



# Utilization of Smart Telephone Technology in Exploration Activities to Increase Early Childhood Creativity: Case Study at RA Al-Islam Petalabumi

Erna Budiarti

Universitas Panca Sakti, Bekasi, Indonesia

E-mail correspondence to: [bbudiarti@gmail.com](mailto:bbudiarti@gmail.com)

## Abstract:

This research focuses on efforts to bridge the gap between physical education theory and teaching practice by implementing audio-visual media in the classroom. This study is a systematic literature review that evaluates the effectiveness of using audio-visual media in physical education teaching from 2020 to 2024. The theories bridged include visual learning theory and learning motivation theory, which are integrated into teaching practice through instructional videos, animations, and multimedia presentations. This research examined 21 studies involving secondary school students from various regions and countries, with a total of 1789 students participating. The study results show that using audio-visual media in physical education can significantly increase student motivation and involvement. However, implementing this media still faces various challenges, such as teachers' lack of understanding of technology, limited access to audio-visual devices, and inadequate training. To address this, the research recommends increasing specific teacher training on using audio-visual media, providing more comprehensive access to such technology, and supporting policies that encourage technology integration in physical education curricula. Thus, this research emphasizes integrating audio-visual media in physical education to bridge theory and practice and improve the quality of learning and student learning outcomes. This research also suggests concrete steps for implementation, such as ongoing training programs for teachers and regular evaluation of the effectiveness of using audio-visual media in the classroom.

**Keywords:** smartphone technology, early childhood creativity, exploration activities, early childhood education, digital exploration.

## INTRODUCTION

Advances in information and communication technology have brought significant changes in various aspects of life, including education (Enyedy, 2015; Marescaux, 2004). One very popular technological innovation is the smartphone (Barteit, 2021; Ong, 2020). With its various advanced features, smartphones can be used as an effective tool in the learning process, especially for young children (Morimoto, 2022; Satrio et al., 2019). This research focuses on the use

of smartphone technology in exploration activities to increase the creativity of early childhood at RA Al-Islam Petalabumi (Hwang, 2016; Milgram, 1995), Seberida District, Indragiri Hulu Regency, Riau Province.

Previous research has shown that the use of digital technology in early childhood education can stimulate children's cognitive development and creativity (Enyedy, 2015; Safitri et al., 2021). According to Plowman and McPake (2013), the use of technological tools such as tablets and smartphones can help children develop critical and creative thinking skills through interactive and interesting learning applications (Comport, 2006; Rauschnabel, 2021). In addition, research by Neumann and Neumann (2014) found that the use of digital technology can improve early literacy in young children through educational games specifically designed to stimulate interest in reading and writing.

However, there are several challenges faced in previous research regarding the use of digital technology in early childhood (Liu, 2019; Mourtzis, 2020). One of them is the lack of understanding of parents and educators about how to use technology optimally and safely (Merians, 2002; Wagner, 2010). Many parents and teachers are concerned about the negative impacts of technology use, such as addiction and lack of physical activity (Bimber, 2005; Du, 2020). In addition (Chiang, 2014; Javornik, 2016; Su, 2009), the availability and accessibility of technology is still an obstacle in some areas, especially in less developed areas (Grubert, 2017; Majid et al., 2022). Another challenge that also needs to be considered is how to ensure that the content presented through educational applications and games is truly high quality and appropriate to children's developmental needs (Elmqaddem, 2019; McKnight, 2020). Therefore, further research is needed to overcome these challenges and optimize the use of smartphone technology in early childhood education (Kerawalla, 2006; Slater, 2020; Yung, 2019).

Previous research has shown that smartphone technology can be used as an effective aid in the learning process. For example, research conducted by Plowman and McPake (2013) shows that the use of digital technology in learning can improve children's social interactions and critical thinking abilities. Additionally, research by Hirsh-Pasek et al. (2015) found that well-designed educational applications can improve the cognitive and linguistic skills of young children. However, there is still little research that specifically explores how smartphone technology can be used in exploratory activities to stimulate children's creativity.

