Gorga : Jurnal Seni Rupa
Vol 13, No 2, (2024) 788-795
ISSN 2301-5942 (print) | 2580-2380 (online)
https://dx.doi.org/10.24114/gr.v13i2.62761

Available online : https://jurnal.unimed.ac.id/2012/index.php/gorga

Designing Constructive Toys to Foster Geometric Exploration in Early Childhood Education

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***How to cite*:** Putri, E. M. P., Bahri, N. F., & Atamtajani, A. S. M. (2024). Designing Constructive Toys to Foster Geometric Exploration in Early Childhood Education. *Gorga : Jurnal Seni Rupa*, *13*(2), 788-795. https://dx.doi.org/ 10.24114/gr.v13i2.62761

Article History : *Received: August 19, 2024. Revised: August 29 , 2024. Accepted: December 27, 2024*

ABSTRACT
During the ages of 4 to 6, children experience substantial growth and development. Interaction with their surroundings becomes a crucial catalyst for their cognitive development. Constructive beam play emerges as an effective medium, but its limitations can diminish children's interest. This study endeavors to design innovative beam gaming tools that cater to the needs and preferences of 4-6 year olds and facilitate their optimal development. The research methodology employed involves qualitative methods guided by a user-centered design approach. The resulting final design emerges as a potent tool capable of strengthening various aspects of children's development. These measures underscore the paramount importance of incorporating children's needs and preferences into the design process. By doing so, the final product becomes more pertinent and suitable for children's use. The culmination of this study yielded a constructive beam APE design that incorporates safety materials. Additionally, it encompasses a constructive system specifically designed for children aged 4 to 6. Furthermore, the child demonstrated focus and problem-solving abilities during the duration of each instruction and the use of playing cards.

KEYWORDS

4-6 years old,
Toys, and
Beam

INTRODUCTION

Childhood, particularly the ages of 4–6 years, represents a critical period for overall development in children. At this stage, Thoha & AN (2021) emphasize that children begin to recognize and interact with various aspects of their environment, which serve as stimuli for their personality, psychomotor, cognitive, mental, and social-emotional growth. During this developmental phase, play emerges as a crucial medium for exploration and learning. Through play, children engage with their surroundings, build character, and develop essential skills. Games at this age are not merely for entertainment but also function as tools for skill-building, thought expression, and behavior preparation. Smilansky (1968), as cited in Papalia et al. (2009), estimates that children spend 10-15% of their time playing with objects, highlighting the importance of play in their daily lives.

Wibisono & Estiyono (2018) further elaborate that engaging in play activities using appropriate media, such as Educational Gaming Tools (APE), is an essential need for children. These tools provide opportunities for fun, relaxation, health, and learning while stimulating various aspects of their development. Nurani et al. (2020) emphasize that through play, children can freely imagine, explore, and create, fostering creativity and problem-solving skills.

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One example of APE suitable for children aged 4–6 is constructive toys, such as blocks, which can be used with or without guidance. Rahman (2009) asserts that playing with blocks can significantly stimulate children's creativity by encouraging them to build and create. Rubin, as cited in Ginting (2018), defines constructive play as the manipulation of objects with the intent of shaping or constructing things. These toys typically include various shapes that children can arrange to form structures or objects, aligning with their imagination and developmental needs.

This study aims to explore the design and implementation of constructive toy blocks as a means to enhance creativity in children aged 4–6. By focusing on the developmental benefits of such toys, particularly blocks, the research seeks to create products that resonate with children's experiences, especially those in kindergarten settings. The design will incorporate elements that are familiar to children, ensuring the toys are engaging and supportive of their developmental milestones. Ultimately, this study underscores the potential of constructive toys to foster creativity and contribute to holistic child development.

METHOD

Sugiyono (2018) stated that literature study is an activity to study theories and other references relevant to the values, cultures, and norms adopted in the social situation that is the object of research. In this study the authors chose library studies or literature studies by collecting book and journal references from previous studies.

