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Augmented Reality Media Prototype for Fine Motor Development of Children Aged 3-6

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Abstract:
This study aimed to design learning in developing fine physical-motoric skills in early childhood students based on augmented reality. Augmented reality media is designed to help early childhood education teachers develop children's fine motor skills by creating interesting and not monotonous learning. The augmented reality application is developed with the Unite AR application installed through the play store on a mobile phone. This research method uses research design and the development of multimedia-based learning materials. This research produces a prototype of three-dimensional augmented reality learning media appropriate and interesting to use in developing fine motor skills in early childhood students: 1) Holding writing instruments correctly; 2) Making vertical, flat, and slanted lines; 3) Tearing into a shape; 4) Cutting out straight patterns; 5) Making shapes from paper, leaves, and patchwork; 6) Coloring according to the picture theme. The results showed that children's good physical development would facilitate their daily activities. Indirectly, motor activities will train children to be more independent and confident. This does not grow alone by the child, but with the right stimulus and exercise given to the child, it will foster a spirit of independence and self-confidence and increase the child's cognitive development. The novelty of the research is Augmented Reality media to improve fine motor skills for early childhood aged 3-6 years.

Keywords: augmented reality, fine motor development, physical development, early childhood education.

用于 3-6 岁儿童精细运动发展的增强现实媒体原型

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摘要：
本研究旨在基于增强现实设计学习，以培养幼儿学生的精细身体运动技能。增强现实媒体旨在帮助幼儿教育教师通过创造有趣而不是单调的学习来培养儿童的精细运动技能。增强现实应用程序是使用通过手机游戏商店安装的联合增强现实应用程序开发的。这种研究方法使用研究设计和基于多媒体的学习材料的开发。本研究制作了一个 3D 增强现实学习媒体原型，适合并有趣地用于培养幼儿学生的精细运动技能：1）正确握写书写工具；2）制作竖线、平线、斜线；3）撕成形状；4）剪出直线图案；5）用纸、树叶和拼凑而成的形状；6）根据图片主题着色。结果表明，儿童良好的身体发育将有助于他们的日常活动。间接地，运动活动将训练孩子更加独立和自信。这不是孩子独自成长的，而是通过给予孩子正确的刺激和锻炼，培养独立和自信的精神，促进孩子的认知发展。该研究的新颖之处在于增强现实媒体，以提高 3-6 岁幼儿的精细运动技能。

关键词：增强现实，精细运动发展，身体发育，幼儿教育。

1. Introduction

Physical-motoric development of early childhood with language development always goes hand in hand in its growth. Children will be said to be developing when they are good at talking and able to move by involving their bodies. Improving the physical abilities of children aged 0-6 involves their physical-motor skills, and it is no wonder that children play without getting tired. Motor competence and physical activity have a low and moderate relationship in children aged 3-18 (Logan et al., 2015). Physically active children will do better at a higher level of motor skills than less active children. Children with higher obesity lack motor skills in early childhood and adolescence (Baghurst et al., 2014; Hamilton et al., 2016; Hume et al., 2008).

Fine motor skills are important in early childhood language development with good control and focus on effective functions (attention and quick naming), phonemics, word repetition, handwriting skills, and receptive and expressive vocabulary. Early fine motor development is important for reading in elementary school (Suggate et al., 2019). Maxim (1993) stated that physical activity would also increase curiosity and make children pay attention to objects, catch, try, throw, hold, and drop them. If this development is not considered properly, it will have a bad impact. The physical growth of children is expected to flow optimally because it will directly or indirectly affect children's daily behavior. The early child's physical growth will directly determine the skills in moving.

The development of children's physical-motor skills will affect the way children see themselves and others. In the world of children, motor skills are moving, holding, and cutting. Children's home environment also affects their motoric development at school age (Ferreira et al., 2018). In addition to motor skills, language also affects a child's development from when they see until they recognize the surrounding environment. Children's physical and motoric potentials can be developed through interesting activities in and outside the classroom to make them feel comfortable without any pressure. Gross and fine motoric physical development can be planned with a structure to get optimal results (Hamilton & Liu, 2018). Children's home environment significantly influences the development of their motor skills at the age of 18-42 months (Valadi & Gabbard, 2018).