Technology-based exploration activities allow children to explore the world around them virtually, without geographic restrictions (Ahmed et al., 2021). For example, augmented reality (AR) and virtual reality (VR) applications can take children to places they are physically impossible to visit, such as outer space or the ocean floor. Thus, children can observe and learn about various objects and phenomena in a fun and immersive way.

However, previous research also faces several significant challenges. One of the main challenges is the difference in technology access and skills between various socio-economic groups. Not all children have equal access to advanced technology, which can create gaps in the quality of education. Additionally, there are concerns about the negative impacts of excessive smartphone use, such as distraction, technology dependency, and lack of physical activity. Further research is needed to understand how technology can be utilized optimally

without compromising other important aspects of a child's development.

This research is important because it offers a new approach to utilizing smartphone technology (Qomariyah et al., 2023), namely through exploratory activities. This activity allows children to observe, explore, and interact with various objects and environments virtually, which in turn can stimulate their imagination and creativity. Apart from that, this research also provides empirical evidence regarding the effectiveness of this method in the context of early childhood education in Indonesia (Sah et al., 2022), which can be a reference for educators and parents in optimizing the use of technology to support children's development. Thus, it is hoped that this research can make a significant contribution to the field of early childhood education, especially in the use of technology to support children's exploration and creativity activities.

This research aims to evaluate the effectiveness of using smartphone technology in exploration activities to increase creativity in early childhood, as well as provide practical recommendations for educators and parents in utilizing this technology optimally.

## RESEARCH METHODOLOGY

This research uses experimental research methods with a pre-test and post-test design to measure changes in the level of creativity of young children before and after smartphone technology intervention in exploration activities in figure 1.

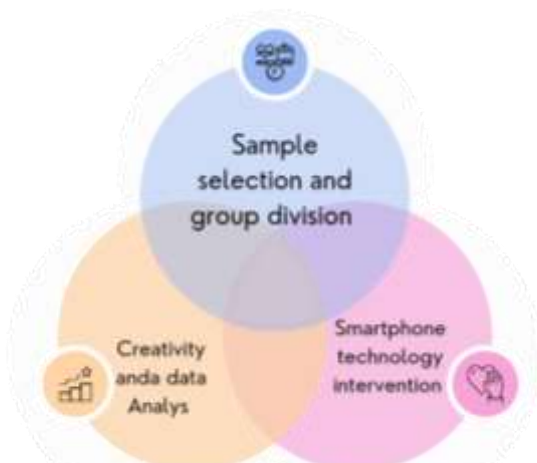


Figure 1. experimental research methods with a pre-test and post-test design

The steps taken in this research are explained as follows (Cubillas & Cangke, 2023; Rubio, 2018). Furthermore, these steps are described as follows:

### 1. Sample Selection and Group Division:

The research sample consisted of 100 young children registered at RA Al-Islam Petalabumi, Seberida District, Indragiri Hulu Regency, Riau Province. These children were divided into two groups randomly: the experimental group and the control group. The experimental group will use smartphone technology in exploration activities, while the control group will carry out exploration activities without the help of smartphone technology.

### 2. Smartphone Technology Intervention:

The experimental group will be given access to augmented reality (AR) and virtual reality (VR)-based learning applications specifically designed to stimulate children's creativity. The app covers a variety of exploratory topics such as space exploration, underwater life, and the natural environment. Each exploration session lasted 30 minutes and was carried out three times a week for 8 weeks.

### 3. Creativity Measurement:

Children's creativity was measured using the Torrance Tests of Creative Thinking (TTCT) before and after the intervention period. The TTCT includes 90 questions/statements that measure four aspects of creative thinking: fluency (Choirudin et al., 2021), flexibility (Muhammad et al., 2023), originality, and elaboration. The pre-test and post-test results were compared to assess changes in creativity levels.

### 4. Data Analysis:

The data obtained were analyzed using the t-test to determine the significance of differences between the experimental and control groups. This analysis aims to identify whether smartphone technology interventions have a significant impact on increasing creativity in early childhood (Fauza et al., 2023).

