

# Enhancing Elementary Students' Spatial Awareness Through Classroom Furniture Model-Making

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## ABSTRACT

Classroom designs in Indonesia typically follow government standards; however, regional variations in conditions and contexts result in diverse classroom shapes and layouts. This diversity can influence students' spatial understanding and familiarity with their learning environments. This study aims to enhance elementary school students' spatial awareness using 1:10 scale flatpack classroom furniture, designed from child-friendly materials and featuring components that students can assemble independently. This interactive approach allows students to explore and recognize the layout of their classroom through play and simulation in collaboration with teachers and peers. The research methodology included school and classroom observations, teacher discussions, creative experiments, and hands-on workshops with students. The study involved students from two elementary schools in different regions of Indonesia, representing various grade levels. The results revealed that students showed distinct

preferences for their work areas within the classroom, which contributed to their comfort and sense of attachment to space. These findings highlight the importance of involving students in activities that foster spatial awareness and territorial understanding. They also offer valuable insights for educators and school stakeholders to create more engaging and adaptive classroom environments. By integrating spatial learning into daily activities, schools can provide a comprehensive learning experience that supports students' cognitive and emotional development while fostering a stronger connection to their learning spaces.

**Keywords:** *Classroom Furniture, Elementary School Student, Model-making, Spatial Awareness*

## INTRODUCTION

A person's spatial awareness plays a crucial role in fostering their connection to the environment they inhabit (Scannell & Gifford, 2010). One environment where this concept can be applied is the educational setting in elementary schools. Students are expected to develop strong spatial awareness within the school environment to support their learning process. This ability enhances their sensitivity, particularly in the classroom, by helping them understand classroom orientation, entry and exit access, personal territory, the distance between objects, their proximity to peers, and much more. Classroom design in Indonesia generally follows government standards with conventional layouts (Anggraeni, 2017). However, variations in school sites, surrounding environmental conditions, and regional contexts lead to differences in classroom shapes and layouts. This diversity influences students' spatial understanding and their comfort during learning activities. Therefore, a method is needed to train spatial awareness for both students and teachers, fostering better environmental and social interactions in the classroom—this serves as the foundation for this research. The implementation of learning in elementary schools requires a conducive learning environment to support an optimal educational process. A well-designed learning environment not only facilitates the transfer of knowledge but also plays a crucial role in shaping students' cognitive, social, and emotional development. The physical and psychological conditions of the learning space influence students' ability to concentrate, engage, and interact effectively with their peers and teachers (Marchand et al., 2014). A conducive learning environment encompasses various factors, including classroom design, spatial organization, lighting, ventilation, noise levels, and the availability of appropriate learning resources. Comfortable and well-structured classrooms help students feel secure and motivated to participate actively in the learning process. Moreover, the arrangement of furniture, accessibility, and visual stimuli within the classroom contribute to the overall learning experience. In the context of elementary education, where students are in a critical phase of development, the learning environment should encourage exploration, creativity, and interaction. The integration of flexible and adaptive spaces allows students to engage in various learning activities that cater to their diverse needs and learning styles. Additionally, the role of teachers in managing and utilizing the classroom environment effectively is essential in fostering a dynamic and engaging learning atmosphere. Therefore, continuous evaluation and improvement of learning spaces are necessary to meet the evolving needs of students and to create an optimal foundation for lifelong learning.

Students gain spatial experiences from the moment they enter the school environment, beginning at the school gate, passing through the courtyard, walking along the corridors, entering the classroom, and finally settling into their designated seats. Throughout this journey, they encounter various elements such as school buildings, greenery, teachers, peers, murals, furniture, and other visual and tactile stimuli. These elements provide sensory information that is processed through their five senses, shaping their perception of the space around them. These spatial experiences become an integral part of a child's memory. If a student encounters enjoyable and stimulating environments, their perception of school will be positive.

Conversely, negative experiences can lead to an unfavorable association with the school environment. This perception is often formed not only through structured learning activities but also through play. Play, in its simplest form, is an activity that does not require direct guidance from others. Schools provide diverse opportunities for play, whether in designated playgrounds or informal spaces around the school, allowing students to explore, interact, and develop their spatial awareness naturally.