Constructive toy design of blocks with the use of materials such as knitted threads and drilled fabrics (Farikha et al., 2015) The toys are made from knitted threads and drilled fabrics formed with geometric patterns. These materials are safe for children and can train the child's motor by touch. In addition, this toy can also be used as a sitting base.

Toys using Dutch teak wood material with a magnetic joint system (Febrian, 2022) have also been shown to be successful in stimulating vibration motors and as a medium for learning shape recognition. This design introduced the geometry of animal transformations (Geonetic Animals), with the help of book modules to make it easier for children to build woodblocks.

In addition, the author used the UCD user-centered design method. Through UCD, it is possible to design by engaging users from the beginning, so that the resulting products or services are exactly what they need.

According to Still & Crane (2017) the six UCD phases are as follows:

1) Engaging users early, putting users as the primary focus in each development stage.
2) Engage users in general, ranging from creating user profiles (persona) to testing directly how our products are used. With focus groups, workflows, prototype generation, usability testing, and analysis.
3) In-context design, products should be designed taking into account everyday user habits and environments.
4) Design in simple form, with simple designs can avoid user confusion when using simple products and designs help users learn more quickly how products work.
5) Giving users instructions or control, if users are given too many options, they are often confused and difficult to use the product. As a result, they became lazy to use the product.
6) Design based on emotional needs (visceral, behavior, reflective)
   a. Visceral: Form or visual of the product to the user reaction of a product.
   b. Behavior: Habitual use of a product.
   c. Reflective: By understanding how when we use a product, researchers can experience firsthand the user experience of the product being designed.

RESULT AND DISCUSSION

1. Geometry

According to Hasanah & Agung (2019) the understanding of geometric shapes in early childhood starts from concrete to abstract, from intuitionistic to analytical, from exploration to

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entrepreneurship over a long period of time as well as from the simplest to the highest stages, and geometry is the basis in mathematics and development. Geometric fundamental forms such as circles, triangles, squares, rectangles, trapezium, parallel bars, cleavage of ketupates, and triangles. In addition to developing logical thinking skills, geometry is also effective in helping solve problems.

2. UCD Implementation

1) Engage users early.
   Conducting field observations directly and analyzing the playing needs of 4-6 year olds at Bandung Montessori school by putting themselves into learning and activities.
2) Involve users in general.
   With focus groups, workflows, prototyping, usability testing, and analysis

Table 1. Involve users in general

Phase Implemented	Description
Group Focus	4–6 years old at Bandung Montessori School.
Work Flow	Create a workflow to map a workflow or design process or a product workflow.
Prototyping	The creation of a beam constructive toy prototype with a scale that approximates the finished product and can be tested in the field directly.
Usability testing	Usability testing was conducted directly at Bandung Montessori School.
Analysis	Conduct an analysis on the prototype products of field test results within a certain period of time.

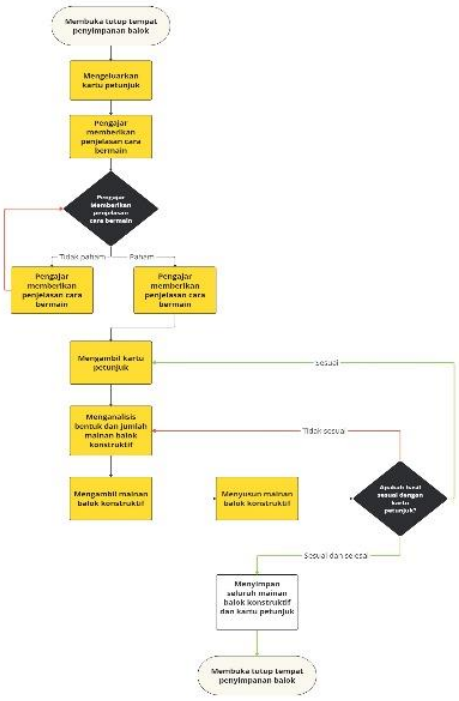

Figure 1. Work flow

3) Design In Context
   The age group of 4-6 year olds requires stimulation in their development, especially fine motor and cognitive development. Based on Peraturan Menteri Pendidikan Nasional Nomor 58 Tahun 2009 (2009) on Early Childhood Education standards, it states that 4-6 year olds have at least the following levels of developmental achievement:

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Table 2. Desain in context

Scope of Development	4-5 Years Old	5-6 Years Old
Fine motors skills	1. Coordinate eyes and hands to perform complex movements. 2. Perform a manipulative movement to produce a form using various media.	1. Imitating form. 2. Exploring with various media and activities.
Concepts of shape, color, size and pattern	1. Classifies objects by shape or color or size. 2. Classifying objects into the same group or similar group or group paired with 2 variations	1. Classifies objects by color, shape, and size (3 variations). 2. Classifying more objects into the same group or similar groups, or paired groups of more than 2 variations

4) Design in simple form
Performing constructive design of beams using simple geometric exploration. Like circles, squares, and rectangles. Shape analysis is performed to select the geometric shapes most effectively used in the constructive design of the beam, with the aim of ensuring they can be well constructed and combined. After consideration of the shape of a circle, a rectangle, and a square were chosen as the basic shapes for design. The combination of these forms is considered most effective in supporting the development of children's motor and cognitive skills, as well as providing flexibility in creating various construction models.

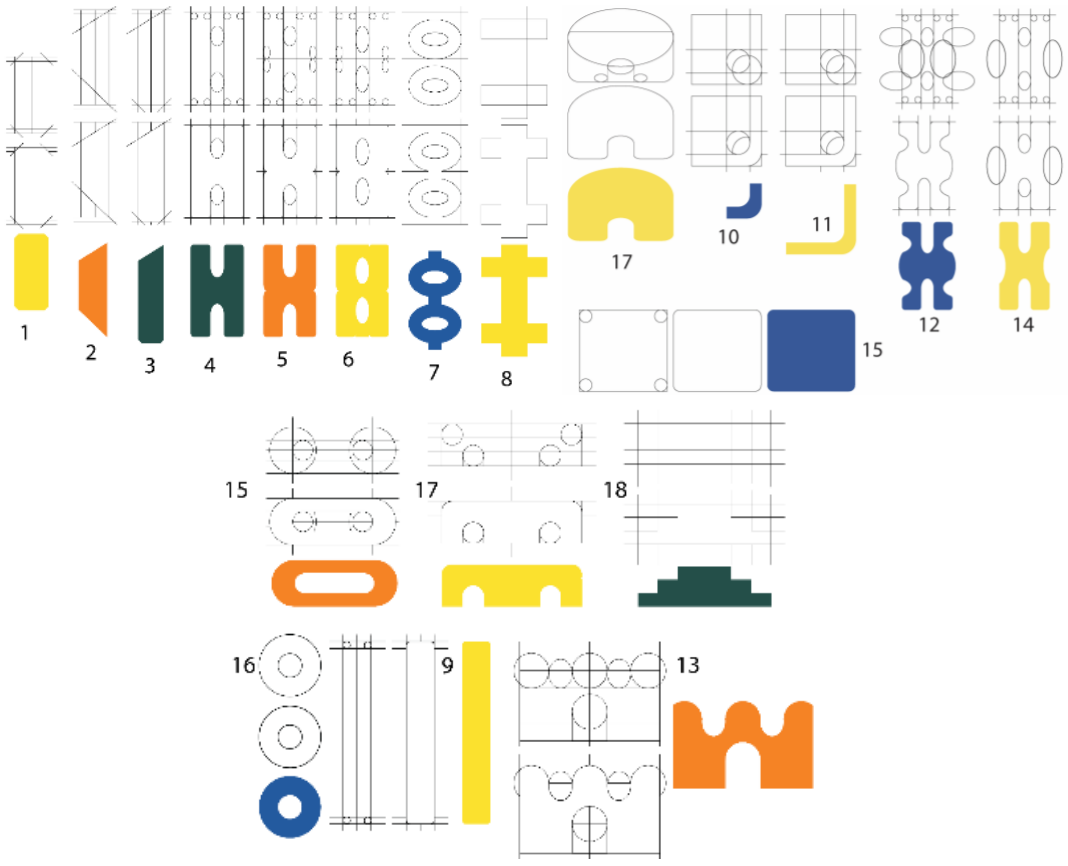

Figure 2. Shape Analysis

5) Give the user instructions or control
To improve the order and understanding of children in play, a special rule was made in the use of constructive toy blocks. Here are the rules for playing constructive toy blocks;

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a. Don't throw, hit with a beam, and snatch the beam from a friend.
b. Playing Together
c. Ask for help when you need help from a friend or teacher

