
JURNAL RUPA VOL 9 NO 2 2024

DOI address: <https://doi.org/10.25124/rupa.v9i2.7340>

Shelf Design for Montessori Teaching Environment at Graha Ananda Kindergarten, West Bandung Regency

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Abstract. *The background of this study refers to the need for a learning environment that supports children's holistic development in accordance with Montessori principles. This research was motivated by the need to design optimal Montessori shelf in Graha Ananda Kindergarten, West Bandung Regency, as an important part of applying the Montessori approach in early childhood education. The urgency of this research is related to the critical role of Montessori shelf prototype in creating learning environments that support children's creativity and independence. The purpose of the study was to explore the visual aspects of Montessori shelf prototype, especially through the application of curve or wave variations on the side wooden structure. The research method used is qualitative with a case study approach, digging in-depth information related to the experiences and perceptions of Montessori shelf users at Graha Ananda Kindergarten. Data collection techniques include interviews and field surveys, while data analysis uses a descriptive approach to detail the visual elements and effectiveness of shelf design. The results of this study are expected to contribute to the improvement of Montessori shelf prototype, improve the quality of learning, and become a reference for similar educational institutions in applying Montessori principles in an early childhood environment. The results of this research indicate that the curved shelf design not only enhances aesthetics but also increases children's engagement and independence, aligning well with Montessori principles.*

Keywords: early childhood, Montessori, product design, shelf design.

Abstrak. Latar belakang penelitian ini merujuk pada kebutuhan akan lingkungan belajar yang mendukung perkembangan holistik anak sesuai dengan prinsip Montessori. Penelitian ini dilatarbelakangi oleh kebutuhan untuk merancang rak Montessori yang optimal di TK Graha Ananda, Kabupaten Bandung Barat, sebagai bagian penting dalam penerapan pendekatan Montessori pada pendidikan anak usia dini. Urgensi penelitian ini berkaitan dengan peran krusial prototipe rak Montessori dalam menciptakan lingkungan belajar yang mendukung kreativitas dan kemandirian anak. Tujuan penelitian ini adalah mengeksplorasi aspek visual dari prototipe rak Montessori, khususnya melalui penerapan variasi lengkung atau gelombang pada struktur samping kayu. Metode penelitian yang digunakan adalah kualitatif dengan pendekatan studi kasus, dengan menggali informasi mendalam terkait pengalaman dan persepsi pengguna rak Montessori di TK Graha Ananda. Teknik pengumpulan data meliputi wawancara dan survei lapangan, sedangkan analisis data menggunakan pendekatan deskriptif untuk merinci elemen visual serta efektivitas desain rak. Hasil

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penelitian ini diharapkan dapat memberikan kontribusi dalam pengembangan prototipe rak Montessori, meningkatkan kualitas pembelajaran, serta menjadi rujukan bagi lembaga pendidikan sejenis dalam menerapkan prinsip Montessori di lingkungan anak usia dini. Hasil penelitian menunjukkan bahwa desain rak melengkung tidak hanya meningkatkan estetika, tetapi juga meningkatkan keterlibatan dan kemandirian anak, sejalan dengan prinsip Montessori.

Kata Kunci: anak usia dini, Montessori, desain produk, desain rak.

INTRODUCTION

As part of Indonesia's national efforts to achieve the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), West Java Province, Indonesia faces challenges in providing adequate education for early childhood. Assessing the quality of early childhood development is recognized as essential for human development, emphasizing the need for accurate data to guide improvements [1]. According to the 2022 Early Childhood Profile published by Indonesia's Badan Pusat Statistik, only 37.6% of children in West Java is enrolled in early education institutes such as kindergartens (*Taman Kanak-kanak* or TK in Indonesian). The report does not provide assessment of quality provided by available institutes, and the author is not yet aware of a report which summarizes the current condition. On the level of kindergartens, Indonesia's central Ministry of Education only provide base guideline for educational requirements which then can be elaborated into various curriculum by individual institutions. For example, there are kindergartens that promoted Islamic curriculum, emphasizing Qur'anic studies and Islamic morale in addition to standard subjects. There are kindergartens with 'international' curriculum, which could either mean they adapted curriculum from overseas bodies or emphasize English as second language. This paper is a study case concerning a kindergarten that employs a Montessori method-based curriculum.