In Indonesia, formal education is predominantly conducted in a structured manner, both inside and outside the classroom, following a predetermined schedule. Classrooms play a crucial role in helping students acquire knowledge, skills, and values, which are the primary objectives of national education. According to the Ministry of National Education Regulation No. 24 of 2007, classrooms serve as spaces for theoretical and practical learning that do not require specialized equipment or can be conducted with easily accessible tools. The physical standards for classrooms include a maximum capacity of 28 students, a minimum area of 2 square meters per student, and adequate lighting to support learning activities while allowing interaction with the external environment. Despite adhering to standardized guidelines, public elementary school classrooms in Indonesia still exhibit variations in spatial orientation, desk and chair configurations, the number of openings, light distribution, and external views. (Satriaji et al., 2020). These differences influence both students' and teachers' spatial awareness in interacting with the learning environment. Therefore, it is essential to develop methods that enhance spatial awareness to create classrooms that foster a strong sense of place for their users.



**Figure 1.** Classroom configuration of Lebak Gede Elementary School, Sumedang, West Java, Indonesia.  
(Source: Satriaji, 2023)

The image above (Figure 1) illustrates a typical classroom configuration found in Indonesian public elementary schools, using Lebak Gede Elementary School in Sumedang, West Java, as an example. Elementary school classrooms generally share the following characteristics: (1) A blackboard or whiteboard is positioned at the front of the classroom as the primary focal point for learning, where teachers deliver lessons and conduct key instructional activities; (2) The teacher's desk and chair are placed at the front, usually on the left or right side, to facilitate supervision and classroom management; (3) Student desks and chairs, typically made of wood, are arranged in the center of the room. These desks and chairs are commonly organized in a structured grid pattern of rows and columns. The design of elementary school furniture plays a crucial role in supporting children's learning activities in the classroom (Walker et al., 2022); (4) Each classroom has windows on the left, right, or both sides, serving as a source of natural light. In some classrooms, windows are covered with paper to minimize distractions from outside activities; (5) Various educational materials and supporting elements are placed throughout the classroom. The walls serve as the primary space for displaying classroom essentials and learning aids. Commonly found items include posters of Indonesian national heroes, multiplication tables, illustrations of traditional houses, class schedules, and duty rosters. The development of classroom interior design in Indonesia is shaped by two key factors. First, the modernist paradigm has heavily influenced the organization of classrooms. This approach emphasizes a systematic arrangement, with formal distances between objects, creating a structured relationship between teachers and students. In this setup, both

teacher and student bodies are disciplined to follow the prescribed layout, which is viewed as essential for fostering productivity and enabling scientific progress. Second, the influence of state ideology plays a significant role. The government sees education to instill discipline and ensure obedience among citizens. As a result, schools function not only as places for academic learning but also as institutions that reinforce state power by imparting ideological values alongside scientific knowledge (Saidi et al., 2023).

Based on the conditions of elementary schools mentioned above, several questions arise: What if students were given the opportunity to explore the seating area they use in the classroom? What if they could simulate different seating arrangements? What if every corner of the classroom provided a unique experience, ensuring that no student felt disadvantaged by sitting in a less preferred spot? These questions form the basis for the idea behind the 1:10 scale flatpack classroom furniture design. Issues related to spatial arrangements can be addressed through various disciplines, one of which is interior design, which focuses on the relationship between humans and the spaces they occupy during different activities (Demirbaş, 2017). A classroom, or even the desks and chairs used by students, can possess a unique identity depending on how students and teachers utilize them. In the field of interior design, spatial identity is shaped by the integration of all elements within a space, including the ceiling, walls, flooring, furniture, colors, lighting, and more elements that are then interpreted uniquely by the space's users. This study focuses primarily on the furniture used by students in the classroom, specifically desks and chairs. These pieces are used daily for both structured and unstructured activities. In the context of a classroom, design plays a crucial role in supporting the learning process. When linked to design thinking, the stages of student learning include observing, questioning, gathering information, processing information, and communicating ideas. These learning stages will be applied through a simple model-making module that utilizes the classroom space and objects that students interact with daily.