Many activities can develop the potential of children. One of them is learning activities using learning media. Well-designed and attractive learning media will generate children's interest and motivation in learning. The designed media is expected to stimulate children's physical and motor development. One of the media that is designed and can attract children's attention is learning media based on augmented reality. Augmented reality media is a supporter and widely available in developing cognitive education for preschool children. Educational features found in augmented reality applications offer an interesting and unique learning experience to blur the boundaries between the real and virtual worlds that children see on the Android application screen. Augmented reality applications motivate and attract children's attention in learning and reduce representational differences between the context in which they learn new information and apply what they have learned (Oranç & Küntay, 2019).

With the rapid development of software and hardware science and technology, including augmented reality technology based on its characteristics and the characteristics of child psychology, augmented reality applications can be developed in early childhood learning (Kuang & Bai, 2019). Augmented reality provides motivation and improvement in learning and effective social relationships for developing English as a foreign language (Redondo et al., 2020).

The purpose of augmented reality is to create a new environment by combining the interactivity of real and virtual environments so that users feel that the created environment is real (Al-Aboody et al., 2021). In line with the above, a more in-depth study is needed regarding the design of a learning media. From the results of in-depth studies and research, it is hoped that any factors can be identified that can improve the physical and motor development of children aged 0-6. For children's physical-motoric development, it is necessary to design appropriate media according to the

stages of children's development in improving their physical-motor skills. Based on this, in this study, augmented reality media for improving fine motor skills was designed, which is expected to attract children's attention and generate motivation in them.

1.1. Physical-Motoric Development

The world's leading organization in child development, often known as the National Association for the Education of Young Children (NAEYC) (2005), argues that it is ideal to acquire basic gross and fine motor skills for motor development at an early age. Fine motor skills are an integral part of the quality of early childhood education standards because of the importance of skills in children's health and education. Motor development is very important in the early childhood curriculum (Copple & Bredekamp, 2009; Kostelnik et al., 2015). Previous research has strongly suggested that motor skills are a very important supporting factor in promoting physical activity in early childhood and beyond (Stodden et al., 2014; Jones et al., 2011). Physical-motoric development is a daily activity including movement and performance results in physical activity, significantly determined by the body scale (McMahon & Bonner, 1983). Childhood is a basic factor in body size and shape changes in physical activity (Malina et al., 2004). Physical-motoric development is a movement activity through coordinated activities of the nerve center, muscles, and nerves.

1.2. Augmented Reality Media

For about 20 years, the augmented reality concept has only undergone a significant technological evolution associated with the miniaturization of electronic components, increased computing power, computer autonomy, and the adoption of other smartphone devices (Hugues, 2011; Rese et al., 2017). On the one hand, augmented reality is defined by Milgram et al. (1995) as a technology capable of enhancing the natural feedback of virtual cue operators; on the other hand, as a form of virtual reality in which the display is transparent. Azuma (1997) describes augmented reality allowing the user to see the real world by superposing virtual objects. Milgram and Kishino (1994) describe augmented reality in the presence of continuum virtualities associated with a mixture of object classes. Augmented reality is the integration of 3D virtual objects in a real environment. Augmented reality can be used to consider and integrate AR into research areas while moving from science fiction to material reality, from blueprints to prototypes, and from laboratories to homes, cars, workplaces, and pockets (Liao, 2019). Augmented reality is a dual world of real and virtual environments in extreme opposites, a mixture of the real and virtual worlds presented simultaneously and in one view.

2. Methods

This study is research and development (R&D). Research and development in education is a process to create and validate educational products such as media, methods, and models according to the needs in the field. In developing this augmented reality media, this research adopts the model of Lee and Owens (2004) with six stages of development: needs analysis, front-end analysis, design, development, implementation, and evaluation. Figure 1 shows Lee and Owens's research and development model.