Graha Ananda Kindergarten is one of the early childhood education institutions located in West Bandung Regency, West Java Province, first established in 2001. As of writing, Graha Ananda Kindergarten has now begun to slowly switch their former curriculum to a new version inspired by Montessori method. This aligns with the institution's vision to create a learning environment that supports the holistic development of children. Administrators and teachers at Graha Ananda consider that Montessori method can better serve their vision moving forward. Amidst the complexity of the educational task, the Montessori method emerged as an innovative approach that promotes a deep understanding of the individual needs of children.

The background of this study was inspired by the need for the development of a learning environment that is more responsive to the characteristics of early childhood. Montessori emphasizes the role of the environment in motivating and guiding children to become independent and potential individuals. One obvious implementation of this method is the Montessori shelf prototype, which is expected to create a stimulating learning environment. This research focused on analyzing the visual aspects of Montessori shelf prototype at Graha Ananda Kindergarten, an early childhood education institution committed to applying the Montessori approach.

Existing studies often focus on Montessori practices in diverse global settings, but few specifically explore into the unique adaptations and implementations within Indonesian educational contexts. This scarcity makes any study addressing Montessori furniture such as shelves in Indonesian settings potentially novel. By introducing and analyzing the effectiveness of Montessori furniture such as shelf in local kindergartens like Graha Ananda, this study seeks to contribute new insights and practical applications in Indonesian early childhood education.

Hereinafter, such shelf will be called “Montessori shelf prototype” by the author. The shape and dimensions produced in the design process will be adjusted to the dimensions and layout of the room in Graha Ananda Kindergarten. The purpose of this study was to detail and explore the design of Montessori shelf in Graha Ananda Kindergarten, West Bandung Regency. This study aims to understand in depth the visual aspects of Montessori shelf prototype. Through an in-depth analysis of visual aspects, this research has the potential to provide valuable guidance for the development and refinement of Montessori shelf prototype in various educational institutions. The study aims to create a shelf that enhances the learning process by fostering independence and regularity, aligning with the core values of Montessori education.

METHOD

This research uses qualitative research methods with a case study approach. Qualitative research methods in general can be used for research on people's lives, culture, history, behavior, concepts or phenomena, social problems, and others [10]. Case studies are research approaches in which researchers conduct a study on a program, event, activity, process in one or more individuals in more depth. Graha Ananda Kindergarten is located on Jl. Graha Bukit Raya I No. 35, Cilame, Ngamprah District, West Bandung Regency, West Java 40552. This location is in a quiet and comfortable environment, suitable to support the learning process of children. The data in the form of text or theoretical studies are used as support in sharpening the results of the analysis to produce a Montessori shelf prototype that can increase early childhood independence in Graha Ananda Kindergarten.

Purposive sampling will be used in this study. The sample includes teachers at Graha Ananda Kindergarten and children aged 4-6 years who interact with the Montessori shelf. The duration of the observation is approximately one month, allowing for a comprehensive understanding of the interactions and the effectiveness of the Montessori shelf prototype. Detailed information about the kindergarten's location, classroom layout, and the nature of activities conducted will be provided in the results and discussion section or appendices to offer a clear context of the sampling method and study environment. Data collection techniques carried out are semi-structured interviews, documentation, observation, and literature studies.

1. Semi-Structured Interviews

Semi-structured interviews have been conducted with teachers at Graha Ananda Kindergarten to gather their views on the role of Montessori shelf in promoting early childhood independence. The teachers' perspectives will provide valuable information about their observations, challenges, and recommendations regarding Montessori shelf prototypes that suit the needs of Graha Ananda Kindergarten. The participants will include teachers who work with children aged 4-6 years.