This study aims to enhance the spatial awareness of elementary school students using 1:10 scale classroom furniture designed in a flatpack format. The furniture is made from child-friendly materials and consists of components that students can assemble themselves. This interactive approach allows students to explore and familiarize themselves with their classroom layout through play and simulation activities conducted with teachers and peers. Models or scaled-down representations are commonly used by artists, designers, and architects to convey ideas in a three-dimensional form, making them easier for others to understand. The research methodology includes school and classroom observations, discussions with teachers, creative experiments, and hands-on workshops with students. The study involved 63 students from two elementary schools in different regions of Indonesia, representing various grade levels. The findings reveal that students have diverse preferences regarding their workspace within the classroom, which significantly influences their comfort and sense of attachment to the learning environment. Additionally, teachers' active engagement in understanding and managing classroom space more dynamically plays a crucial role in improving the effectiveness of the learning process.

## LITERATURE REVIEW

Flat-pack furniture, also known as ready-to-assemble (RTA) or self-assembly furniture, refers to furniture that is sold in disassembled form and designed to be easily put together by the consumer. The concept is popular because of its cost-effectiveness, convenience in transportation, and ease of storage. Instead of purchasing a fully assembled piece, customers receive furniture parts, often in a flat box, along with instructions and the necessary hardware. The flatpack concept was first introduced in the mid-20th century by Swedish furniture designer Gillis Lundgren, who worked for IKEA. According to legend, Lundgren struggled to fit a table into his car and decided to remove its legs to make it easier to transport. This idea later inspired IKEA to market furniture in a flat-packed form, allowing customers to assemble it themselves.

The convenience of flatpack design is also evident in the way multiple furniture components are packaged together and accompanied by clear assembly instructions (Agustiano et al., 2018). The flat-pack furniture design produced can serve as a new interactive activity, allowing students to experiment with different desk and chair configurations in the classroom. By introducing design awareness from an early age, this approach aims to enrich and enhance the learning experience. The flat-pack desk and chair design considers opportunities for students and teacher involvement in assembling, engaging with, and implementing the furniture in a real school setting. Nowadays, children's play patterns have significantly changed compared to the past. They spend more time in front of screens, immersed in virtual worlds, which limits their interaction with nature and the physical environment (Kamal et al., 2024). This flat-pack design also serves as a medium to shift students' attention away from digital devices by engaging them in hands-on activities. Student engagement can be affected from various activities provided (Joyce et al., 2023). Interpersonal distance is a component for understanding the effects of seating arrangement in the classroom. The desk arrangement within the classroom is linked to the possibility of movement and interactions among students and with the teacher to the interpersonal distance between individuals. For example, the traditional row and column seating arrangement places students relatively far away from each other, compared to the cluster or "horseshoe" arrangements (Tobia et al., 2022). The significance and role of the environment in the process of elementary education is connected not only to the formal organization of the curriculum, but also to a great extent to the role of the participants in that process during their informal, leisure activities (Tanic et al., 2018). Although privacy is related to environmental control, it is also an environmental attribute believed to be related to the competence of young children. There are specific environmental characteristics that directly affect children's abilities to achieve privacy. The concept of privacy is central to understanding the relationships between the environment and behavior; it provides a key link among the concepts of crowding, territorial behavior, and personal space (Altman, 1975).

