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WHAT CAN YOU DO WITH BOXES? CONSTRUCTING BOXES AND THEIR SURFACES INTO A SPATIAL SYSTEM TO SUPPORT CREATIVE LEARNING

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ABSTRACT

This paper addresses the challenges in developing design ideas that can promote creativity in primary school children's learning environment. The findings of the study illustrate how boxes, as simple three-dimensional objects, can be constructed into a system that offers various possibilities for enhancing learning activities. The possible arrangements of boxes and the possible utilization of their surfaces were investigated through a series of creative workshops with children in which they explored different ways of constructing the arrangement of boxes and using them for their activities. The possibilities offered by the arrangement of boxes and their surfaces indicate the importance of understanding the presence of objects in space not as independent entities but as a part of the whole spatial system. It is suggested that, essentially, the learning environment needs to be designed as an integrated system of learning spaces and objects that together can promote creative learning.

Keywords: Creativity; Design; Learning environment; Spatial; System of objects

1. INTRODUCTION

Creativity is an important aspect of today's education. Creativity fosters learning as it includes many components beneficial to learning, such as imagination, originality, productivity, problem solving, and "the ability to produce an outcome of value and worth" (Sharp, 2004). In the effort to promote creativity, developing an environment that is conducive to creativity is essential. It is important to explore how creativity can be promoted in everyday learning environments, especially in schools.

It is important to consider the extent to which the physical environment contributes to learning process. The learning environment should not be seen merely as a "container" for social interaction, exploration and learning, but should also be seen in terms of educational "content" in the forms of educational messages and learning stimuli (Gandini, 1998). In relation to the creative learning process, the learning environment needs to be designed in such a way that it includes various stimuli for creativity. The school environment can promote creativity by providing stimulation in the form of ideas, experiences, materials and resources with emphasis on ideas (Joubert, 2001). Also, the physical environment itself can serve as a medium for displaying the children's creative works in various forms (NACCCE, 1999).

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The learning process is supported by the various elements of the environment from school buildings, classrooms and other learning spaces in the building to various objects that are present in the learning spaces, including furniture and other items. According to Reggio Emilia, it is important that the presence of these spaces and objects are considered in their entirety as meaningful learning resources; in other words, as "the third teacher" in the learning process (Gandini, 1998).

However, from the point of view of spatial design, it is challenging to develop a learning environment by integrating spaces and objects as complementary elements for learning, especially for the creative learning process. The architectural design and construction of a school involves various elements of buildings and spaces, and the furniture and other objects should be complementary to the overall plan. All materials and tools for learning, as well as all elements of the spaces and buildings, should be carefully chosen, designed and arranged to promote learning (Gandini, 1998). Further, the design and construction of school furniture and ancillary objects should be consciously integrated into the configuration of classroom spaces in order to cater for different needs, tasks and topics of learning (Edwards, 2005; Steelcase, 2010).

2. CHALLENGES OF DEVELOPING INNOVATIVE DESIGNS FOR LEARNING

The current condition of primary school facilities in Indonesia, especially in state schools, indicates the lack of understanding about the importance of physical spaces and objects for creative learning. Our observations in some primary schools suggest that the space layout and school furniture are not yet conducive to creative learning needs. The classroom usually consists of an array of chairs and desks with the teacher's desk in front, and it is hard to rearrange them for dynamic learning activities due to the heavy weight of the desks. The students are forced to sit in this array of chairs and desks, or tables, throughout the school day.

Storage spaces and shelves tend to have ergonomically inappropriate dimension for primary school children. There is little evidence of any supporting tools for creative learning. In addition, it is rare for lockers or personal storage to be provided and, if they do exist, are usually used for books and exam papers. Further, the media and venues available for students' creative expression are highly limited, and interaction between students is rare.

Generally the "design of learning spaces in formal education has traditionally been restricted by complex building regulations and procurement procedures" (Beard & Wilson, 2006,). Indeed, in Indonesia the procurement activities of facilities and of items for the learning environment tend to be conducted separately. The construction of school buildings, the procurement of school furniture and the procurement of learning media and facilities are each dealt with by separate programs. In addition, the procurement of school facilities tends to be restricted to certain types and models prescribed by the government standard. And there is not enough flexibility for schools to use alternative forms of learning facilities, tools or equipment.

This situation suggests that there have not yet been enough attempts to promote the development of creative and innovative design of school spaces and facilities, which has resulted in dull and less innovative learning environments. Innovation in the development of learning spaces and objects for creativity is critical. The purpose of this paper is to illustrate the possibility of innovative ideas in transforming ordinary three-dimensional objects into the tools for creative learning.