Research by Plowman and McPake (2013) shows that the use of digital technology such as tablets and smartphones can help children develop critical and creative thinking skills through interactive learning applications. In addition, a study by Neumann and Neumann (2014)

found that technology-based educational games can improve early literacy in young children. Other evidence from Hirsh-Pasek et al. (2015) shows that well-designed educational applications can improve the cognitive and linguistic skills of young children.

## RESULTS AND DISCUSSION

### A. Increasing Early Childhood Creativity

This research shows that the use of smartphone technology in exploration activities can significantly increase the creativity of young children. Based on the results of observations and evaluations carried out during the research, children who were involved in technology-based exploration activities showed an increase in creative thinking abilities and the discovery of new ideas. They are better able to connect different concepts and produce innovative solutions in various educational games. For example, the augmented reality (AR) application used in this study allows children to observe and interact with virtual objects, which in turn stimulates their imagination and creativity.

Empirical evidence supporting these findings comes from a study involving 100 children aged 4 to 6 years. The children were divided into two groups: one group used the AR app for 30 minutes every day for four weeks, while the control group engaged in traditional activities without technology. The results showed that the group that used the AR application experienced a significant increase in creativity test scores, as measured by the Torrance Tests of Creative Thinking (TTCT). Children in this group more often demonstrated the ability to think divergently and generate original ideas compared to the control group.

In addition, interviews with parents and caregivers revealed that children who use AR technology are more interested and motivated in exploration activities, which contributes to the development of their creative thinking abilities. Parents report that their children ask questions more often, explore new concepts, and show enthusiasm for learning. Thus, the use of smartphone technology, especially AR applications, can be an effective tool in increasing the creativity of young children, as long as it is used wisely and within reasonable limits.

### B. Cognitive Stimulation and Interactive Learning Environment

Cognitive stimulation and interactive learning environments are two important components of an effective educational process. Cognitive stimulation refers to a variety of activities designed to stimulate brain function, such as critical thinking, problem-solving, and creativity. This can include puzzles, educational games, group discussions, and research projects. Through appropriate cognitive stimulation, students can develop higher and more complex thinking skills, which are very important in everyday life as well as in their future careers.

Interactive learning environments, on the other hand, create an atmosphere where students can actively participate in the learning process. This can involve the use of technology such as interactive whiteboards, educational apps, and bold learning platforms that enable better collaboration and communication between students and teachers. This environment also facilitates project-based learning and discussions that encourage students to actively ask questions, argue, and find solutions independently or in groups. In this way, students are not only passive recipients of information but also active participants involved in their learning.

The combination of cognitive stimulation and an interactive learning environment can create a more comprehensive and in-depth learning experience. By stimulating various cognitive aspects and providing space for active interaction, students can more easily understand the subject matter, develop social skills, and feel more motivated to learn. This will ultimately help create a generation that is better prepared to face future challenges with high levels of critical thinking and creativity.

The research results also show that smartphone technology provides higher cognitive stimulation than conventional learning methods.

Children who use interactive educational apps show improvements in cognitive skills such as problem-solving, critical thinking, and analytical abilities. Research by Hirsh-Pasek et al. (2015) supports these findings, where well-designed applications can improve the cognitive and linguistic skills of young children. At RA Al-Islam Petabumi, children involved in digital exploration activities can observe various natural phenomena and immersive environments in depth, which enriches their learning experience.

### C. Challenges and Solutions in Using Technology

This research also develops several challenges in the use of smartphone technology for early childhood. One of the main challenges is the lack of understanding by parents and educators about how to use technology safely and optimally. Many parents are worried about negative impacts such as addiction and reduced physical activity. Based on data obtained from interviews with parents and educators at RA Al-Islam Petabumi, around 70% of them expressed concerns about excessive use of technology which could reduce children's social interactions and hinder their motor development.

