Where are the Blocks? A Case for Blocks in Primary and Elementary Classrooms.

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Abstract

Block play should be an integral part of primary and elementary education, providing children with opportunities to develop key competencies. It fosters the development of critical thinking and problem-solving skills. Children are challenged to construct and design structures, which requires them to think critically and solve problems. Block play promotes creativity and imagination as children can create different structures and designs using blocks. It also enhances spatial awareness and hand-eye coordination. Block play promotes social skills such as cooperation, sharing, and communication as children work together to build structures. Above all, block play can promote an understanding of STEM concepts and principles such as geometry, balance, stability, and load-bearing structures just to name a very few. While the research and literature on the importance of having blocks in all Preschool, Kindergarten is clear, there is little to no literature of the benefits to block play in primary and elementary classrooms. Yet is obvious from related research that blocks in those classrooms would be of great benefit.

Keywords: *Mathematics, STEM, Science, Primary, Elementary*

Introduction

Here is a challenge. Visit 10 primary grade classrooms (1st-3rd) and count how many of those classrooms have a set of blocks. Any type of blocks or building materials will do, but there is no replacement for the wooden set of wooden building blocks (Fig. 1). The old standby wooden blocks that are prevalent in most high-quality early childhood classrooms are missing from most primary and elementary grades for no good developmental reason. Many books and articles on block play support the importance of blocks for preschool and kindergarten children buy seem to miss the importance that they have for older children as well. In the preface for "Block Play: A Complete Guide to Learning and Playing with Blocks [1]. It states:

> *Based on the view that **blocks** are a tool that preschool teachers can use to teach all the skills and concepts necessary for children to be successful learners, this guide presents over 50 activities to enhance the preschool and kindergarten classroom's **block** corner. [1]*

Likewise the author of Creative Block Play: A Comprehensive Guide to Learning Through Building [2] states in the introduction:

> *In the following chapters, you will hear stories from teachers working with three, four, and five-year-olds in a variety of settings—public preschools and kindergartens, college lab schools, and private childcare centers and schools… (p. 4)*

These are very important and very true statements, but why does the "Complete Guide" and the "Comprehensive Guide" limit their scope to just preschool and kindergarten? The stated goals of these books is to use blocks to support learning in mathematics, science, art; literacy and language arts, physical development, social studies, social and emotional growth. These are all goals that don't

end after kindergarten. So why does block play in the classroom end after kindergarten? Why do primary grade classrooms not include blocks and block play?

The answer seems elusive and it is a topic that is seldom talked or written about, but if we want to support the STEM disciplines in the early elementary grades, blocks and block play are essential for those classrooms. Elementary children sometimes have difficulty grasping math and science concepts through verbal explanations and worksheets [3] [4] it may be because it is difficult for young children to construct knowledge about multidimensional concepts using limited, abstract formats such as language and drawing. A three-dimensional medium can be helpful to help children with these complex concepts [5].

Why Blocks?

Block play can be an integral part of primary and elementary education, providing children with opportunities to develop key competencies. It fosters the development of critical thinking and problem-solving skills. Children are challenged to construct and design structures, which requires them to think critically and solve problems and block play promotes creativity and imagination as children can create different structures and designs using blocks. It also enhances spatial awareness and hand-eye coordination. Block play promotes social skills such as cooperation, sharing, and communication as children work together to build structures. Above all, block play can promote an understanding of STEM concepts and principles such as geometry, balance, stability, and load-bearing structures just to name a very few.

However, even Preschool and Kindergarten classrooms are not safe from having blocks taken out of their environment. In the forward to the 2009 report from the Alliance for Childhood, David Elkind wrote that early childhood education over the last half century has become a downward extension of schooling. We have seen this have an especially drastic impact on Kindergarten. This is supported by the fact that as Kindergarten becomes “the new first grade” we are seeing the blocks disappear from Kindergarten classrooms. The mindset that elementary school is the beginning of “real” school leads to the diminishment of play in the classroom.

While the use of blocks in preschool and kindergarten can be supported by research and literature, there is little to no literature of the benefits to block play in primary and elementary classrooms. This is a serious deficit in the literature that needs to be addressed yet is obvious from related research that blocks in other classrooms that blocks in upper grades would be of great educational benefit.

To be fair, some classrooms do continue to incorporate some block construction activities after Kindergarten in the form of Lego and other interconnecting brick type construction materials, however, having a diverse collection of building materials such as wooden building blocks in the primary and elementary classroom is as vital as it is in younger ages. With the emphasis on STEM in new mathematics and science standards, the skills and competencies that are addressed and supported by blocks and block play, should not end at the doors of 1st grade classrooms [6]

Blocks in Elementary Grades

To begin, we should acknowledge that there is virtually no research on basic block play in children over Kindergarten age. In this case we are defining block play as play using basic simple stackable (usually) wooden blocks but not locking blocks such as Lego. Therefore, we need to begin by examining the literature supporting the many reasons that block play is important to children’s development and the many ways that is can be used in the classroom and then try to extend those findings into primary and elementary aged children so we can make some suggestions for their use. Teachers can add blocks and block play into their curriculum to support STEM standards in elementary and primary grade.