In particular, this paper investigates the spatial characteristics of boxes (or cubes) and their potential to be constructed into a system that could generate various possibilities for creative learning activities. This paper is based on a series of creative workshops that were conducted with primary school children in Depok, West Java, Indonesia, during which the children explored the possibilities presented by using the boxes as three-dimensional objects. The

findings from the children's workshops will be elaborated further to reveal how the ideas of boxes as learning tools might be relevant to the broader issues of designing and constructing a spatial system for promoting a creative learning environment.

3. INVESTIGATING BOXES AS TOOLS FOR CREATIVE LEARNING

The children's workshops were based on the idea of elaborating on the use of boxes as simple three-dimensional objects. There were two kinds of workshops involving fourth and fifth grade primary school children, who were divided into several groups to accomplish several creative tasks using the boxes. The first workshop investigated the process of constructing various arrangements of boxes and how, for various activities, the children could utilize the arrangements for creative learning. The second workshop investigated in more detail how the surfaces of boxes could be utilized for various creative learning activities. The workshops were facilitated by a group of interior architecture students, whose roles were to encourage the children to both think creatively and to explore as many possibilities as possible with the boxes.

3.1. Investigating the Configuration of Boxes as Learning Tools

The first workshop was aimed at exploring possibilities offered by different configurations of boxes for different learning-related activities. In this workshop, the children were given a number of cardboard pieces that were ready to be constructed into boxes sized approximately 40 cm × 40 cm × 40 cm. The workshop began with the children working together to construct the boxes. Each child was responsible for constructing a box, resulting in approximately five to six boxes from each group of children. Some boxes were complete with six sides while others had only five sides with one side being left open.

Once the boxes were ready, the children were asked to explore various possibilities in creating different configurations of the boxes. They might stack the boxes on top of one another, arrange the boxes horizontally, or mix both vertical and horizontal configurations. The configurations might consist of only two, three, four or more boxes. After they explored the different possible configurations of boxes, the children explored various actions or activities that they could enjoy with those configurations.

The children were able to construct various configurations of boxes and to discover various possibilities for using them for activities. Some configurations could be used to support certain static bodily positions such as sitting, studying or writing. Meanwhile, other configurations encouraged active body movements; positioning the boxes in line and walking along them, positioning the boxes in certain distances and running through the gaps, or positioning the boxes as stepping surfaces. Some configurations triggered the children's creative imagination: imagining riding on a train, imagining crawling under a bridge, and so on. Some of the configurations indicated the use of the boxes surfaces (for sitting on, standing on, or stepping on), while others utilized the space inside the boxes (for sitting in or putting things into). Figure 1 illustrates the various activities that the children performed with the boxes. These possibilities suggest that the different configurations of boxes could be used for various possibilities.

Figure 1 Various actions and activities using different configurations of boxes

While conducting their exploration, the children were asked to make collages to document the different configurations of boxes that they constructed. The collages were created using different colored squares arranged on a piece of white paper to represent the configurations of boxes, accompanied by drawings of how the arrangements were used. Figure 2 illustrates the collages created by the children to show these possibilities.

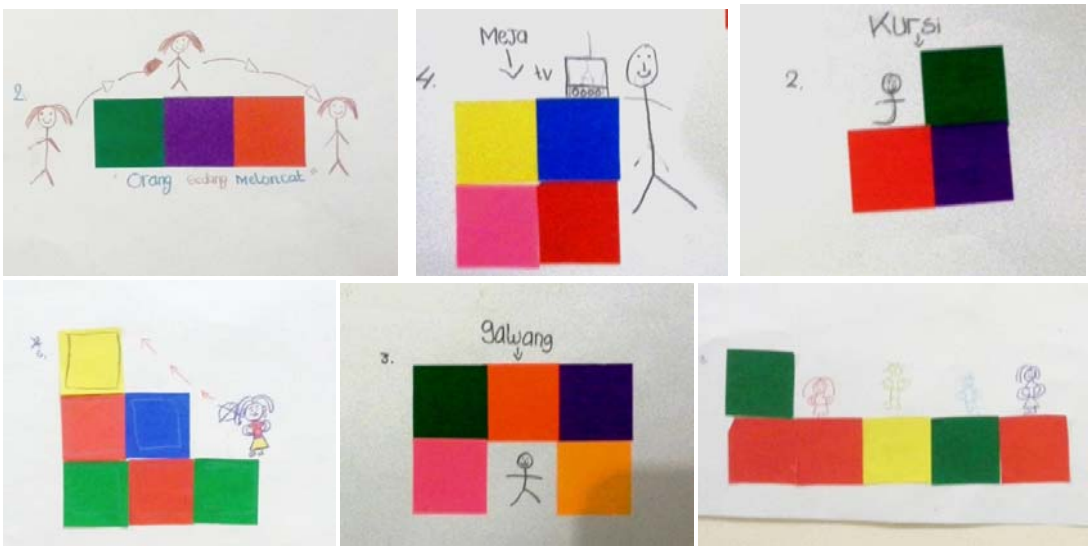

Figure 2 Children's collages reflecting possibilities of boxes for various activities