As well as developing experience while playing designed play instruction cards to help children coordinate their eyes and hands, train children's imagination, and imitate shapes. In line with Wardani et al. (2024) information delivery design can be customized to meet specific audience needs, so that messages can be communicated effectively. Play cards are made 3 levels, 1 level for 4-year-olds to train hand grips and to know colors, 2 level for 5-year-olds to train hand grips and follow the rules of play, and level 3 for a 6-year-old child to understand that a word is related to a particular object and explore the child's ideas and imagination. The size of the playing card has an A5 size.

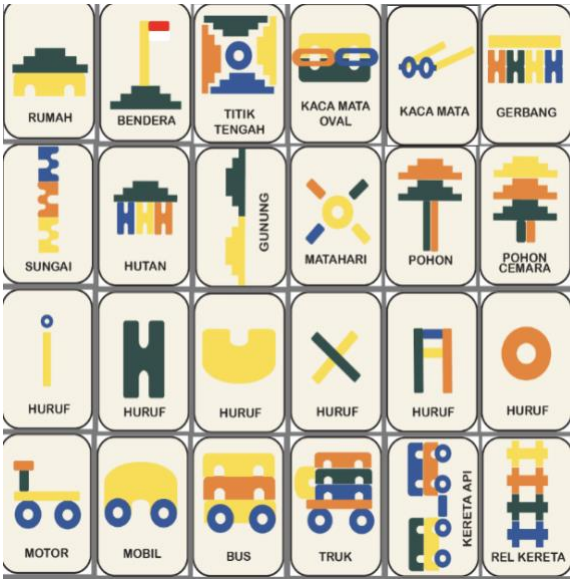

Figure 3. Level 1 for 4 years old

Figure 4. Level 2 for 5 years old

Figure 5. Level 3 for 6 years old

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6) Design based on emotional needs
Visceral: Children see the blocks and colors used to show enthusiasm and desire to play by asking and holding the blocks directly.
Behavior: In playing the beam has been directly directed by regulations in playing such as not throwing, not hitting using blocks, etc.
Reflective: Researchers play blocks and experience the level of difficulty from easy to difficult and because of the many variations offered, they do not get bored easily when playing them

3. Prototyping

According to Kementerian Pendidikan (2021) the provision of toys that are safe to use for children is:

a. The criteria are safe for children, clean, odorless, non-hazardous, non-rough, and non-rusting.
b. Size and shape are designed ergonomically for children. The angle is not sharp (minimum 0.3 mm), not pointed (minimum 2 mm), the size is not too small to be swallowed easily.
c. Damaged toys are immediately repaired or replaced to prevent injury or injury to the child.

