Designing play mats as a tool for gross motor stimulation for early childhood using design thinking

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ABSTRACT

The development of gross motor skills in early childhood is an important aspect of their initial growth stage. However, in the process of guidance, parents often face difficulties and limitations in stimulating their child's motor skills due to the lack of effective and adaptive play equipment. This research aims to address that gap by designing a practical play mat that can assist parents or institutions in supporting and stimulating the gross motor skills of early childhood children through design thinking steps. Qualitative research methods with a practice-based design approach were applied to develop a play tool that not only stimulates children's gross motor skills through movement but also supports social interaction and collaboration. The research results show that this tool facilitates parents and institutions in meeting children's gross motor development needs more effectively. These findings contribute in the form of practical and functional play mats, based on user-centered design, which can be applied in early childhood education institutions and family communities.

1. Introduction

Early childhood is a very important phase of life for an individual's development, so this period is often referred to as the golden ages [1]. Early childhood is defined as the early years of a child's life from birth to six years of age, in accordance with the statement in Article 1, Paragraph 14, of Law No. 20 of 2003 on the National Education System [2]. During this period, children require educational stimulation to facilitate their growth and development, as they exhibit remarkable learning capabilities [3], Therefore, appropriate stimuli must be provided to optimally stimulate their development, especially concerning the development of children's motor skills. This is also closely related to the child's capacity to perform various skills as they grow up [4]. Hurlock in Aulina (2017) states that motor development is defined as the development of the elements of maturity in body movement control and the brain as the center of movement [5]. Based on the precision in performing movements, children's motor skills can generally be divided into two categories: gross motor skills and fine motor skills [6]. In addition, according to [7] the mature age in providing movement skills to children is when the child is entered at the age of five years. Meanwhile, Cook *et al* (2019) argues that the age of 4-7 years is a very appropriate age for developing their motoric skills by providing various stimuli to master these motor skills [8]. One way to improve the gross motor skills of early childhood children is through basic movements such as running, jumping, catching, and throwing [9] that involve the large muscle movements of the child's body [4]. These basic movements are usually found in the form of simple games, such as jumping rope, walking on a balance beam, hopping on one foot, mimicking animal movements, throwing a ball into a basket, and so on. In addition to stimulating gross motor skills, movements that involve sensory tools also have the potential to stimulate children's development, both physically and emotionally [10]. The process of active play is a way to train

children to strengthen their muscles so that they can become stronger, faster, and more agile, and have better movement control [11].

In early infancy, various factors must be considered in the implementation of play, particularly those pertaining to gross motor stimulation, such as safety and security issues [12]. Games designed for early infancy can be developed to enhance gross motor stimulation associated with children's play skills. According to Nation Association for the Education of Young Children (NAEYC), the developmental phases in early childhood are categorised as follows: infant (0-6 months), older infant (7-12 months), young toddler (1 year), older toddler (2 years), preschool (3-5 years), and primary school (6-8 years) [13]. According to the categorisation of developmental phases, several game genres can be examined to enhance gross motor abilities at each age level. Each age category encompasses specific achievements or objectives that children are expected to attain. Consequently, there exists an opportunity to expedite and facilitate these accomplishments, ensuring equitable attainment for early children across Indonesia, especially those who experience certain obstacles or disorders during their development.

One of the potentials that can be developed to stimulate children's gross motor skills is through games that use patterns on the floor, or play mats with instructions on the floor by adopting traditional games [14]. These play mats can be made from materials such as carpets, mats, banners, mattresses, or similar items, as long as they are safe for children to use. To obtain the appropriate form of play and play mats, this design process will be carried out using a design thinking approach. This approach is known as a holistic thinking method, focusing on creating solutions that begin with empathetic understanding of specific human-centered needs towards sustainable innovation based on user needs [15]. It is hoped that the results of this play mat design process can help improve the gross motor skills of young children in an appropriate manner that considers aspects of enjoyment and interactivity. In the design process using the design thinking method, several aspects required by the users [16] will be considered in this context, which is early childhood, such as the need for movement stimulation, the role and consideration of the surrounding environment, as well as creative and aesthetic aspects to create a product that is not only useful but also attractive and motivating for children to play and capable of stimulating their gross motor skills. The design thinking process has five steps as shown in Fig. 1 [17].