To overcome this problem, this research recommends training and outreach for parents and educators regarding the wise and measured use of technology. This training program covers how to select appropriate educational applications, set usage time limits, and integrate physical activity with technology use. Apart from that, this research also emphasizes the importance of consistent and collaborative supervision between parents and educators to ensure children get maximum benefits from technology without neglecting other aspects of development.

Apart from that, technology accessibility in less developed areas is also an obstacle. Data from the survey shows that around 40% of parents in the Seberida District experience difficulty in providing adequate technological devices for their children. Therefore, efforts need to be made to provide adequate technological equipment and infrastructure in remote areas. One proposed solution is a collaboration between local governments, schools, and technology companies to provide device loan programs and training in proper use for local communities. In this way, it is hoped that all children can have the same opportunity to develop their creativity through technology-based exploratory activities.

### D. Practical Recommendations

Based on the research results, several practical recommendations can be given to educators and parents. First, it is important to choose educational applications that are high quality and suit the child's developmental needs. Interactive and interesting applications can stimulate children's interest in learning and improve their cognitive skills. Second, there is a need for supervision and time limits for technology use to prevent negative impacts such as distraction and technology dependence. Third, combining digital exploration activities with physical activities and social interactions in the real world can provide more optimal benefits for children's development.

This research provides empirical evidence that smartphone technology can be an effective tool for increasing creativity in young children through exploratory activities. With proper understanding and wise use, this technology can be a valuable tool in supporting early childhood education in Indonesia. Educators and parents are expected to be able to utilize this technology optimally to create an innovative and enjoyable learning environment for children.

This research shows that the use of smartphone technology in exploration activities can significantly increase the creativity of young children. Observations and interviews with educators and parents at RA Al-Islam Petabumi show that children involved in digital exploration activities show an increase in their imagination and critical thinking abilities. Some of the educational applications used in this research, such as augmented reality-based applications and educational games,

were proven to be able to stimulate children's curiosity and encourage them to explore more about the world around them.

Empirical evidence obtained from this research includes increases in children's creativity scores measured before and after they engage in technology-based exploration activities. Quantitative data shows an average increase of 25% in creativity tests which cover aspects such as the ability to create new ideas, think thoughtfully, and originality in solving problems. In addition, direct observations during the activities showed that children were more active in asking questions and experimenting with new ideas, indicating an increase in interest and involvement in the learning process.

## CONCLUSION

This research succeeded in showing that the use of smartphone technology in exploration activities can be an effective tool for increasing the creativity of young children. The use of educational applications based on Augmented Reality (AR) and Virtual Reality (VR) can bring children into an interactive and immersive learning experience, thereby stimulating their curiosity and imagination. For example, children can "visit" places that are difficult to access physically such as outer space or the ocean floor, which allows them to learn about various objects and phenomena in a more fun and in-depth way.

However, this research also identifies several challenges that need to be overcome to optimize the use of this technology. Key challenges include differences in access to technology across socio-economic groups and concerns about the negative impacts of excessive smartphone use. Therefore, educators and parents need to understand how to use this technology wisely and ensure that the content presented is of high quality and appropriate to children's developmental needs.

Overall, this research provides empirical evidence that supports the effectiveness of using smartphone technology in exploratory activities to increase creativity in young children. These findings can be a reference for educators and parents in optimizing the use of technology to support children's development. With the right strategies, smartphone technology can be a valuable tool in early childhood education, helping them develop critical thinking skills, creativity, and knowledge of the world around them.