2. Observation

Researchers have been conducted systematic observations of early childhood interactions with Montessori shelf during classroom activities over approximately one month. Observations will be guided by a structured observation protocol, capturing details of children's choices, involvement, and material use. The focus will be on students aged 4-6 years, and the observations will take place within the classroom environment at Graha Ananda Kindergarten.

3. Documentation

Researchers will collect documentation related to Montessori shelf prototype, such as photos and records of rotation and material presentation. This documentation will help in understanding the physical layout of Montessori shelf and the materials available to children. The classroom layout and atmosphere, as well as the arrangement of Montessori shelf, will be documented thoroughly.

4. Literature Study

A literature study will be conducted to collect relevant literature related to the research topic. This includes reviewing existing studies and theories on Montessori shelf prototype and early childhood education.

The data analysis process will follow a thematic analysis approach. Researchers will transcribe interview recordings, organize observation notes, and review documentation to identify recurring patterns and themes associated with Montessori shelf prototype and early childhood independence.

LITERATURE STUDY

Montessori education is an educational approach formulated by the Italian physician and educator, Dr. Maria Montessori, in the early 20th century. It rests on the basic principle of viewing children as inherently proficient learners who have an innate tendency to investigate and understand their environment [3]. The Montessori teaching technique, with its emphasis on developing an atmosphere that encourages the child's natural development and facilitates independent learning, champions the idea of cultivating an environment conducive to the child's growth [4]. Within Montessori teaching technique, the design of learning environments is essential in facilitating children's independence, exploration, and learning. The environment should be carefully structured to facilitate independent learning and encourage children's curiosity and instinct to explore. Important things to consider when preparing for a Montessori-style learning environment include order and organization, child-sized furniture and materials, freedom of movement, natural materials, and personalized learning spaces [5].

The Montessori method of education, widely recognized for fostering independence, creativity, and hands-on learning, relies heavily on the organization and accessibility of learning materials. The development of independence is one important aspect of early childhood development, as it allows children to explore and engage confidently with their environment [2]. By cultivating independence, children acquire fundamental life skills, including problem-solving, decision-making, self-help abilities, and self-regulation. This ability not only contributes to overall development but also prepares children for future academic and social success. Stimulation of independence in early childhood can yield many benefits, such as increased self-confidence, a sense of accomplishment, and a desire to always improve. In addition, independent children tend to be curious learners and are highly motivated, as they will take an active role in exploring the world around them [3].

The orderly and organized physical layout of Montessori style classrooms is necessary to create order for children. Child-sized equipment and materials are provided to enable children to access and use them independently, empowering them to take control of learning and foster ownership of the environment. Montessori classrooms are designed to allow an unlimited range of movement, thus allowing children to choose their activities and move freely around the space, which supports the development of motor skills and concentration. By creating an environment that aligns with Montessori teaching principles, children are encouraged to be active learners, taught to develop problem-solving skills, and build confidence through independent discovery and exploration [6]. Therefore, in this study, a shelf which supports Montessori teaching principles will be designed that can support the learning process by increasing independence in children through regularity [7]. Montessori education emphasizes independence, self-directed learning, and an orderly environment. The shelf is intended to support these principles by providing a structured and organized space for children to access educational materials independently [8]. By having a shelf that is well-designed and orderly, children can easily find and return materials on their own, promoting a sense of responsibility and autonomy. This regularity in the learning environment helps children develop organizational skills and independence, which are key components of

the Montessori approach. The study aims to create a shelf that enhances the learning process by fostering independence and regularity, aligning with the core values of Montessori education [9].