The ambient qualities of an educational space can be seen as a mediating factor not only in various forms of pedagogical activities but also in students' leisure activities. In this context, the potential impact of spatial changes—particularly at the classroom level—is examined in relation to how architectural characteristics of the immediate environment influence students' leisure experiences. Understanding the factors that contribute to high-quality classroom environments is an important endeavor (Sutton et al., 2021). We must not overlook the importance of any dimension of human activity and should recognize that every activity has spatial aspects, as it inherently involves movement and interactions with different types of space. The spatial behavior of school children can vary depending on the context in which it occurs, often displaying unique characteristics. Within the school environment, this behavior can manifest in different ways on both individual and collective levels. In relation to space, interactions can take place in the following forms: (1) an individual, (2) individual vs. individual, (3) a group, (4) individual vs. group, and (5) group vs. group. The formation of personal territory in an individual's spatial behavior is driven by fundamental needs for security and identity, particularly among younger school children. In the school environment, children instinctively claim or construct their own micro-spaces within the broader social setting, utilizing both fixed and mobile elements in their immediate surroundings. Fixed elements may include structural features such as pillars, the spaces between walls and pillars, parapets, staircases, stair railings, the gaps between desks, corners, niches, and built-in benches. Meanwhile, mobile elements, such as chairs, benches, shelves, and bulletin boards, allow for more flexible adaptation of space to suit their needs.

This spatial behavior is closely linked to specific activities that occur in various locations within the school. Children often establish these spaces not only as areas for studying and concentration but also as safe retreats where they can find solitude or escape from overwhelming social interactions. Different activities have different effects on place experiences. Activities observed in children's psychologically valued places tend to be more dependent on behavioral resources of the places (Min et al., 2006).

Additionally, these spaces serve as informal gathering spots for small groups of close friends, fostering social bonding and group identity. Furthermore, such personal territories often become settings for play, creativity, and exploration, allowing children to engage in imaginative activities that contribute to their cognitive and emotional development. Understanding how children interact with their physical environment and establish personal territories is essential in designing school spaces that support both individual and social needs. By recognizing the significance of these micro-spaces, educators and school designers can create more adaptable and inclusive learning environments that encourage both autonomy and social engagement among students.

## METHODOLOGY

This research is conducted through a creative-based approach aligned with the disciplines of fine arts and design. The methods used include observation, interviews, and creative experimentation, directly involving users to develop a product that meets their needs. The model produced will indirectly train students' spatial abilities by assembling and constructing an object according to given instructions, as well as enhancing their problem-solving skills. This innovative research is part of a socially driven study aimed at addressing contextual issues within the community (Wenzel & Babbie, 1994). The spatial elements highlighted in this innovative research are student desks and chairs within the classroom. Several stages were undertaken to identify the most suitable form, assembly method, and ultimately develop an appropriate design. The goal is to train and introduce students to a heightened awareness and sensitivity toward the furniture and classroom environment they use daily.

### Data Collection and Field Survey

The collected data includes children's characteristics, the types of furniture used in schools, child-safe plastic materials, and various classroom model designs. This data was gathered through direct field surveys as well as references from standard books, journals, and digital media. The selected locations were SD Negeri Lebak Gede, Tanjungsari, Sumedang, and SDN 031 Pelesiran, Bandung, West Java. These schools were chosen because they are public schools with intriguing potential in terms of location and resources. The study involved 4th to 6th-grade students, considering their cognitive maturity in processing spatial concepts. Additionally, both schools were willing and open to the implementation of this research.

### Determining Design Criteria and Concept

The design criteria for the model were developed by considering several key aspects, primarily the characteristics and behavior of children as users. Another important aspect was ensuring that the component shapes and assembly process were easy to understand for elementary school-aged children. Additionally, the selection and use of materials had to be safe, non-toxic, and suitable for children. Practicality in packaging and mobility was also considered. Furthermore, the design needed to incorporate elements of challenge and entertainment, as children naturally possess a high level of curiosity. More detailed criteria can be found in the table below (Table 1).