3.2. Investigating the Possibilities of Box Surfaces as Learning Tools

The second workshop was aimed at exploring the possibilities for using the surfaces of the boxes. In this workshop, the children were again provided with a number of cardboard boxes, except that this time the boxes had two different kinds of surfaces - plain surfaces and surfaces with holes. Similar to the boxes in the first workshop, some boxes had six sides while others were only five sided. The students were then presented with a series of tasks to complete by using the different features of the box surfaces.

The first task was to measure body height; the children stacked the boxes on top of one another and used the surface to measure their height. The second task was to display their drawings. The children created some drawings and then discussed how they could use the surfaces to display their creations; for example, by hanging the drawings by sticking them on the box surfaces. The third task was to use the surface of the boxes as surfaces for drawings. The students traced their bodies on a box surface and then mixed and matched the drawings of heads, bodies and legs by exchanging the drawings of different persons. For the fourth task, the children were required to classify various objects in the classroom into groups, using the boxes to organize the objects. Each type of object was put into a different box. For the final task, the children used the box surfaces with a series of holes in them to create patterns using colored threads.

All these activities provided opportunities for the students to explore several possibilities for using the box surfaces for various activities in which they could learn certain skills or knowledge. The resulting possibilities for using box surfaces are illustrated in Figure 3.

Figure 3 Various possibilities of using box surfaces

4. DISCUSSION

4.1. Constructing a Learning Environment as an Integrated Spatial System

The workshop activities described above illustrate how using boxes, for either their surfaces or as simple three-dimensional objects, can be constructed into a system that provides opportunities for various learning activities. Baudrillard (1996) introduced the concept of a "system of objects" that consists of objects as "components" and requires "joints" and "assembling" to achieve the multiple functions that the system offers. The construction of the boxes as a learning support system depends on assembling and using them in various ways, thus creating multiple possibilities of function through one system.

This system is formed by relationships, particularly relationships among objects. An object is not necessarily perceived on its own but as a part of a sign value system, with the object possessing a particular value within the system. "The rest of the story provides a glimpse of the function of such an object/sign system: far from symbolizing a relationship, these objects are external to it in their continual reference" (Baudrillard, 2001). This reference provides meaning to the objects as their users share information and perceptions about the objects, thereby creating a 'language' of reference.

In order to exercise the language of reference/ideas, identification of the system through relationship is important. The identification of the system requires the ability to relate to recognizable elements of the system (Ceppi & Zini, 1998), especially for children. Additionally, children must relate to and utilize other elements in the school's spatial setting. The setting must be flexible enough to manipulate and transform the environment for learning purposes, including the adjustment of horizontal hierarchies between spaces as well as the creation of spaces that foster discovery and experimentation (Ceppi & Zini, 1998). These relational forms – the system and the setting – promote the language of ideas that the learner needs in order to access the system of objects and use it to construct a diverse, creative learning environment. Indeed, the language of ideas acquired and exercised by the children in the workshops allowed them to use the boxes holistically rather than for a single purpose. Further, the children's creativity in using the boxes for various activities indicates the possible construction of a system of objects that is meaningful for creative and imaginative learning.

For the object to be recognizable, its affordances must be perceived. Affordances are what the environment offers, provides and furnishes to the users that imply a complementary relationship between the users and the environment (Gibson, 1986). In addition, "They are not just abstract physical properties, they have unity relative to the posture and behavior…" (Gibson, 1986). The environment is perceived by the users through the properties of its surfaces and how those surfaces relate to the performance of particular activities by the users' body. For example, if a surface is knee-high to the children and flat, it can be perceived as a surface for sitting. In addition, if there is another flat surface below that surface, it can be used as a place for storage of books or other objects, or for resting the feet.

The element of affordance indicates certain uses for the surfaces, such as arranging materials to encourage exploration or experimentation. Creating recognizable elements may also drive the understanding of a system of objects, enabling the learners to perceive the various possibilities for different affordances. For example, placing two boxes together enables more children to gather and discuss. Two boxes placed together create a recognizable long surface to sit on and demonstrates the relationship of the boxes as a part of the creative learning environment.