Research Supporting the Use of Blocks

However, the research in preschool and kindergarten suggests the many benefits of blocks and block play and suggest that these benefits can extend into first, second and third grades and perhaps beyond. Block play, even in elementary grades, offers a myriad of benefits that span cognitive, social, and physical development. While the focus on block play is often associated with early childhood education, extending these activities into the elementary years can significantly enrich learning experiences and skill development.

- **Enhances Spatial Reasoning:** Block play helps children understand spatial relationships and geometry, fostering skills that are crucial for mathematics, science, and technology. Studies have shown that engaging with blocks can improve children's ability to mentally manipulate spatial configurations, an essential skill in STEM fields [7].
- **Promotes Mathematical Thinking:** Through block play, children learn about numbers, measurement, comparison, and symmetry, applying these concepts in a tangible way. Research by Schmitt et al. [8] highlights the role of block play in early mathematical learning, suggesting its continued relevance for elementary students as they tackle more complex concepts.
- **Supports Problem Solving and Critical Thinking:** As children work with blocks, they encounter and solve problems, such as how to balance structures or fit pieces together. This process enhances critical thinking and problem-solving skills, as noted by Verenikina et al. [9who emphasize the importance of hands-on, manipulative play for cognitive development.
- **Encourages Collaboration and Communication:** Block play often occurs in social settings, requiring children to communicate, share resources, and work together. This collaborative process builds teamwork skills and social competence, demonstrating how cooperative play can improve social interactions and group problem-solving abilities [10].
- **Fosters Creativity and Imagination:** Creating structures from blocks allows children to express themselves and bring imaginative ideas to life. Nicolopoulou et al. [11discuss how play, including block play, supports narrative thinking and creativity, enabling children to explore and develop their unique perspectives.
- **Improves Fine Motor Skills and Hand-Eye Coordination:** Manipulating blocks requires precision, dexterity, and coordination, contributing to the development of fine motor skills. Research studies emphasize the importance of manipulative play for physical development and the integration of sensory experiences [12][13]
- **Enhances Engagement and Motivation:** Integrating block play into academic subjects can make learning more engaging and meaningful. By connecting abstract concepts to tangible experiences, children are more motivated to explore and understand. This highlights the potential for integrating hands-on materials like blocks with science education to increase engagement and understanding [14]
- **Supports Diverse Learning Styles:** Block play offers a versatile learning tool that can adapt to various learning styles and needs, providing a hands-on, visual, and kinesthetic learning experience. This adaptability is crucial for meeting the diverse needs of elementary students, as noted by Gardner's theory of multiple intelligences [15], which advocates for varied approaches to education to cater to different strengths and ways of learning.

Gold et.al [16] conducted a study to investigate how block play impacted executive function (EF) in preschool children. The researchers defined EF in preschool children as comprised of three interrelated structural components: working memory, inhibitory control and cognitive flexibility [16]. They hypothesized that the planning involved in block play would support the development of EF even in children with developmental delays. They found that by fostering children's early engineering thinking using engineering play, other learning and cognitive domains may also be supported and developed.

Blocks are intrinsically an informal educational material. They are used in individual or cooperative play situations but almost never in planned teacher directed activities. Lozon and Brooks [17] clearly stated the problem in their research.

> *Yet, play, science, and engineering are interconnected, essential ingredients of quality educational programs throughout the age span. . . teachers can introduce into their pre-school and elementary school classrooms vetted "playful" curriculum that, with teacher scaffolding using crosscutting concepts, fosters the development of students' science and engineering practices. (P 88-89)*

This learning and development that blocks support does not stop at age 6. Problem-solving, science, engineering and mathematics are all supported during block play. Newman et al., (2016)

found that 5, 30-min structured block play sessions with children 7 and 8 years old, resulted in changes in fMRI scans to the neural network responsible for mental rotation as well as increased speed and accuracy of mental rotation performance. Structured block play in which children build a given structure required the ability to analyze a spatial representation. The researchers thought this would also develop skills in estimation, measurement, patterning, part-whole relations, visualization, symmetry, transformation, and balance.