Montessori shelf, or low open shelf designed specifically for Montessori classrooms, play a crucial role in facilitating independent learning and exploration among children [3]. The shelf are strategically placed at child-height levels, allowing easy access to materials and promoting self-directed activities. However, there is a notable gap in the literature concerning the specific impact and design principles of Montessori shelf. The ideal shelf standard in a Montessori environment is one that supports children's cognitive and physical development through thoughtful design. These shelves must be low enough for children to access without assistance, with clearly defined spaces for each learning material [2]. The use of natural materials, such as wood, is emphasized to provide a sensory-rich experience that aligns with Montessori's emphasis on connecting children to the natural world. Moreover, the design should incorporate safety features such as rounded edges and stable structures to ensure a secure learning environment. Beyond functionality, aesthetic considerations also play a vital role in Montessori classrooms. Research suggests that visually appealing environments can enhance children's engagement and motivation; however, excessive visual stimuli may overwhelm their ability to concentrate, potentially hindering learning outcomes [10].

DISCUSSION

The Role of Shelving in Montessori Classrooms

One critical component in the Montessori classroom is the shelving unit, which not only serves as a storage space but also functions as an integral part of the learning process itself. Montessori shelves are typically designed to be child-accessible, fostering independence by allowing children to choose and return materials on their own. This autonomy is key to the Montessori philosophy, where children are encouraged to engage in self-directed learning activities. In recent years, there has been a growing emphasis on designing educational environments that support not only cognitive development but also sensory engagement, creativity, and motor skills. As a result, schools and educational institutions are seeking innovative furniture designs that cater to the developmental needs of children. The existing phenomenon reveals that traditional classroom shelves often fail to meet the specific needs of early childhood education. Standard shelves tend to prioritize storage capacity over accessibility and aesthetic appeal, limiting children's interaction with learning materials. These conventional designs lack the ergonomic considerations that are crucial for fostering independence and self-directed learning in a Montessori setting.

Design Principles for Montessori Shelves

In designing Montessori shelf prototype to increase children's independence in Graha Ananda Kindergarten, West Bandung Regency, design principles became the main foundation that guided the creative and functional process. First, the principle of affordability and accessibility underscores the importance of ensuring that children can easily access Montessori materials and tools placed on such shelf. The design should consider shelf height and material placement to match the level of early childhood physical development. Second, the principle of visual attraction and appeal emphasizes that Montessori shelf prototypes should captivate children's attention. The colors, shapes, and presentation of the materials should be designed to pique children's interest, stimulate curiosity, and provide a fun learning experience [11]. Thus, shelf design is not only a learning tool, but also a means of stimulating children's creativity and imagination.

Montessori-Based Furniture Criteria

Montessori-based furniture is designed with several key criteria in mind that fit the

principles of Montessori education. Here are some of the criteria that are important in Montessori-based furniture [9]:

1. **Affordability and Accessibility**
Montessori-based furniture should be easily accessible to children without the assistance of an adult. For example, low bookshelves or easily accessible storage areas.
2. **Child Size and Scale**
Furniture should be adapted to the height and body size of the children. For example, tables and chairs with the right height so that the child can sit comfortably and use the furniture independently.
3. **Materials and Safety**
The materials used must be safe and durable for use by children. Montessori-based furniture is often made from natural wood or other environmentally friendly materials that are non-toxic and do not contain harmful chemicals.
4. **Ease of Use**
Montessori-based furniture designs should make it easy for children to use and tidy up on their own. For example, easy-to-reach handles or clear labels to distinguish storage places.
5. **Facilitate Independent Learning**
Montessori-based furniture should support children's independent activities and exploration. For example, providing space for children to explore their own learning materials or do activities such as drawing or playing musical instruments.