**Table 1. Design criteria and consideration**

Criteria	Description	Contents
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Dimension	The product is designed to be lightweight, easy to carry, and conveniently packaged. It has dimensions that are neither too large nor too small, making it practical for use.	The dimensions of the flat-pack furniture design are kept compact so that it can be assembled on each student's desk. 10,5 x 14,8 x 0,3 cm (A6) Postcard size
Shape and form	The components of the school desk and chair are arranged in flat sheet form, allowing them to be assembled into a three-dimensional model of desk and chair.	The components are divided into main components and supporting components to ensure functionality and flexibility in assembly. The main components of the desks and chairs can be assembled from 2D into a 3D shape of furniture at scale 1:10.
System	The design follows a flat-pack system, where each piece can be put together to form a functional school desk and chair. Each component includes box-shaped joints that fit into corresponding slots, ensuring a secure assembly.	Students can assemble the desk and chair modules following the given instructions and then place the supporting components according to their preferences.
Material	The product must be made from child-friendly materials, as it is intended for elementary school students. It was created using 3D printing and the prototype is constructed using PLA+ material.	The prototype is created using 3D printing technology with PLA+ filament, which is child-friendly, non-toxic, and classified as a safe food substance.
Color	Bright colors are incorporated to align with children's characteristics	The colors used are currently limited to those available in the filament. Some of the colors that have been tested include black, white, gray, orange, and pink.
Age	Usable for children ages 9 and above	This design uses many small components that could be swallowed by children under the age of 9.

The concept behind this design is to create a product that students and teachers can assemble themselves (DIY), encouraging creativity among students. The assembly process helps develop students' motor skills by practicing hard skills such as cutting, gluing, attaching, and composing objects. The play process is designed to be as simple as possible, inviting students to engage in hands-on activities. So far, assembling objects has rarely been practiced in schools.

## Form Ideation

The primary forms to be designed are elementary school desks and chairs. Various models and styles of desks and chairs used in elementary schools have been observed and documented. The most suitable and representative designs were selected and then sketched manually in different versions. The next step was to break down the desk and chair structures into individual components while considering how each part would connect.

## Modelling

The modeling process utilizes the SketchUp 3D digital software to translate the chosen desk and chair components into a detailed design. The models are created at a 1:10 scale, meaning the final product



will be ten times smaller than the actual furniture. This scale is considered ideal for student use while also optimizing material efficiency in each module.

## Prototyping

Prototypes are manufactured using a Creality K1 3D printer, an award-winning industrial design device recognized with the 2024 Red Dot Award. The expected outcome requires high precision, as the design incorporates an assembly system. The filament material used is polylactic acid (PLA), known for its durability, resilience, and eco-friendly properties.

## Assembly Testing

Assembly tests are conducted to evaluate the precision of the flat-pack furniture modules, focusing on the joints between components. The initial assembly tests are performed by the development team. After multiple trials and refinements, the team successfully finalized a design that meets all criteria. The initial assembly is intended to be tool-free, without the need for adhesives.

## Student Workshop

This stage engages students and teachers in a hands-on workshop. Students are invited to assemble the models and place supporting components according to their preferences. The outcomes are analyzed to identify trends in students' workspace preferences at school. This also provides insights into their preferred configurations and interactions with the designed objects.

## ANALYSIS AND FINDINGS

The design of desks and chairs used in elementary schools varies widely, including single-student desk and chair sets, two-person desk and bench models, and more modern designs (Figure 2). The primary materials used for desks and chairs in public schools are mainly wood and aluminum. Meranti wood is commonly used, providing a sturdy and durable structure, though it is heavier compared to fabricated aluminum desks and chairs. While aluminum furniture is lighter, it often appears less robust when handled.



**Figure 2.** Several models of student desks and chairs used in elementary schools include the single-seater model (left), the long bench model (middle), and the aluminum-based model (right)

*(Source: Satriaji, 2024)*



The desks and chairs used in schools were then translated into scale models at a 1:10 ratio, with a focus on wooden desk and chair models. This model was chosen not only because of its simpler design but also because it is the most widely used in public elementary schools across Indonesia (Figure 3). Measurements were first taken to obtain valid dimensional data. The process of translating real objects into digital data required several size and detail adjustments to achieve the right proportions while maintaining similarity to the original form. Some shape adjustments included simplifying the desk and chair corners, rounding the edges of each object, and modifying the leg structures of both objects to facilitate easier assembly.



**Figure 3.** Student desks and chairs made of meranti wood  
(Source: <https://e-katalog.lkpp.go.id/>)

The chosen design is a single-seat desk and chair set, allowing each student to have their own personal workspace. The desk and chair are designed to be simple yet functional. The chair has a rigid and upright structure, featuring a backrest that supports the student's posture during learning activities. Additionally, the backrest is often used by students to hang their bags. To ensure stability, the four legs of the chair are reinforced with support structures to keep it sturdy during use. Meanwhile, the desk is equipped with a drawer underneath, serving as a storage space for bags and stationery. The standard dimensions of the desk and chair can be seen in Table 2.