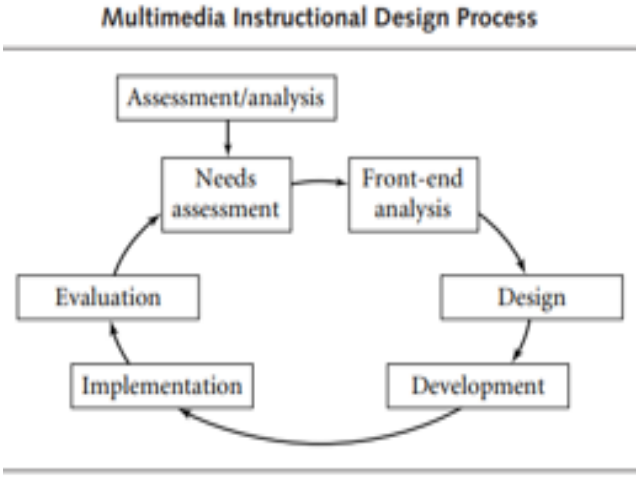

Figure 1. Lee and Owens's development model

3. Results and Discussion

3.1. Augmented Reality Media Design for Developing Fine Motor Skills in Children Aged 3-6

Based on the described background, the augmented reality media is designed by displaying fine motor movements digitally to develop fine motor skills in children aged 3-6, equipped with pictures. This augmented reality media is designed to help early childhood education teachers develop children's fine motor skills. Augmented reality media is expected to create motivating learning for children and provide fun and not boring learning activities for them. This augmented reality media was developed using the Unite AR application on mobile phones to ease its installation. Image display makes it easy to scan target images or augmented reality tracking processes; we can choose the waking space we will need. Next, we provide a hint on the object for tracking. The tracker is made to make it easier to detect augmented reality media to read the image display. Figure 2 shows how to scan an image easily.

Figure 2. How to scan an image on a marker with a mobile phone

The next step is to input the image object by installing the Unite AR application on the mobile phone. The target image is scanned for operating

augmented reality scan marker media using the Unite AR application on a mobile phone. Then, the video is played for tracking on augmented reality media. This augmented reality media was developed according to six sub-themes: 1) Holding writing instruments correctly; 2) Making vertical, flat, and slanted lines; 3) Tearing into a shape; 4) Cutting out straight patterns; 5) Making shapes from paper, leaves, and patchwork; 6) Coloring according to the theme of the picture. Each marker is equipped with instructions and stages in developing each fine motor material, making it easier for teachers to provide examples of fine motor development followed by children. The image display on augmented reality media for children's fine motor development can be seen as follows:

3.1.1. Holding Stationery Properly

This augmented reality design contains instructions on how to hold a writing instrument properly. For developing children's fine motor skills, in the beginning, they are taught to hold writing instruments properly. When the child can hold the writing utensil correctly, there will be no difficulty in learning to write. The augmented reality design for holding stationery properly can be seen in Figure 3.

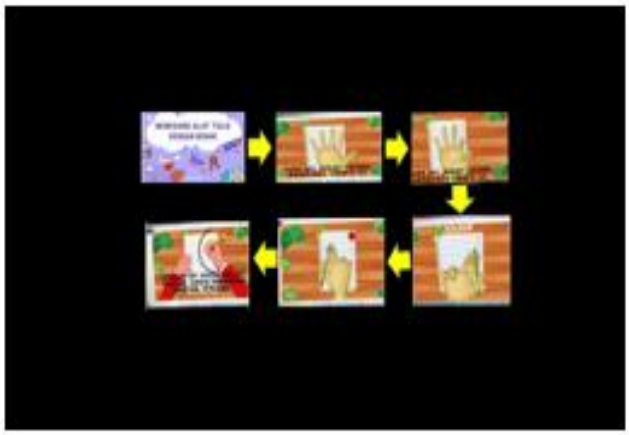

Figure 3. Holding stationery properly

3.1.2. Making a Vertical Line

This augmented reality is designed by providing instructions on creating straight, upright, flat, and slanted lines. Figure 4 shows an augmented reality design to emulate and create plumb, straight, flat, and slanted lines.