Furthermore, the principle of material safety and durability emphasizes the need to use safe and durable materials. The design of Montessori shelf must ensure that the materials used do not harm children, both in terms of physical and health. Sustainability and material durability are also key considerations for shelf to be used for a long period of time, supporting the concept of sustainability in early childhood education. The principles of order and organization are other crucial aspects in Montessori shelf prototype. The design should facilitate the orderly preparation and organization of materials, promote the order and discipline of the child. This creates a structured environment while still giving children the freedom to choose activities and utilize materials in their own way. Lastly, the principles of flexibility and adaptability demand that Montessori shelf prototype can be tailored to the individual needs and development of the child [8]. Shelf should be designed to be altered or modified according to the child's personal development. This flexibility creates opportunities for children to learn independently, in accordance with the Montessori method which emphasizes developing each child's unique potential.

Application at Graha Ananda Kindergarten

Based on an interview with Yeti Sukmawati, the principal and educator at Graha Ananda Kindergarten in Bandung Barat on September 20, 2023, student activities are meticulously crafted to embody Montessori principles, emphasizing independence, exploration, and learning through hands-on experiences. The following details various activities conducted by students at Graha Ananda Kindergarten in line with Montessori principles:

1. **Free Time for Exploration**
Every day, students are given free time to explore the various materials and aids available in class. These materials are arranged regularly and within the reach of children, allowing them to choose activities that interest them. This activity helps develop independence and decision-making, two important aspects of the Montessori method.
2. **Practical Activities of Life**
Students engage in practical life activities such as washing hands, preparing snacks,

watering plants, and cleaning their environment. This activity not only teaches practical skills but also instills a sense of responsibility and respect for the surrounding environment. Children learn through hands-on experience and acquire essential basic life skills.

3. Sensory Activities

Sensory activities at Graha Ananda Kindergarten are designed to help children develop and perfect their senses. Students participate in activities such as grouping objects by texture, color, shape, and size. Sensory materials help children understand the world around them in a concrete and direct way, allowing them to develop a deeper understanding of abstract concepts.

4. Integrated Academic Learning

Although Montessori's primary focus is on experiential learning, academic activities such as reading, writing, and math are also integrated into the curriculum. The learning materials are tailored to each child's developmental level and presented through interactive and engaging tools. For example, children learn math through the use of colored beads and number boards, which makes abstract concepts more real and easy to understand.

5. Arts and Creativity Activities

Art and creativity have an important place in the Montessori curriculum at Graha Ananda Kindergarten. Children are encouraged to express themselves through various art forms such as drawing, painting, and making handicrafts. This activity not only develops fine motor skills but also provides an outlet for self-expression and imagination. Art in Montessori education is seen as an important way to develop children's creativity and confidence.

6. Social and Collaborative Activities

Social interaction and cooperation are also integral to the learning experience at Graha Ananda Kindergarten. Children often participate in group activities where they learn to work together, share, and respect each other. Activities such as group games, joint projects, and small group discussions help children develop important social skills, such as communication, empathy, and teamwork.

Through these activities, Graha Ananda Kindergarten applies Montessori principles effectively, creating a learning environment that supports the holistic development of children. Each activity is designed to develop independence, creativity, and social skills, while providing opportunities for children to explore and understand the world around them through hands-on experience [12]. In Montessori environments, furniture design must adhere to specific criteria that support the core principles of independence, order, and sensory engagement in children's daily activities. One of the main criteria is accessibility [8]. Montessori furniture, especially shelving units, should be child-sized, allowing children to access educational materials without the need for adult assistance. This promotes independence, as children can choose, use, and return materials on their own, which is a fundamental part of Montessori pedagogy. Additionally, ergonomic design is critical; furniture must be designed to fit children's proportions, ensuring that they can sit, stand, and work comfortably. Shelves and chairs should be lightweight and easy to move, enabling children to interact with their environment dynamically and to exercise autonomy in arranging their space.