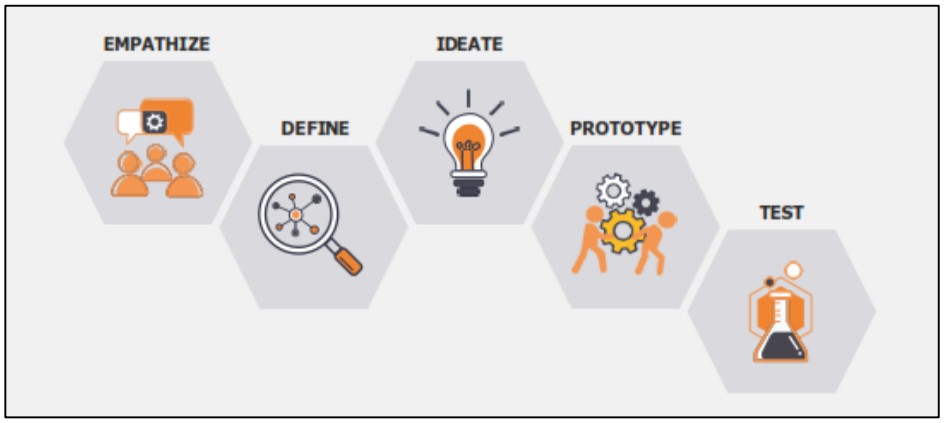

Fig. 1. Design Thinking Steps [17].

The initial phase of this process is the Empathize phase, which is the core of the human-centered design method [18]. This first step aims to understand the desires, needs, and perspectives of users regarding the design or product being developed. This process of approaching users is carried out through observation, interviews, and conducting experiments using previous methods and/or products. The second step is the Define phase (Problem Definition), which involves analyzing and understanding various insights obtained during the empathy stage. Define part is the process of bringing definition to meaningful possibilities from the discovery phase and making the most effective decision for the starting point [19]. The goal of the Define process is to formulate the problem statement as the main focal point in the research [15]. The third step is the Ideate phase, marking the shift from problem formulation to solution identification. At this stage, the current emphasis is on producing ideas or concepts to serve as a foundation for developing design or product prototypes.

Techniques such as brainstorming, mind mapping, and rapid prototyping are utilized to enhance divergent thinking and produce innovative ideas [20]. The fourth step is the Prototype phase, which entails developing a preliminary design of the product for testing purposes. This seeks to ascertain the suitability of application and potential faults at an early stage, hence enabling the exploration of new solutions. The prototypes developed will undergo user testing to gather answers and comments essential for design refinement [21]. The fifth or final step is the Test stage, where various final designs formulated in the previous prototype stage are tested on users. This process is the final stage, but it is cyclical, allowing for iterations or repetitions, and returning to the previous design stage if necessary to correct mistakes [22]. The use of the design thinking method in the process of creating assistive tools aimed at stimulating gross motor movements will provide better and more targeted benefits, for example, for parents and educators, as it will enable them to provide the right stimuli for children's needs. The design products produced can also be adjusted to meet the different needs of children and can be developed according to the child's developmental stage.

2. Method

This research employs qualitative research with a practice-based design approach which is a direct practice and real experience in creating products or solving problems conducted with control [23], utilizing data gathered through observation, interviews, and experiments, which constitute the initial phase of design thinking, specifically empathy [15]. Observation was conducted in a structured manner by providing several tasks and instructions to be carried out and directly observed [24]. The tasks consisted of motor activities given to 40 early childhood children in the Familia Kreativa (FK) community and the Pramuka Pra-Siaga (PPS) community. These two communities were chosen because they had participants of different ages, 2-3 years (FK) and 3-4 years (PPS), as well as diverse activity locations, indoors (FK) and outside (PPS). Observation utilizing the AEIOU framework consists of five components: activity, environment, interaction, object, and user [25]. The motor activities given to participants from these two communities consist of several different instructions, including (1) walking while pinching a balloon; (2) balance jumping; (3) crossing with a hula hoop; (4) carrying a ball with a paper plate; (5) carrying a ball on a balance board; and (6) rolling on a cardboard wheel. This series of motor activities is a structured development of basic movements [9] that stimulate children's gross motor skills.

Riyanto (2022) states that early childhood children are advised to receive motor education by practicing a structured movement program as a strategy to enhance the development of children's motor skills, where this structured movement can be achieved through play-oriented activities [26]. Interviews were conducted with three sources, first an unstructured interview with Devi Arifiani Azhar, the founder of the Familia Kreativa community. This interview was conducted to obtain guidance and input regarding the validation of activities that should be provided to children. Next, semi-structured interviews were conducted with Dra. Eva Delva, M.M.Pd, the Principal of Madinah Kindergarten and Elementary School, who discussed methods for developing children's motor skills. Finally, semi-structured interviews were also conducted with Zahra Zahira, S.M., M.S.M., Mont. Dipl., the owner of Granada Preschool Montessori & Kindergarten, who provided a perspective from the psychological and emotional realm regarding the impact of motor stimulation on children.