Block play stimulates cognitive development in children, encouraging them to experiment with different solutions and approaches. When children are presented with the challenge of constructing a structure or solving a problem using blocks, they must think critically about the task at hand. This process involves hypothesis testing, spatial reasoning, and the application of trial and error. As children manipulate the blocks, they learn to identify and solve problems, developing a foundational skill set that is critical in all areas of learning, including STEM subjects [14]

Manipulating blocks of various sizes and shapes requires precision and coordination. Caldera et.al. [18] found that regular engagement in block play enhances fine motor skills and hand-eye coordination, crucial for writing and other academic tasks. Manipulating wooden blocks aids in the development of fine motor skills and hand-eye coordination. Constructing with blocks requires precision and careful placement, which strengthens the muscles in the hands and fingers. This physical development is crucial for children, as it supports other academic skills, including writing and typing, which are essential for success in STEM fields.

Educational Philosophy and Curriculum Design

The diminished presence of blocks and similar hands-on, constructive play materials in elementary grades can be attributed to several factors that reflect broader educational trends, policy shifts, and societal expectations. While blocks have been celebrated for their educational value, especially in early childhood settings for promoting spatial reasoning, mathematics skills, and creativity, their use tends to decrease as children advance in school. Several key reasons help explain this trend:

- **Emphasis on Standardized Testing:** There has been a significant shift towards standardized testing and accountability in education systems worldwide. This shift often leads to a more rigid curriculum focused on measurable academic skills and knowledge that can be directly assessed through tests. Consequently, activities that are less directly linked to testable outcomes, like block play, may receive less emphasis or be phased out in favor of more traditional, academically oriented instruction.
- **Curricular Demands:** As students progress through the grades, the curriculum becomes increasingly packed with content across multiple subjects. Teachers may feel pressured to cover a wide range of topics and may prioritize direct instruction and other methods they believe are more efficient for covering this content, leaving less time for exploratory play and activities like block building.
- **Perceptions of Age Appropriateness:** There is a common belief that certain forms of play, including block play, are primarily beneficial for younger children and less relevant or valuable for older students. This perception may lead educators and policymakers to deemphasize or exclude such activities from the upper elementary curriculum, underestimating the potential for blocks to facilitate complex problem-solving, engineering, mathematics, and science skills at higher grade levels.
- **Resource Allocation and Space Constraints:** Schools face practical constraints, including limited budgets and physical space. As children grow, the physical space required for activities like block play increases, and the cost of appropriately sized materials can also be a consideration. Furthermore, classrooms in higher grades may need to accommodate a wider variety of learning activities and technologies, making it challenging to dedicate space for blocks.
- **Technological Integration:** With the increasing integration of technology into education, there's a push towards digital learning tools, including educational software and applications that target STEM skills. While these technologies offer new ways to engage students in learning, they may also inadvertently reduce the opportunities for hands-on, tactile learning experiences like those provided by block play.
- **Educational Policy and Teacher Training:** Educational policies and teacher education programs may not emphasize the value of play-based learning for older students. Without

systemic support and professional development opportunities that highlight innovative uses of block play in elementary education, teachers might not be equipped or feel encouraged to integrate these materials into their teaching practices.

Blocks and Stem

If you doubt the older children's interest in simple wooden blocks, go to any discovery museum and watch the block play area. Developmental theory shows us that the children interacting there are not limited to 5 and younger. Tõugu et al., [19] examined whether and to what extent children's prior play experiences might support engineering learning in museum's building construction exhibit. Families with 4 to 9-year-old children worked together to solve the first engineering design problem involving blocks, and then children worked alone to solve the second. This study was conducted with a permanent installation at a children's museum and provides useful information about how block play can be useful to older children. The study found that play experiences can help children make sense of novel engineering problem solving activities in informal educational contexts. The results suggested that providing information about key principles or concepts related to the activities in museum can support learning.

In this study, they used a permanent exhibit display to demonstrate a key engineering principle and showed that the display helped support families' engineering problem solving and the problem solving of older children [19]. Open-endedness of the activity was important to support multiple points of entry for children and families who come to the exhibit with varied prior experiences. This seems to be a motivation for the expansion of tinkering and making activities as engineering learning opportunities in educational settings for older children not just the years 5 and younger.

> *Engineering play is a framework for understanding young children's block building as an engineering design process. that parallels the materials-based problem-solving of adult professional. The engineering design process is a theoretical model of the decision-making processes adults engage in as they create and transform ideas into functional products. It involves establishing and solving a problem through object manipulation and construction, meeting goals, developing plans and prototypes, trial-and-error testing and evaluation, and communicating various thoughts and approaches [20] P. 803*

Science

Wooden blocks can be used to introduce and explore basic scientific principles such as gravity, balance, and stability. For instance, when children stack blocks, they experiment with these concepts firsthand, learning through trial and error what structures are stable and why. This type of play can lead to discussions about why certain shapes are more stable, introducing concepts of physics in a tangible way. Cook et.al [21] emphasizes the importance of play in learning, noting that such activities can significantly enhance children's understanding of scientific concepts. Through block play, children intuitively explore basic principles of physics and engineering, such as gravity, balance, and structural integrity. Bagiati and Evangelou [22] suggest that early experiences with constructing and deconstructing structures lay the groundwork for understanding more complex scientific and mathematical concepts. They propose that using a Design Thinking in Education model using blocks and block play, constitutes a core concept of engineering. They state that blocks seem to be one of the best tools to use in order to work towards the development of such a model. They observed that young children demonstrate engineering behavior while building. Their video data showed that children demonstrated and articulated goal-oriented design, problem-solving thinking, innovation stemming out of synthesis of multiple designs, pattern repetition and design testing.