**Table 2. Student chair and desk dimension standard**

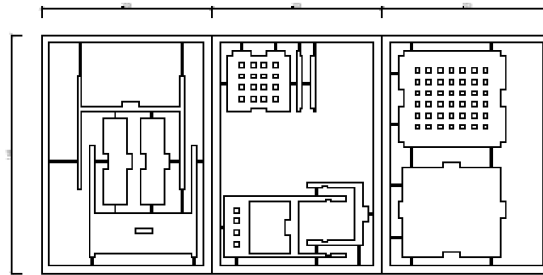
Furniture	Dimension (cm)		
	Length	Width	Height
Single desk	60	55	65-71
Double desk	120	55	65-71
Chair	38	38	40-44
Bench	120	38	40-44

The selected desk and chair models were then broken down into separate components. The classroom chair model consists of five components: the backrest and rear legs, the front legs, the seat, the right leg support structure, and the left leg support structure. The seat and backrest feature a perforated grid with 3.5 x 3.5 mm square holes. These holes allow for the attachment of additional supporting objects to the model or for assembling the flat-pack furniture onto a special base. The seat contains 16 holes, while the backrest has only four holes, all of which can be used by students to explore creative possibilities. The desk model consists of six components: the front legs, the back legs, the left side panel, the right-side panel, the tabletop, and the drawer cover. The tabletop includes holes to facilitate the placement of items on the model desk. Each component is arranged into a frame the size of a postcard.

The configuration of all the desk and chair components requires three postcard-sized sheets, carefully arranged (Figure 4). Component placement considers several factors:

- No overlapping components.
- Clear distinctions between parts and connections to prevent incorrect cuts.
- Avoiding assembly errors that could make the model impossible to put together.

Using a postcard-sized frame makes the product portable and suitable as a school souvenir. However, as of this writing, packaging design has not been fully addressed. The recommended packaging should be simple yet appealing to students. The package should also include clear assembly instructions in both text and illustrations, using isometric projections with labeled components for easy understanding.



**Figure 4.** Initial configuration of desks and chairs in flat-pack form  
 (Source: Satriaji, 2024)

Based on the above configuration, the main components have been placed according to the criteria. There is still some empty space that can be utilized. This empty space provides an opportunity to add additional supporting objects around it. The process of adding supporting objects into the gaps between the products was not done arbitrarily. The team felt it was necessary to directly listen to the opinions of the users, namely elementary school students. Therefore, we asked elementary school students what objects they would most like to have around their desks in the classroom. Students were asked to fill out a questionnaire with the following question:

*"Please list 3-5 objects you would like to have in your classroom, especially around your desk."*

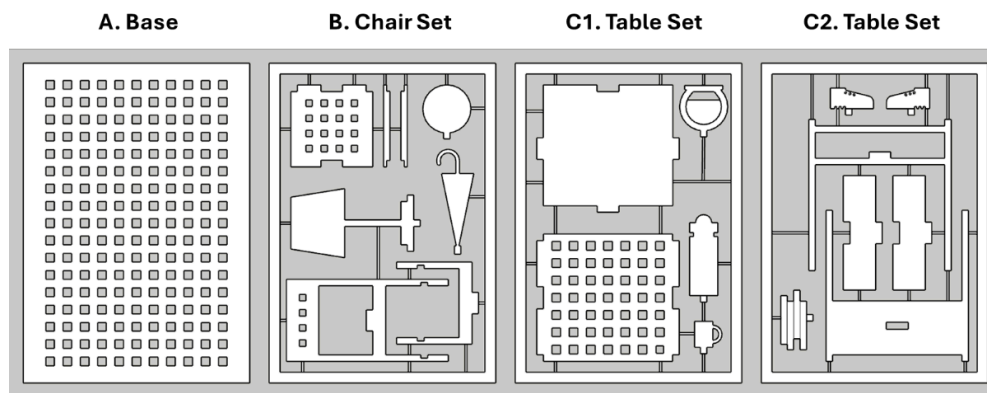
The answers were open-ended without any guidance, aiming to understand students' perspectives on their needs in the classroom (Figure 5).