Another essential criterion is order and organization. Montessori principles emphasize that children learn best in environments that are neat and orderly. Furniture design must provide clearly defined spaces for each activity or material, making it easy for children to understand where items belong. Shelves should feature well-organized compartments with visible materials that can be easily categorized and accessed. Moreover, the use of natural materials is emphasized in Montessori environments. Wooden furniture is often preferred due to its durability, tactile qualities, and connection to nature, which enhances the child's sensory experience. Safety considerations, such as rounded edges and stable structures, are also non-negotiable to ensure that the

furniture supports daily activities while minimizing risks during use. Overall, the integration of these design criteria ensures that the furniture is not only functional but also aligns with Montessori's educational goals of fostering independent, engaged, and orderly learners.

Analysis of the functional, likeness, and material aspects in the Montessori shelving design process is critical to ensure that the design is not only aesthetically appealing but also meets the functional needs of children in the learning process. In terms of function, Montessori shelf should be designed to support the development of children's independence and facilitate the use of Montessori materials. The height of the shelf, the location of the material, and the organization of the space must consider the level of physical and cognitive development of the children in Graha Ananda Kindergarten. The design should promote the accessibility of the material well so that children can easily achieve and develop their independence skills.

Visual aspects in design include aesthetics and visual appeal. The design of the shelf should consider the suitability of the kindergarten environment, create a child-friendly atmosphere, and stimulate their interest [13]. The use of bright colors and interesting shapes can provide the visual appeal needed to encourage children to interact with the shelf. The material aspect becomes a critical consideration in ensuring the safety, strength, and durability of the design. The materials used must be safe for children, free from hazardous materials, and easy to clean. Sustainability can also be a consideration by using environmentally friendly materials. In addition, durable materials will ensure that Montessori shelf can be used for long periods of time without suffering significant damage. In the overall analysis, the integration of aspects of function, appearance, and material is key to designing effective and attractive Montessori shelf [13]. A design that considers all these aspects will create a learning environment that conforms to Montessori principles and facilitates the development of children's independence in Graha Ananda Kindergarten, West Bandung Regency.

Design Aspect Analysis

Based on the results of an interview with Yeti Sukmawati, Graha Ananda Kindergarten in West Bandung on September 20, 2023, there are several things that need to be considered in designing a Montessori shelf prototype, the aspects discussed are then associated with the design aspects that need to be considered in product design according to Palgunadi, namely aspects of function, shape, material, color, and safety [14]. These aspects are then linked or associated with the implementation of Montessori principles in the process of designing furniture for early childhood. A description of each aspect can be seen in Table 1.

Tabel 1 Design Aspect Analysis. Source: authors

No	Design Aspect Analysis	Description
1	Function	Montessori shelf prototype has a very important use as a storage space for various educational props and toys at Graha Ananda Kindergarten. The main function of this shelf is to store and organize learning materials that will be used by children for a week. With its organized and easily accessible design, the shelf helps to ensure that all the necessary tools and materials are available and ready to always use. In addition to being a storage space, Montessori shelf also allow the rotation of educational props and toys according to the theme or learning activities that last for a week. This is important because the Montessori method emphasizes the variety and relevance of teaching materials according to the child's interests and development [3]. By doing this rotation, children will always have access to materials that are interesting and in accordance with the ongoing learning theme, so they stay engaged and motivated to learn.