3. Results and Discussion

3.1 Gross Motor Skills

While gross motor skills enhance and coordinate with a child's physical maturation and normative growth, gross motor competence can advance more rapidly when these skills are explicitly taught and deliberately practiced through developmentally appropriate planned activities [27]. Planned activities essential for the development of gross motor abilities including rolling, crawling, walking, jumping, tiptoeing, twirling, throwing, and running. Observations conducted using the AEIUO framework as outlined in Table 1, variations were tried on these activities to further stimulate the development of gross motor skills, such as (1) walking while pinching a balloon; (2) balancing jumps; (3) crossing with a hula hoop; (4) carrying a ball with a paper plate; (5) carrying a ball on a balance board; and (6) rolling on a cardboard wheel. The six play activities are part of the motor skills intervention program [26], which consists of free play (non-directive or experiential type) and goal-oriented play activities (or functional).

Table 1. AEIOU Framework for Gross Motor Activities

Activities	Environments	Interactions	Objects	Users
Walking while pinching a balloon	Indoor	Walking while pinching a balloon on a foam mat	Balloon and foam mat	Familia Kreativa
Balancing jump	Indoor	Jumping over a hurdle while carrying a ball	Hurdle cones, rope, and ball	Familia Kreativa
Crossing with a hula hoop	Indoor	Jumping into a hula hoop placed on the floor	Hula hoop	Familia Kreativa
Carrying a ball with a paper plate	Outdoor	Outdoor Walking on a mat while carrying a ball on a paper plate	Ball, paper plate, and foam mat	Pramuka Pra-Siaga
Carrying a ball on a balance beam	Outdoor	Walking on a balance beam while carrying a ball	Ball and balance beam	Pramuka Pra-Siaga
Rolling on a cardboard wheel	Outdoor	Rolling inside a cardboard for a certain distance	Circular-shaped cardboard	Pramuka Pra-Siaga

The participants' tendencies during gross motor activities appeared to be varied; most were able to perform the activities easily and the movements were structured, such as in the balloon pinching walking and crossing with a hula hoop. Others performed the activities with repeated effort, such as in balance jumping, carrying a ball with a paper plate, and carrying a ball on a balance board. The atmosphere created during the activity was also very lively and joyful. The process of these motor activities is akin to play; by performing structured movements actively, it can train the child's muscles to become stronger, faster, and more agile, as well as improve their movement control [11]. All game actions depicted in Fig. 2 are conducted utilising various uncomplicated apparatuses, including foam mats, hula hoops, duct tape, cardboard, balls, balloons, hurdle cones, ropes, balance beams, and other play equipment. Some other game activities require quite a lot of equipment and preparation, and take a considerable amount of time to be played by the participants. These activities include, for example, tightrope board games, balance beams, balloon pinching agility games, obstacle courses, cardboard wheels, and several other games as shown in Fig. 3.

Fig. 2. Gross Motor Skill activities at Familia Kreativa

Similarly, the process of organising the game qualities as a whole is time-consuming. In the observation phase of the children's responses, the researchers found that in a limited space, children were still able to perform structured gross motor movements with simple visual instructions on the floor. What can be optimized is by creating an instructional aid aimed at stimulating gross motor skills that is portable so it can be easily moved within a limited space. In fact, there are several portable instructional aids such as balance beams, balance blocks, play mats, and so on, but among these various types of play equipment, not many have visual instructions that can be easily understood for their use.

Fig. 3. Gross Motor Skill activities at Pramuka Pra-Siaga

The step taken after conducting observations, interviews, and experiments as part of the empathize process in design thinking is to define, which involves formulating contextual problems [28], one of the apparent issues is how to ensure that these gross motor-oriented activities can be easily carried out and that children understand the instructions to perform structured movements. Because what is happening now is that a considerable amount of time and effort is required to prepare these play activities. After identifying the problem, the next step is to explore solutions through the ideation process [29]. This ideation process is carried out by determining the goals regarding the skills that children will achieve through several gross motor-oriented activities. Based on this, there are several design directions that can be placed on the floor and are portable. The research found that gross motor skills for preschool children that can be trained and instructed in a structured manner are (1) jumping; (2) climbing up and down stairs without assistance using alternating feet; (3) walking backward; (4) jumping 4-6 steps on one foot; (5) jumping while running; (6) making sudden movements; (7) performing spinning and stopping movements effectively [30]. These seven movements are taken into consideration in the design direction of the play surface as part of the practice-based design outcomes of this research.