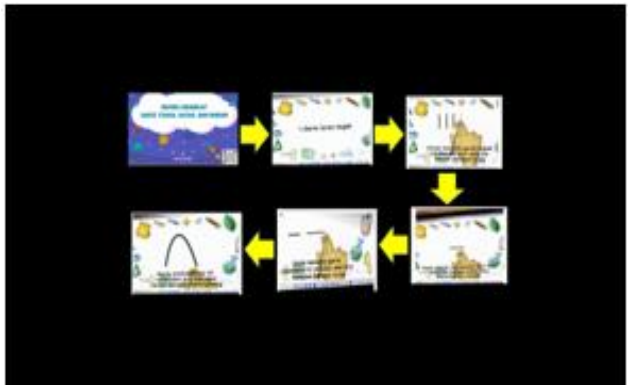

Figure 4. Making a vertical line

3.1.3. Tearing into a Shape

This augmented reality design illustrates how to train children's fine motor skills by tearing paper into shapes, for example, human shapes, car shapes, and animal shapes that children like. The augmented reality is designed as in Figure 5.

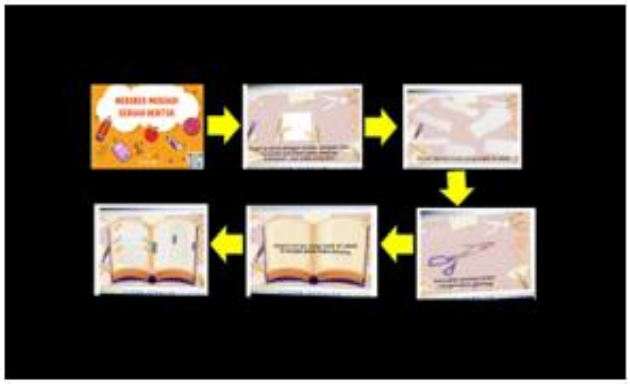

Figure 5. Tearing into a shape

3.1.4. Cutting Out a Straight Pattern

This augmented reality is designed by providing instructions on cutting the pattern according to the lines that form a straight, upright, flat, and sloping pattern. Figure 6 shows an augmented reality design for cutting out straight patterns.

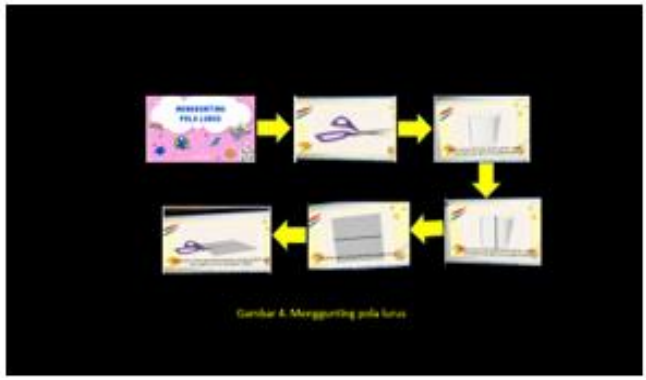

Figure 6. Cutting out a straight pattern

3.1.5. Making Shapes from Paper, Leaves, and Patchwork

The next augmented reality design is for making shapes from various materials: paper, leaves, and patchwork. Figure 7 shows the augmented reality design.

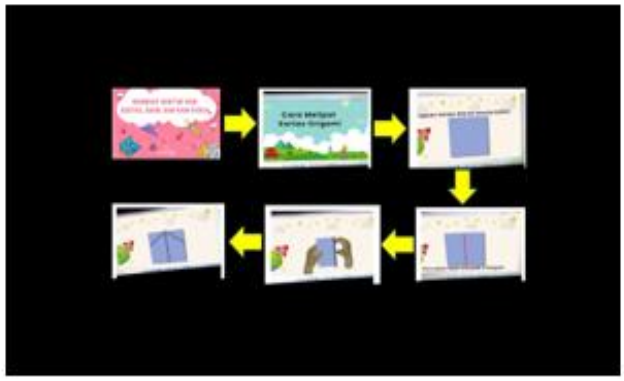

Figure 7. Making shapes from paper, leaves, and patchwork

3.1.6. Coloring According to the Theme of the Picture

The next augmented reality design is for coloring

according to the picture; this gives children the freedom to color the pictures they like. Figure 8 shows an augmented reality design for coloring activities according to the picture.