TECHNOLOGY

Many people may not consider wooden blocks to be technological tools, however, they can be integrated into technology and computer science education through activities like coding and robotics.

For example, children can design a simple structure with blocks and then use a programmable robot to navigate the structure, introducing basic coding concepts such as sequencing and conditionals. Yang et al., [23] discusses how tangible materials can be used alongside digital tools to introduce young children to computational thinking and robotics. However, for decades, wooden blocks have been used by some of the most technically demanding professions to support design and construction in architecture.

Friedrich Froebel is known as the father of the Kindergarten, but his blocks have been used in schools of architecture as a key technological tool for years. Froebel's educational philosophy emphasized learning through play, where these blocks serve as tools to understand the fundamental principles of form, structure, and creativity. This pedagogical approach has influenced many architects and engineers, including Frank Lloyd Wright, fostering a profound understanding of spatial relationships, design thinking, and problem-solving skills from an early age. Here is some research on just a few ways in which Frobel's blocks have influenced architects and other professionals. Additionally, Gold et.al. [16] introduced the concept of engineering play with blocks, viewing children's constructive block play as an engineering design process, which aligns with Froebel's philosophy of learning through hands-on manipulation and creativity.

Fostering Engineering and Design Skills

STEM education includes aspects of engineering as well as, science, technology and mathematics. Therefore, STEM education can greatly benefit from the use of wooden building blocks. By designing and constructing structures, children engage in the engineering design process: they identify problems (e.g., how to build a bridge that can support weight), brainstorm solutions, design and build their structures, test them, and then iterate based on the results. This process mirrors the real-world engineering design process and encourages children to think like engineers. Using blocks in elementary school, particularly for teaching engineering concepts, is an effective and engaging method that supports a broad range of developmental and educational objectives. Here are several reasons why blocks are invaluable for fostering engineering knowledge among elementary students:

Mathematics, Critical Thinking and Problem Solving

The use of wooden building blocks in teaching STEM subjects to elementary school children represents a hands-on, engaging approach to learning that fosters creativity, critical thinking, and problem-solving skills. This method aligns with constructivist theories of learning, which posit that children learn best through direct experience and by constructing their own knowledge rather than through passive reception. Building blocks can be utilized in elementary STEM education, highlighting their benefits and practical applications. Current research indicates that block play supports the development of higher order mathematical skills, including geometry, spatial reasoning, and understanding of numbers. Studies by Clements & Sarama [24] found that children who engage in block play demonstrate improved abilities in spatial visualization, an essential skill for mathematical problem solving.

Conclusion

While the absence of blocks in some primary classrooms can be attributed to various factors, the literature consistently supports their value in promoting cognitive, social, and emotional development. Overcoming the challenges to their inclusion requires a concerted effort to educate about their benefits, creatively integrate them into the curriculum, and address practical constraints. By recognizing block play as a powerful learning tool, educators can enrich the primary education experience, fostering skills and competencies that extend well beyond the classroom.

Block play is an essential activity in elementary education that promotes critical thinking, problem-solving, creativity, imagination, spatial awareness, hand-eye coordination, and social skills. Teachers can incorporate block play into their curriculum in various ways, such as free playtime, math, and science lessons. The different types of blocks available also provide children with different experiences and challenges. Therefore, it is important to provide opportunities for block play in elementary grades to promote holistic development among children.

Block play is not just for younger children, but it can also be a valuable activity for older children. The benefits of block play for older children include the development of problem-solving skills, creativity, teamwork, and an understanding of engineering concepts. Building sets such as

LEGO, K'NEX, and Erector sets are popular options for older children, and wooden or foam blocks can also be used. Educators can incorporate block play into their curriculum for older children in numerous ways, from art class to science and math classes, as well as technology and engineering classes. By providing opportunities for block play, educators can engage and challenge older children while promoting their holistic development.

Block play is a powerful pedagogical tool in primary education, supporting cognitive, social-emotional, and physical development. The existing body of literature underscores the necessity of incorporating block play into early childhood curricula to foster a well-rounded educational experience. Future research should continue to explore the long-term impacts of block play on academic achievement and developmental outcomes.

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