2	Shape	The shape of the Montessori shelf is designed as a rectangle with curved accents on the left and right. This decision was based on interviews and discussions with teachers at Graha Ananda Kindergarten, which highlighted the need for aesthetically pleasing forms that attract the attention of early childhood. The use of curved accents on the left and right aims to add an aesthetic impression, create an attractive look, and stimulate children's interest and curiosity towards Montessori shelf prototype.
3	Material	Based on the results of an interview with Yeti Sukmawati, S.Pd., principal and educator at Graha Ananda Kindergarten in West Bandung on September 20, 2023, the use of wood materials with natural textures on this shelf adds to its visual appeal. Wood with a clearly visible grain pattern gives it a warm and inviting look. This natural material is also in line with the Montessori principle which prioritizes the use of natural materials, helping children to connect with their natural environment. The natural wood chosen must be strong and durable, and treated with materials that are safe for children.
4	Color	The use of natural wood is not only about aesthetics, but also about creating a welcoming learning environment and supporting children's development. The visible wood grain provides a texture that children can feel, adding an important sensory dimension in Montessori education. In addition, natural wood provides warmth that cannot be achieved with synthetic materials, creating a more intimate and comfortable atmosphere for children. According to her, the selection of this material also considers durability and safety. This ensures that the shelf can be used for extended periods of time without sustaining significant damage, while also reducing the risk of harm to children as they interact with the shelf. The curved design also reduces the risk of injury because there are no sharp corners that could harm children.
5	Safety	Safety is a top priority in designing Montessori shelf prototype. The design of the shelf should avoid sharp corners and use curved shapes to reduce the risk of injury. The materials used must be safe and harmless to children, as well as durable for long-term use. Additionally, the shelf must be stable and sturdy to prevent them from tipping over when children pick up or rearrange the materials on the shelf. These safety considerations ensure that children can learn and play freely without the risk of injury, supporting Montessori's principles of the importance of creating a safe environment and supporting optimal child development.

The table provides a comprehensive analysis of various design aspects of the Montessori shelf prototype at Graha Ananda Kindergarten. Functionally, the shelf serves as a crucial storage space for educational props and toys, facilitating organized access to learning materials that are rotated weekly to align with thematic learning activities. This approach not only supports the Montessori principle of providing varied and relevant materials but also enhances children's engagement and motivation in learning. The shape of the shelf, featuring curved accents, was selected to enhance aesthetics and attract children's attention, promoting a visually appealing environment conducive to early childhood education. Material-wise, the use of natural wood with visible grain patterns not only enhances the shelf's visual appeal but also aligns with Montessori principles emphasizing natural materials and sensory experiences. This choice ensures durability and safety, crucial for maintaining a conducive learning environment. Moreover, safety considerations such as avoiding sharp corners and ensuring stability underscore the commitment to child safety, reinforcing Montessori's emphasis on creating a secure environment that supports optimal child development. Overall, these design elements collectively contribute to a holistic educational environment that integrates functionality, aesthetics, sensory engagement, and safety in fostering children's learning experiences at Graha Ananda Kindergarten.

The Montessori shelf at Graha Ananda Kindergarten plays a pivotal role in fostering children's independence. Designed to be accessible, it allows children to independently select and return their educational materials. This promotes organizational skills and

responsibility, fundamental aspects of Montessori education [15]. The shelf serves not only as a storage space but also as a tool for developing critical life skills, aligning with current educational philosophies that emphasize self-directed learning and autonomy. The analysis of the Montessori learning model highlights its effectiveness in fostering children's character development and independence, key elements of personal growth during early childhood [16]. The Montessori approach encourages children to take charge of their learning environment, which aligns with the idea that a shelf can facilitate not just organization but also decision-making and problem-solving skills. By interacting with their surroundings and selecting materials from a well-organized shelf, children learn to make choices and develop a sense of responsibility, reflecting current educational philosophies that prioritize autonomy and self-directed learning.

In terms of design philosophy, the Montessori shelf prototype at the kindergarten embodies practical Montessori principles. It integrates considerations of function, form, material, and safety, reflecting a holistic approach to early childhood education [17]. By addressing these elements, the shelf supports cognitive development while ensuring a safe and aesthetically pleasing learning environment. Recent literature emphasizes the importance of such integrated design approaches in enhancing educational outcomes and child development [18].



Figure 1. Montessori Shelf Prototype. 2023. Source: Author

Prototype Implementation and Recommendations

The recommendations of the Montessori shelf prototype design results produced in this study pay close attention to the basic principles of Montessori in designing furniture. The main principle applied is accessibility for children. The shelf is designed to be of the appropriate height so that children can easily pick up and return the educational props or toys independently without the assistance of an adult. This is important because one of the main goals of Montessori is to encourage children's independence in their learning process [2]. In addition to accessibility, the design of this shelf also pays attention to the aspects of order and neatness. Montessori emphasizes the importance of an organized learning environment because it can help children understand and internalize order in their daily lives [5]. The shelf is designed with clear and organized compartments, allowing children to easily find and restore props in their place. This regularity helps reduce confusion and increase efficiency in the learning process [2]. Montessori shelf prototype could be seen on Figure 2.