4.2. Flexibility and Modularity as Elements of the Learning Environment

A system of objects is "founded by disposition and play" (Baudrillard, 1996) of the objects and is depends solely on its user to exercise the flexible relationship between the objects. Flexibility is increasingly important in today's learning because "learning is hands on and project based" (Loeffelman, 2007). Different activities of learning require different environments which forces change on how we see the furniture. "A change of layout due to complex forces refers to any alteration of the shape of the surfaces of the environment, including the repositioning of detached objects by displacement." (Gibson, 1986).

Providing dynamic learning environments requires the commitment to utilize a system of objects to construct an entirely new environment, not only to reconfigure a layout, but to also create learning opportunities with various affordances. Altering the shape of the surfaces and repositioning the object is essential to redefining the system. In this study by exposing different shapes of surfaces and positioning the boxes interchangeably, the children were able to meet their learning needs in a flexible way. This flexibility was demonstrated through the way the children tailored the boxes' arrangements to accommodate their group and to perform the different learning activities.

Exercising flexibility through boxes allows the classroom space to be transformed from a static array of chairs and tables into a dynamic learning environment. Flexibility also allows classroom spaces to be used in various configurations. The classroom is usually arranged in certain hierarchies in which the children sit facing the teacher. Flexible arrangements of learning furniture as a system of objects enable an alternative hierarchy, implying that every space in the classroom has the same degree of value and therefore suggests the equal role and importance of each space. This equality encourages interaction in such spaces while students and teachers engage in the learning process.

To construct the design of a system of objects in a classroom space based on the above relational forms, the idea of modularity is involved. Modularity can be explained as follows:

> "The significance of the module is evident in architecture as the most basic unit… and also in interior design as a system for fabricating any number of elements. …The module, like a brick, on its own does not accomplish its intended function. However, in repetition the module can function as a creator of defined spatial environments…" (Schneiderman, 2011).

Modules act as a component of the system of objects and can be used to initiate a programmatic environment. Modules act as building blocks, while a unit is "an element that is created in its entirety as single all-inclusive piece" (Schneiderman, 2012). Therefore, a unit can act as a piece that can immediately provide all the needed function for its intended use, while a comprehensive programmatic function of modules is achieved through repetition of the module in various ways of arrangements. Through this approach, the possibilities of functions are endless as they are based on the user's creativity and needs.

In the first workshop the boxes functioned as modules in the system of objects that constructed the creative learning environment. Each module related to another module in the system of objects, allowing the children to discover various possibilities of positions, uses, and directions

as they made connections between modules. For example, the box with an open side was stacked above another box to provide a bookshelf, while placing it below the other box provided possible storage for use as a shoebox or for larger, heavier items.

The second workshop resulted in the children using the surfaces of the boxes to create additional tools that complemented the modules. Through the children's learning activities, i.e. displaying, drawing, measuring and categorizing items, it was shown that the development of relational forms in the system of objects provided a rich environment for creative learning. The integration of the modules into the learning tasks provided the children with a broad scope of possibilities for accomplishing the tasks either independently or in groups.

5. CONCLUSION

Furniture design can play an important role in promoting creativity in the learning process, particularly for primary school students. To fully utilize the potential of this idea, furniture must be designed and constructed with the ideas of extending the spatial capabilities of the classroom and integrating the furniture as support for various learning activities. Because current learning methods require hands-on experimentation, exploration and project-based learning, students must be able to move about and manipulate their environment. Therefore, flexibility in the physical environment is essential for students to be able to create and construct a learning environment suitable to their own learning processes.

Such flexibility can be achieved through utilizing boxes as modules in the classroom. The modules, along with the surfaces and configurations of the furniture, create rich possibilities for supporting creative learning activities. In other words, objects in the classroom, including furniture and other items, can be considered part of a system of objects that when considered collectively, provide a means for creating meaningful learning experiences.

Our findings from these workshops demonstrate both the flexibility described above and the effects of that flexibility. The boxes were utilized not as sole objects but as a part of a spatial system that was constructed into a learning environment where students could work energetically and creatively. The children's activities produced various scenarios in which they combined objects and utilized surface features of the objects to engage in learning tasks. It was evident that manipulating the spatial system by reconfiguring the furniture and including boxes as modules and surfaces triggered the children's creativity and made learning meaningful.

In school spaces, including classrooms, different objects sharing the same space can be considered a system of objects that together can be used to create and support a creative learning environment. The future design of these spaces should include plans for constructing them as integrated spatial systems with thought given to the possible configurations of the spaces and objects (including the objects' surface features) as they relate to creative learning.

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