits of sociodramatic play. However, less

research has been conducted on block play. Current research has shown that block play can foster literacy and mathematics skills in students. Particularly, block play can positively influence student growth in symbolic representation, oral language development, problem solving skills, and spatial awareness. Furthermore, collaborative block play can foster vocabulary acquisition as well as social skills. Incorporated literacy materials can help students understand real-world use of literacy skills and help students communicate meaning. Complexity of finished block structures documents students' mathematical knowledge. Even so, teachers should not observe only the end product of block play. Teachers should also observe the process as students participate in block play. According to Pate (2009), the academic value of block play is in the "process, not the end product" (p. 15).

In order to attain the most benefit from block play, teachers should model, encourage, and support block play in the classroom. More research has yet to be conducted on the influence of block play, but it is clear that students are already benefiting. Unlike the Common Core State Standards which are adopted by many elementary schools, NAEYC recommends using developmentally appropriate practice with preschool students. Specifically, NAEYC suggests using play as a means of learning in the preschool classroom. Therefore, block play is important to incorporate in the classroom. Block play gives time and place for young learners to build foundational skills that will set them up for future academic success in literacy and mathematics.

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