3.2 Design Result

This research uses five stages of design thinking, from empathize, define, ideate, prototype, to testing, to gather information, suggestions, aspirations, and viewpoints from parents, experts, and early childhood participants involved in the research. The response obtained from the implementation of the design thinking process indicates the need for a tool that facilitates structured play activities for children. This tool must be easy to use, from the preparation process to the end of use, and it should be instructional and visually understandable. Through several ideation stages, namely by creating mind maps, mood boards, and action scenarios, several design alternatives were obtained to serve as solutions for structured play activities for young children. The results of the interview process indicate that there is a spectrum of activities that can be visualized, ranging from hand coordination motor movements, foot coordination motor movements, hand, foot, and eye coordination motor movements, body coordination motor movements, and several other motor movements that can be supported by play activities. Specifically, the movements to be visualized are (1) variations of jumping; (2) walking or jumping backward; (3) jumping while running; (4) making sudden movements; and (5) performing spinning and stopping movements effectively. In this research, the consideration made is the level of ease so that children can use it independently according to the instructions they see, with minimal assistance from a companion. Therefore, the support base to be designed is related to exercises for hand, foot, and eye coordination. The design commenced with an experiment on the floor, which was marked with a picture; subsequently, the children were invited to engage with and interact with the design on this surface. A testing was conducted on a large, simply designed printed material. This design activity was repeated three times until an optimal design result was achieved, as shown in Fig. 4. The final step was to create the final design with color touches to attract children's attention [31]. The colors applied in the design tend to be bright colors such as yellow, blue, green, and red. The design can be seen in Fig. 4.

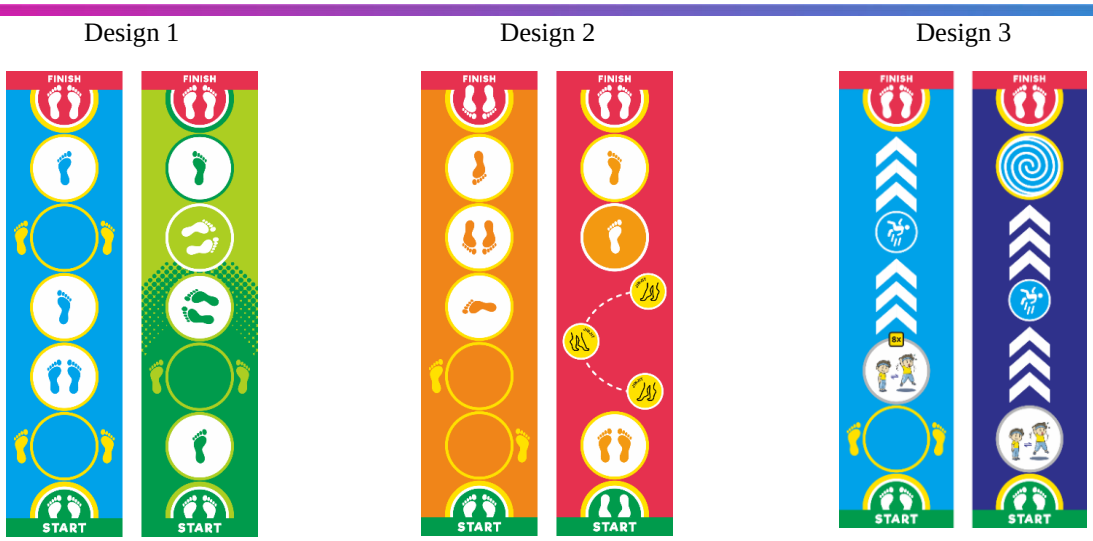

Fig. 4. Play Mat Design

The three preliminary designs were created with dimensions of 200 x 80 cm, taking into account several factors validated during the empathise and define phases. Design 1 focusses on alternating one-legged jumping and stepping, Design 2 incorporates jumping, backward walking, and supplementary movements such as tiptoeing, while Design 3 emphasises jumping, running, and rotational movements. The material used in the production of this aid is banner material, which is easily found at digital printing shops at a fairly affordable price.

4. Conclusion

Activities to train and stimulate children's motor skills need to be conducted regularly by performing movements such as running, jumping, throwing, spinning, jogging, and so on. These activities can be done independently or in groups. The gross motor activities can be carried out using assistive tools that make it easier for children to perform them well. Through this research, several results were obtained, which are developments of existing tools, products, or concepts, initiated due to identified opportunities or problems [32]. The innovation takes the form of a play mat with instructional movement images. The advantages of this aid, which is an enhancement of existing activities and aids, are that it can facilitate the implementation of gross motor stimulation activities, make it easier for children to perform movements instructed through images, and simplify the process of packing the aid after use. Additionally, as an educational play equipment [33], this play mat can be easily duplicated and disseminated to other regions throughout Indonesia, especially in early childhood education institutions. This play mat can also be used by other fields of study, such as those that examine early childhood development, health, and sports, to enrich the realm of scientific collaboration. In the realm of design, the findings of this research lead to alternative designs in the form of play mats that can be created starting from the types of motor movement instructions, sizes, to materials, in order to support a wider variety of play activities with the aim of training and stimulating the gross motor development of young children.

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