Figure 2. Built Montessori Shelf Prototype at Graha Ananda Kindergarten. 2023. Source: Author

Regarding the mention of wood structures with curves or waves, it's noted that such design elements can contribute to a dynamic and adaptable appearance. These features are intended not merely for aesthetic appeal but also to facilitate children's engagement and exploration [19]. However, it's essential to clarify that while these design choices can enhance attractiveness and provide a softer aesthetic, the claim that they universally appeal to all users or significantly enhance attractiveness might be subjective. The incorporation of dynamic shapes aims to support diverse learning styles and promote a personalized learning experience [20]. The Montessori shelf prototype at Graha Ananda Kindergarten integrates contemporary design principles with educational theory, aiming to optimize learning environments for young children. While the inclusion of curved or wave-like structures may enhance aesthetic appeal and functionality, further research and empirical evidence are needed to substantiate claims regarding their universal attractiveness. This approach underscores the importance of evidence-based design in educational settings, ensuring that physical environments align with educational goals and support holistic child development. By paying attention to function, form, material, and safety, the Montessori shelf prototype at Graha Ananda Kindergarten is a practical embodiment of the Montessori approach philosophy. This design not only considers the needs of children in terms of cognitive development, but also aspects of aesthetics, environmental sustainability, and safety, creating a balanced learning environment and supporting early childhood development [3]. However, it is important to remember that aesthetic preferences can vary between individuals, and the effectiveness of these designs in appealing to all children may require further research [19].

CONCLUSION

This study shows that the shelf prototype design recommendations have successfully implemented the basic principles of Montessori. The Montessori shelf prototype at Graha Ananda Kindergarten effectively supports children's independence and engagement through accessible design, clear organization, and safety features, aligning with Montessori principles of fostering self-directed learning. To further enhance concentration and exploration, future design recommendations should incorporate ongoing feedback and empirical research to refine aesthetic elements and ensure the prototype universally meets children's diverse needs and learning styles. Clear and organized compartments help children understand the importance of order, which further supports efficiency in their learning process. This design that considers order also helps to create a structured and calm learning environment, in keeping with the Montessori philosophy that emphasizes the importance of an environment that supports concentration and exploration. Furthermore, this study also integrates design aspects according to Palgunadi, which emphasizes the importance of harmony between function and aesthetics in educational furniture. Safety is another major factor that is considered in the design of the shelf. All corners and edges are curved to reduce the risk of injury, and the material used is high-quality wood that is safe and durable. Thus, these shelves not only support children's cognitive and motor development, but also ensure that they learn in a safe and healthy environment. The sustainability of the materials used also demonstrates a commitment to sustainable practices, in line with Montessori values that

value harmony with nature.

In terms of aesthetics, the use of curved or wavy shapes on wooden structures is designed to attract children's attention and interest, as well as create a friendly and pleasant atmosphere. While this design is intended to stimulate children's creativity and exploration, its effectiveness in appealing to all children may be subjective and require further research. However, this dynamic design is expected to support a variety of learning styles and personalized learning experiences. Although these design recommendations have been implemented based on Montessori principles and the specific needs of Graha Ananda Kindergarten, the effectiveness of this Montessori shelf prototype design requires further analysis. Additional research is needed to evaluate how these designs affect children's engagement and development in the long term. In addition, it should be noted that aesthetic preferences and responses to the design can vary between individuals, so further research should consider various perspectives and user experiences to ensure that these designs truly meet the educational and developmental needs of the children at Graha Ananda Kindergarten.

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