The following is the author's findings regarding the materials used in this design. According to Lefteri (2014) Pine wood is used because it has a strong, rigid, stable, and minimal shrinking structure. According to Gusnaldi (2022) Mahoni wood has excellent hard and wood quality, is commonly used as accessory items to complement the house, and lasts and does not change shape easily. With a smooth surface and a mild type of period when compared to pine wood, mahogany wood is suitable for application to toys for early childhood. The wood is easily painted with water-based dyes and can be sanded to a very smooth surface. The age difference of the type of pine wood aims to train a child's fine motor in grasping objects of different types.

4. Product Testing

The trials involved 12 early childhoods (4–6 years old). According to Elpalina et al. (2024) The evaluation process includes implementation measures aimed at collecting and compiling evidence as conclusions regarding the quality of a program, product, individual, policy, proposal, or planning. Accompanied by a teacher, children are involved in planned activities. Intensive observations of 5 children were selected as samples to obtain a comprehensive overview of the understanding of children's concepts. The child's name is disguised so that it does not violate the child's rights, so the initials are used:

Table 4. Product Testing

Name	Description
Am (6 Y.O)	1. The use of level 3 playing instruction cards takes 2 minutes to arrange according to cards. 2. The author explained only one time and interrupted the directive once. 3. The size of the product is right for holding hands. 4. Children have little difficulty finding shapes that suit their needs, as many forms available in one place 5. Children enjoy playing while studying with constructive blocks and playing cards
Ig (5 Y.O)	1. The use of level 1 and level 2 instruction cards takes 2 minutes to complete the challen 2. The explanation was only done once because it was understood. 3. The size of the product is easy for children to grasp. 4. The child doesn't have any trouble during the play. 5. Children enjoy playing while waiting for their next turn to play.
D (4 Y.O)	1. Time spent searching the shape of a level 1 card for 30 seconds to complete the challen 2. The explanation was only done once. 3. Children can pick up blocks easily and easily be held by the child. 4. The child doesn't have any trouble during the play. 5. The child becomes jolly when playing
Da (4 Y.O)	1. The use of level 1 instruction cards takes approximately 1 minute to locate and adjust cards.

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	2. Children need to be explained twice in order to understand form. 3. The size of the product corresponds to the child's hand grip. 4. Children have difficulty finding shapes because of many shapes in one place and the sa color. 5. The child shows his joy in playing.
Q (4 Y.O)	1. The use of level 1 instruction cards takes 2 minutes to complete the challenge. 2. The explanation was carried out once so that children could understand the form to composed, and interrupt once. 3. Product size is too big for a child's hand grip. 4. Children have difficulty finding the shape of the block that matches the playing instruct card because in one place there are various shapes. 5. Children display a rigid and enthusiastic attitude at the same time in play.

Analysis of the table data showed that the study subjects had excellent adaptability and understanding of new instructions. In the context of a given game, the subject is able to complete tasks with high efficiency, on average completing challenges within 1-2 minutes. This ability indicates a strong concentration power and effective visual processing ability in the subject.

The study subjects showed a deep understanding of the rules of the game, such as prohibiting throwing or hitting using blocks. His ability to understand instruction cards without requiring repeated explanations indicates a good understanding of the instructions. A high level of focus during activity shows good cognitive development, especially in aspects of problem solving, pattern recognition, and adherence to instructions

CONCLUSIONS

This design using geometry exploration for early childhood has been designed using UCD's design method, with the addition of playing cards and storage space. This design aims to design learning aids that are enjoyable for early childhood. Through geometry blocks and instruction cards, children are invited to learn while playing. The choice of bright colors also supports an effective learning process. Children demonstrate their focus and problem-solving skills as seen by the duration of their play from each instruction and playing card used. Further suggestions for researchers to explore the strengths in playing joyful, hypnotics, intensity, variety, improve.