Classroom Object Recommendation																																											
Cupboard	Desk	Chair	Sofa	Pillow	Blackboard	Information board	Math Poster	Mirror	Decorative	Balloon	TV	Shoe shelf	Books	Ruler	Eraser	Art tools	Skeleton	Laptop	Ball	Badminton	Table Tennis	Doll	Bicycle	Slides	Swing	Light	Pond	Bird cage	Flower pot	Watch	Picture	AC	Fan	Wifi	CCTV	New paint	Window	Door	Roof	Duster	Wash cloth	Trash bin	Broom
12	9	47	9	1	4	3	6	9	31	6	13	5	13	3	4	5	1	4	43	10	2	10	12	7	2	31	7	5	37	26	23	4	9	0	1	7	14	3	0	1	1	6	11

**Figure 5.** Students' opinions regarding objects in the classroom  
 (Source: Satriaji, 2024)

There were 63 elementary school students who responded to this question. The data visualization presents student recommendations for classroom objects, gathered through participatory activities aimed at enhancing spatial awareness. The results show that the most frequently suggested items were essential learning tools, such as chairs (49 votes), desks (47 votes), whiteboards (44 votes), skeleton models (43 votes), and laptops (43 votes), indicating that students prioritize the core components of their learning

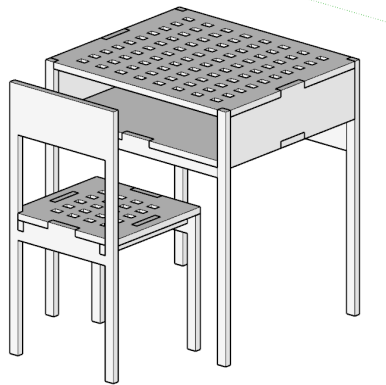
environment. Additionally, items like books, rulers, and projectors were moderately recommended, suggesting an awareness of functional and academic needs. Interestingly, students also proposed a range of playful and comfort-oriented elements, including slides (25 votes), swings (31 votes), ponds (31 votes), and pictures (23 votes), reflecting a desire for classrooms that support both learning and emotional well-being. Some unconventional suggestions, such as balloons, dolls, and table tennis equipment, further highlight the importance of incorporating informal, recreational features into classroom design. On the other hand, practical infrastructure elements like Wi-Fi, doors, dustbins, and washcloths were among the least mentioned, possibly reflecting students' limited exposure to or prioritization of such features. Overall, the findings underscore the capacity of students to critically reflect on and articulate their preferences for classroom design, supporting the need for more dynamic, flexible, and student-centered learning environments. For the final design, we included some student's choices, as examples, ball, table lamp, umbrella, aquarium, tumbler, mug, shoes, etc (Figure 6).



**Figure 6.** Final design result  
(Source: Satriaji, 2024)

### Flat-Pack Classroom Furniture Model

The components were then assembled and simulated into a 3D representation of the desk and chair (Figure 7). The image depicts a 1:10 scale flat-pack model of a student desk and chair, designed as part of a spatial awareness activity for elementary school students. The model features a minimalist and modular construction, with interlocking joints that allow for easy assembly and disassembly. The top surfaces of both the desk and chair include a perforated grid pattern, which serves both aesthetic and functional purposes—providing visual cues for spatial alignment and offering opportunities for students to personalize their model with accessory elements. This model was utilized in the study to encourage students to critically examine their classroom environment by reconstructing their personal seating area. Through this hands-on activity, students were able to reflect on their spatial preferences, comfort, and daily interactions within the classroom. The simplicity of the design supports ease of use by children while maintaining fidelity to the actual classroom layout. Additionally, it fosters creativity and discussion by enabling students to modify and compare their models in group settings, thereby enhancing their spatial understanding and sense of ownership over their learning environment.