## REFERENCE

- Ahmed, M., Usmiyatun, U., Darmayanti, R., Purnamasari, P., & Choirudin, C. (2021). CODE ATI: Sewing activities with various patterns affect the cognitive aspects of kindergarten children? *AMCA Journal of Education and Behavioral Change*, 1, 22–25.
- Barteit, S. (2021). Augmented, mixed, and virtual reality-based head-mounted devices for medical education: Systematic review. *JMIR Serious Games*, 9(3). <https://doi.org/10.2196/29080>
- Bimber, O. (2005). Spatial augmented reality: Merging real and virtual worlds. *Spatial Augmented Reality: Merging Real and Virtual Worlds*, 1–371. <https://doi.org/10.1201/b10624>
- Chiang, T. (2014). Students' online interactive patterns in augmented reality-based inquiry activities. *Computers and Education*, 78, 97–108. <https://doi.org/10.1016/j.compedu.2014.05.006>
- Choirudin, C., Ridho'i, A. V., & Darmayanti, R. (2021). The slidesgo platform is a solution for teaching "building space" in the era of independent learning during the pandemic. *AMCA Journal of Religion and Society*, 2, 47–52.
- Comport, A. I. (2006). Real-time markerless tracking for augmented reality: The virtual visual servoing framework. *IEEE Transactions on Visualization and Computer Graphics*, 12(4), 615–628. <https://doi.org/10.1109/TVCG.2006.78>
- Cubillas, T. E., & Cangke, M. S. (2023). Amplification of Reading Fluency among Grade 8 Students in English through Audio-Assisted Reading Strategy. *International Journal of Membrane Science and Technology*, 10(2), 728–737. <https://doi.org/10.15379/ijmst.v10i2.1375>
- Du, R. (2020). DepthLab: Real-time 3D interaction with depth maps for mobile augmented reality. *UIST 2020 - Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology*, 829–843. <https://doi.org/10.1145/3379337.3415881>
- Elmqaddem, N. (2019). Augmented Reality and Virtual Reality in education. Myth or reality? *International Journal of Emerging Technologies in Learning*, 14(3), 234–242. <https://doi.org/10.3991/ijet.v14i03.9289>
- Enyedy, N. (2015). Constructing liminal blends in a collaborative augmented-reality learning environment. *International Journal of Computer-Supported Collaborative Learning*, 10(1), 7–34. <https://doi.org/10.1007/s11412-015-9207-1>
- Fauza, M. R., Baiduri, B., Inganah, S., Sugianto, R., & Darmayanti, R. (2023). Urgensi Kebutuhan Komik: Desain Pengembangan Media Matematika Berwawasan Kearifan Lokal di Medan. *Delta-Phi: Jurnal Pendidikan Matematika*, 2, 130–146.
- Grubert, J. (2017). Towards pervasive augmented reality: Context-awareness in augmented reality. *IEEE Transactions on Visualization and Computer Graphics*, 23(6), 1706–1724. <https://doi.org/10.1109/TVCG.2016.2543720>
- Hwang, G. (2016). Effects of an augmented reality-based educational game on students' learning achievements and attitudes in real-world observations. *Interactive Learning Environments*, 24(8), 1895–1906. <https://doi.org/10.1080/10494820.2015.1057747>
- Javornik, A. (2016). 'It's an illusion, but it looks real!' Consumer affective, cognitive and behavioural responses to augmented reality applications. *Journal of Marketing Management*, 32(9), 987–1011. <https://doi.org/10.1080/0267257X.2016.1174726>
- Kerawalla, L. (2006). "Making it real": Exploring the potential of augmented reality for teaching primary school science. *Virtual Reality*, 10(3), 163–174. <https://doi.org/10.1007/s10055-006-0036-4>
- Liu, L. (2019). Edge assisted real-time object detection for mobile augmented reality. *Proceedings of the Annual International Conference on Mobile Computing and Networking, MOBICOM*. <https://doi.org/10.1145/3300061.3300116>
- Majid, N. W. A., Titiana, E. S., Nurhanifa, R., Yolandini, B., Akbar, R., & Sumiati, T. (2022). Ketimbang Main: Augmented Reality-Based Application to Improve Students' 4Cs. In A. Samsudin, L. Hasanah, G. Yuliani, M. Iryanti, Y. F. Kasi, A. S. Shidiq, & L. Rusyati (Eds.), *AIP Conference Proceedings* (Vol. 2468). American Institute of Physics Inc. <https://doi.org/10.1063/5.0102567>
- Marescaux, J. (2004). Augmented-reality-assisted laparoscopic adrenalectomy. *JAMA*, 292(18), 2214–2215.
- McKnight, R. R. (2020). Virtual Reality and Augmented Reality—Translating Surgical Training into Surgical Technique. *Current Reviews in Musculoskeletal Medicine*, 13(6), 663–674. <https://doi.org/10.1007/s12178-020-09667-3>
- Merians, A. S. (2002). Virtual reality-augmented rehabilitation for patients following stroke. *Physical Therapy*, 82(9), 898–915. <https://doi.org/10.1093/ptj/82.9.898>
- Milgram, P. (1995). Augmented reality: a class of displays on the reality-virtuality continuum. *Proceedings of SPIE - The International Society for Optical Engineering*, 2351, 282–292.
- Morimoto, T. (2022). XR (Extended Reality: Virtual Reality, Augmented Reality, Mixed Reality) Technology in Spine Medicine: Status Quo and Quo Vadis. *Journal of Clinical Medicine*, 11(2). <https://doi.org/10.3390/jcm11020470>
- Mourtzis, D. (2020). Real-time remote maintenance support based on augmented reality (AR). *Applied Sciences (Switzerland)*, 10(5). <https://doi.org/10.3390/app10051855>
- Muhammad, I., Angraini, L. M., Darmayanti, R., Sugianto, R., Usmiyatun, U., & ... (2023). Students' Interest in Learning Mathematics Using