REFERENCES

Elpalina, S., Ambiyar, Agustina, & Azis, A. C. K. (2024). Implementasi Model Evaluasi Formatif-Sumatif dalam Meningkatkan Pembelajaran Seni Budaya. *Gorga: Jurnal Seni Rupa, 13*(1), 1–8. https://doi.org/10.24114/gr.v13i01.55826

Farikha, A. Y., Widiastuti, Th., & Affanti, T. B. (2015). Mainan Anak Berbahan Tekstil Menggunakan Teknik Rajut dengan Ide Mainan Balok Susun. *Texfile*, *2*(1), 1–13. https://jurnal.uns.ac.id/texfile/article/view/32732/21656

Febrian, B. (2022). *Perancangan Media Pembelajaran Permainan Konstruktif sebagai Upaya Pengenalan Bentuk Geometri pada Siswa TK. Sunan Giri Surabaya* [Universitas Dinamika]. https://repository.dinamika.ac.id/id/eprint/6322/

Ginting, M. B. (2018). Membangun Pengetahuan Anak Usia Dini melalui Permainan Konstruktif Berdasarkan Perspektif Teori Piaget. *Jurnal Caksana-Pendidikan Anak Usia Dini*, *1*(2), 159–171. https://doi.org/10.24114/gr.v13i01.56904

Gusnaldi, A. (2022). Analisis Sifat Fisik dan Mekanik Kayu Mahoni dengan Kayu Bayur. *Universitas Negeri Padang Repository*, 1. http://repository.unp.ac.id/id/eprint/32395

Hasanah, L., & Agung, S. (2019). Kemampuan Pengenalan Geometri melalui Kegiatan Bermain Balok Anak Usia 5-6 Tahun. *Journal of Early Childhood Education (JECE)*, *1*(2), 45–52. https://doi.org/10.15408/jece.v1i2.12873

Kementerian Pendidikan, K. R. dan T. (2021). *Panduan APE Aman bagi Anak Usia Dini*. Direktorat Pendidikan Anak Usia Dini. https://paudpedia.kemdikbud.go.id/

Lefteri, C. (2014). *Materials for Design*. UK: Laurence King Publishing.

Nurani, Y., Hartati, S., & Sihadi. (2020). *Memacu Kreativitas melalui Bermain* (B. S. Fatmawati, Ed.; 1st ed.). Jakarta: Bumi Aksara.

Papalia, D. E., Olds, S. W., & Feldman, R. D. (2009). *Human Development* (M. Ryan, Ed.; 11th ed.). United States: McGraw-Hill.

Peraturan Menteri Pendidikan Nasional Nomor 58 Tahun 2009, Peraturan Menteri Pendidikan Nasional 1 (2009).

Rahman, U. (2009). Karakteristik Perkembangan Anak Usia Dini. *Lentera Pendidikan*, *12*(1), 46–57. https://doi.org/10.24252/lp.2009v12n1a4

Still, B., & Crane, K. (2017). *Fundamentals of User-Centered Design a Practical Approach*. CRC Press. https://doi.org/10.4324/9781315200927

Sugiyono. (2018). *Metode Penelitian Kuantitatif, Kualitatif,dan R&D* (19th ed.). Bandung: ALFABETA.

Thoha, M., & AN, R. A. E. (2021). Learning of Srintil's Creative Dance in an Effort to Improve Children's Cooperation Attitudes in Cepoko Hamlet, Canggal Village, Temanggung District. *Early Childhood Education Papers*, *10*(1), 78–84. https://doi.org/10.15294/belia.v10iNo

Wardani, W. G. W., Winarni, R. W., & Rabuhandoko, N. (2024). Desain Boneka Tangan Karakter Wayang sebagai Model Saluran Kampanye. *Gorga: Jurnal Seni Rupa*, *13*(1), 108–117. https://doi.org/10.24114/gr.v13i01.56904

Wibisono, L. N., & Estiyono, A. (2018). Desain Mainan Konstruksi Bertransformasi untuk Melatih Motorik Anak Usia 4-6 Tahun. *Jurnal Sains Dan Seni ITS*, *7*(1), 2337–3520. https://doi.org/10.12962/j23373520.v7i1.29889