**Figure 7.** Digital simulation of the assembly process  
(Source: Satriaji, 2024)

### Findings from Workshop Implementation

The subsequent phase of the study involved direct testing with both students and teachers. During this stage, students were invited to participate in several parallel activities, including completing a visual questionnaire, drawing on a whiteboard, and constructing a model of their desk and chair area. Prior to the activities, the research team introduced themselves and organized the students into groups. The session was conducted with the support of the class teacher, who served as a facilitator throughout the workshop. The results indicated that fifth and sixth-grade students were capable of effectively identifying both the primary and supporting elements of their classroom environment—such as the physical layout, the types of furniture used, and specific features that contributed to either comfort or discomfort. In addition, students demonstrated the ability to envision and communicate their ideal classroom settings, expressing their ideas both verbally and through visual representations. Their responses reflected a capacity for critical thinking regarding their learning environment.

The workshop progressed smoothly, with students actively participating and asking questions whenever clarification was needed. The outcomes aligned with expectations: students provided objective, insightful feedback about their current classroom conditions and offered creative, forward-thinking suggestions for improving the learning space—often proposing ideas that went beyond conventional norms.



**Figure 8.** Students assembling the design with their peers  
(Source: Satriaji, 2024)

The activity received positive responses from both students and teachers. The classroom teacher noted that they had never previously conducted a similar activity, particularly one that engaged students in exploring and reflecting on their seating area. Although all students worked with the same flat-pack model, none of the outcomes were identical—demonstrating the uniqueness of each student's spatial preferences. Based on the research findings and the outcomes of the implemented design, several key conclusions can be drawn:

**Standardization vs. Student Needs:** While public elementary school classrooms in Indonesia generally adhere to government-mandated standards, implementation varies widely across schools. These standards often fail to accommodate students' natural curiosity and sense of spatial ownership. Students are typically required to use classroom spaces as they are, with limited opportunity to personalize or express territorial preferences. However, students do possess individual perceptions and ideas about how to make their classroom environment feel more personal and meaningful (Satriaji et al., 2025).

**Enhancing Spatial Awareness through Scaled Models:** The 1:10 scale flat-pack classroom furniture design serves as an effective medium to foster students' spatial awareness, particularly in relation to their own seating areas. The inclusion of customizable accessories allows for creativity and facilitates communication and comparison among peers, teachers, and even parents.

**Practical Application for Teachers:** For educators, this model can be utilized as a recurring activity at the beginning of each semester to gain insights into students' seating preferences. Additionally, it can inform teaching strategies that make more effective and intentional use of classroom space.

**Scalability and Contextual Adaptation:** The flat-pack classroom furniture model holds potential for further development. Its adaptability to the unique contexts and needs of different schools may enhance its effectiveness in promoting spatial understanding and student engagement.

## CONCLUSION

This study emphasizes the importance of active participation by both students and teachers in activities that enhance spatial awareness and territorial understanding within the learning environment. The flat-pack desk and chair model has proven to be an effective tool for helping students comprehend spatial concepts such as directional orientation (front-back-left-right), distance, social interaction, and personal preferences regarding seating arrangements in the classroom. These findings offer valuable insights for educators and school stakeholders in designing more dynamic and responsive learning environments. For teachers, this model can be implemented as an introductory activity at the beginning of each semester to identify students' seating preferences and serve as a reference for developing teaching strategies that actively engage with classroom space. Students' varying perceptions of their school environment, partially shaped by habits formed within family life, reflect the significance of balancing structured and open physical spaces. This balance supports both formal and informal social interactions, accommodates diverse needs, facilitates specific behavioral patterns, and enables a wide range of student activities. In contrast to traditional elementary school architectural models, the current approach shifts toward creating dynamic and adaptable learning spaces. It emphasizes spatial boundaries that are fluid, clearly defined yet not restrictive, providing students with greater flexibility in their learning experiences and overall engagement. By integrating spatial learning into daily activities, schools can offer a more holistic educational experience that supports students' cognitive and emotional development while strengthening their connection to the learning environment.

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