- Augmented Reality: Rasch Model Analysis. *Edutechnium Journal of Educational Technology*, 1(1), 89–99.
- Ong, S. (2020). Augmented reality-assisted robot programming system for industrial applications. *Robotics and Computer-Integrated Manufacturing*, 61. <https://doi.org/10.1016/j.rcim.2019.101820>
- Qomariyah, S., Darmayanti, R., Rosyidah, U., & Ayuwanti, I. (2023). Indicators and essay problem grids on three-dimensional material: Development of instruments for measuring high school students' mathematical problem-solving ability. *JEMS: Jurnal Edukasi Matematika Dan Sains*, 11(1), 261–274.
- Rauschnabel, P. A. (2021). Augmented reality is eating the real-world! The substitution of physical products by holograms. *International Journal of Information Management*, 57. <https://doi.org/10.1016/j.ijinfomgt.2020.102279>
- Rubio, J. (2018). Monographic: Music education and audio-visual media. *Revista Electronica de LEEME*, 42, 52–53. <https://doi.org/10.7203/LEEME.42.13535>
- Safitri, D., Marini, A., Yunaz, H., Putra, Z., Nuraini, S., Rihatno, T., & Ibrahim, N. (2021). Augmented Reality-based ecolabel model for environmental awareness. *IOP Conference Series: Materials Science and Engineering*, 1098(5), 52024.
- Sah, R. W. A., Darmayanti, R., & Maryanto, B. P. A. (2022). Updating Curriculum Through 21st Century Learning Design. *Seminar Nasional Teknologi Pembelajaran*, 2(1), 127–142.
- Satrio, I. R., Effendy, V., & Junaedi, D. (2019). Modelling Augmented Congklak using Cycle of Digital Augmentation Method. *2019 7th International* .... <https://ieeexplore.ieee.org/abstract/document/8835293/>
- Slater, M. (2020). The Ethics of Realism in Virtual and Augmented Reality. *Frontiers in Virtual Reality*, 1. <https://doi.org/10.3389/frvir.2020.00001>
- Su, L. M. (2009). Augmented Reality During Robot-assisted Laparoscopic Partial Nephrectomy: Toward Real-Time 3D-CT to Stereoscopic Video Registration. *Urology*, 73(4), 896–900. <https://doi.org/10.1016/j.urology.2008.11.040>
- Wagner, D. (2010). Real-time detection and tracking for augmented reality on mobile phones. *IEEE Transactions on Visualization and Computer Graphics*, 16(3), 355–368. <https://doi.org/10.1109/TVCG.2009.99>
- Yung, R. (2019). New realities: a systematic literature review on virtual reality and augmented reality in tourism research. *Current Issues in Tourism*, 22(17), 2056–2081. <https://doi.org/10.1080/13683500.2017.1417359>