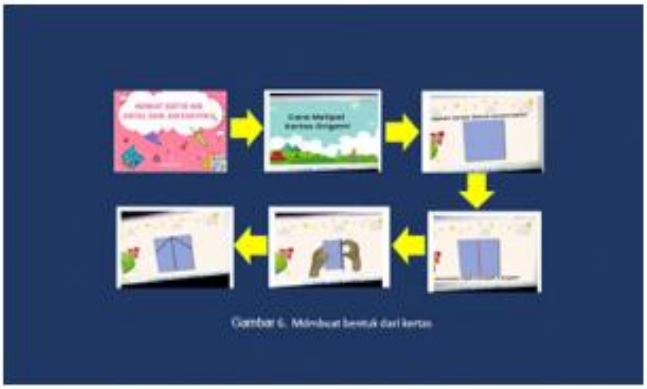

Figure 8. Coloring according to the theme of the picture

Indirectly, motor activities will train children to be more independent, confident by doing activities such as buttoning their clothes without the help of adults, tying their shoelaces, and spreading butter on bread at breakfast. This does not grow alone in the child. The right stimulus and exercises for the child will develop a spirit of independence and self-confidence and strengthen their cognitive development. This augmented media prototype is designed to assist early childhood education teachers in developing children's fine motor skills.

The design of augmented reality media prototypes is very helpful in education. It makes it easier for teachers to prepare and conduct classes and improve children's learning experiences in mastering English vocabulary interactively and interestingly (Lee et al., 2019). The framework was developed through an augmented reality media prototype as an application on the screen of mobile devices, which can help people with autism and cognitive impairment, which has a real-world space displaying favorite cartoons useful in the real world (El-Seoud et al., 2019). The PRONTO project prototype is a tablet-based video system prototype with 2D integration with 3D manipulation. This system supports four interrelated activities: 1) Capturing 3D spatial information in addition to video scenarios; 2) Sketching and positioning 2D images in a 3D world; 3) Animation based on physical interaction; 4) Professional observational studies showing that using PRONTO in prototyping varies based on augmented reality experiences (Leiva et al., 2020). Augmented reality media prototypes make the learning process easier for teachers and children. The prototype was designed using a simple Unite AR application on a mobile phone. The ease of installing the Unite AR application is expected to help teachers develop fine motor skills in early childhood students. Augmented reality media has a positive impact in the visualization from the virtual to the real world and vision-haptic visualization and annotations (Santos et al., 2014). Augmented reality was developed based on media through hypothetical learning trajectory to develop students' abilities in spatial intelligence (Amir et al., 2018). Based on constructivism learning theory, augmented reality media facilitates developing children's fine motor skills and provides hands-on experience of using the virtual and real worlds simultaneously.

4. Conclusion

This Android-based augmented reality media prototype is suitable for developing fine motor skills in early childhood with the following indicators: 1) Holding writing instruments correctly; 2) Making vertical, flat, and slanted lines; 3) Tearing into a shape; 4) Cutting out straight patterns; 5) Making shapes from paper, leaves, and patchwork; 6) Coloring according to the theme of the picture. Augmented reality media motivates children to carry out fine motor development activities. With AR media, children will have direct experience through the virtual world displayed together with the real world. Augmented reality media provides challenges and fantasies for children to explore their cognitive abilities through fine motor skills. The novelty of the research is Augmented Reality media to improve fine motor skills for early childhood aged 3-6 years.

This study's limitation is that augmented reality media has not been tested on users directly in the classroom; it is still in the form of a prototype, so for further research, it is necessary to perform expert validation to determine the feasibility of the product being developed. This learning media needs to be tested in the field to determine the effectiveness of the product being developed.

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