

# Preservice Elementary School Teachers' Need for Interactive Multimedia Based on Augmented Reality in Science Learning

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**Abstract:** Technological development in the 21st-century learning requires the development of interactive multimedia in science learning in elementary school teacher education. The purpose of this study is to describe the pre-service elementary school teachers' need for interactive multimedia based on augmented reality (AR) in science learning. This study used descriptive quantitative method. Samples were taken using purposive random sampling consisted of 148 pre-service elementary school teachers. The instrument of the study was a valid questionnaire ( $r_{\text{value}} > r_{\text{table}} = 0.361$ ) and reliable (Alpha Cronbach coefficient = 0.912). The results can be concluded that: 1) pre-service elementary school teachers' had a good perception of interactive multimedia based on AR for improving science learning quality; 2) the science learning media was needed to involve various media (multimedia); interactive; presents more real objects; attractive design; friendly; and equipped with instructions. The development of interactive multimedia based on AR in science learning was urgent.

**Keywords:** *augmented reality, interactive multimedia, preservice elementary school teacher, science learning*

## INTRODUCTION

Elementary school teacher education programs should be able to prepare new teachers to act skillfully while doing complex teaching at the elementary school, including teaching science. Teaching science in elementary schools should be fun and useful (Greenspan, 2016; Pasha et al., 2012), so that it can be a way for students to learn about themselves and the natural surroundings, as well as prospects for further development in applying them in their daily lives day (BNSP, 2006). The teacher has an important role in classroom learning activities. In addition to having knowledge of the concept of science, teachers must also have the skills to teach science. Knowledge of subject matter is necessary for the teacher to effectively deal with questions that students may ask (Aydeniz & Brown, 2010). In order to fulfill these skills, the teacher's ability to think critically is needed. The teacher must be able to find and assess relevant and credible information, and be able to analyze scientific concepts in order to making decision.

Elementary school teachers also need to develop an environment which allows students to study science (National Research Council, 1996). Teachers with high teacher efficacy has a positive influence on student outcomes such as motivation, achievement and students' personal self efficacy (Can, 2015). Therefore, science education in elementary school teacher education programs needs to be designed using a constructivism approach. Pre-service elementary school teacher being trained in using technology in the science classroom (Pasha et al., 2012) because it has become an inseparable part of elementary school teachers for educational practice (Hlásná et al., 2017). The development of information technology-based media using smartphones is one way to build critical competence of teachers in learning science.

The development of smartphone technology provides users in the form of data and information, as well as various multimedia contents and interesting applications which can be utilized in the development of interactive multimedia in universities. Multimedia programs and multimedia learning environments have the potential to increase the type of information that is accessible to students and active participation (Lloret et al., 2009). An increased availability, sophistication and use of these devices have the potential to improve efficiency and effectiveness in learning, in addition to improving learning outcomes and work skills (Morris & Lambe, 2017). Interactive multimedia presents material in an effective, efficient and interesting way to help students achieve optimal learning outcomes. Interactive multimedia can be used by students to improve good understanding to improve their ability to solve problems in science learning (Rajendra & Sudana, 2018).

New Media Consortium released Horizon Report in 2012 which stated that augmented reality (AR) technology is the latest technology for teaching, learning, and creative research (Tekedere & Göker, 2016). Augmented reality as a system that can combine real and virtual environments, run interactively in real time, and integrated with three dimensions (3D) (Azuma, 1997). AR allows virtual objects produced by computers to be placed on physical objects (video, sound, photos, text, 3D models, etc.) in real time (Ozdemir et al., 2018; Tekedere & Göker, 2016). The seamless integration of digital information with the real world environment makes the boundary between the two very thin. Users can interact with virtual objects that are inserted in the surrounding real scenes and gain the most natural and genuine human-computer interaction experience (Cai et al., 2014). AR technology could be an interesting technology choice being applied as interactive multimedia in science learning in elementary school teacher education programs, ensuring learning by doing, and learning based on experience.

Using AR technology in learning process according to the idea of constructivism learning because learners can control their own learning processes and manipulate objects that are not really in an enlarged environment to gain understanding and knowledge (Wang, 2012). Dewey (1938) states that we have to recognize that there is no kind of thing as knowledge "out there" independent of the power, but only knowledge, we construct for ourselves as we learn (Hein, 1991). Strengthened by Piaget (1977) confirms that learning does not occur passively; rather it occurs by active construction of meaning. By explanations above, Piaget focuses more on learners as individuals who add new concepts to prior knowledge to build their own understanding (Henson, 2003). Through 3D interaction facilities that exist in interactive multimedia based on AR, certain concepts will be easily learned by students (Martín-Gutiérrez et al., 2010).

The use of AR-based interactive multimedia in science learning offers us new ways to interact with the physical world (real) (Grubert & Grasset, 2013). Application of AR technology in mobile devices creates new types of services and applications that can improve the quality of science learning (Joan, 2015). Interactive multimedia based on AR in science learning at elementary school teacher education is expected to give pre-service elementary school teacher the opportunity to deepen their knowledge in different and interesting ways. For example, students learn the concept of earth structure and various types of rocks in Indonesia. Through the use of multimedia with AR technology, pre-service elementary school teachers see objects of earth structure, layers of the earth, and various types of rocks that exist in Indonesia that are not easily modeled in the classroom to become more real.

The use of AR technology in science learning has been studied by Techakosit & Wannapiroon (2015). The results of the study conclude that learning physics with AR can help students to gain a better understanding of the concept of electromagnets. AR-media applications

in science learning are similar to this research. Nevertheless, in contrast to previous research applied at the high school level, this study was aimed at Elementary School Teacher Education Program with a more complex scope of material. The development of interactive multimedia based on AR in science learning for a pre-service elementary school teacher is new that has never been studied before in Indonesia. The integration of technology and media in 21st-century learning in elementary school teacher education programs is an element of novelty so that pre-service elementary school teachers can understand learning material widely and in depth, and can solve problems in science learning.

The purposes of this study were to explore the perceptions of pre-service elementary school teachers toward the importance of interactive multimedia-based AR in science learning and to describe pre-service elementary school teachers' needs for interactive multimedia based on AR in science learning. The results of this study are very useful as information material and reference for researchers to develop interactive multimedia based on AR in science learning at elementary school teacher education programs.

## **METHOD**

This study used descriptive quantitative method that aimed to explore pre-service elementary school teachers' perception toward the importance of interactive multimedia based on AR in science learning and knowing pre-service elementary school teachers' needs for interactive multimedia based on AR for science learning at elementary school teacher education. Respondents in this study were pre-service elementary school teachers for the third semester in the academic year of 2018/2019. The selection of respondents was purposively sampled taking into account that respondents were a pre-service elementary school teacher who contracted the Basic Concepts of Sciences' Courses (BCSC).

The data collection techniques used questionnaires. The research instrument was a questionnaire consisting of four aspects: science learning for a pre-service elementary school teacher, the science learning process at elementary school teacher education program, the importance of interactive multimedia based on AR, and the pre-service elementary school teachers' need for interactive multimedia-based AR in science learning. The questionnaire used in this research has been tested the validity and reliability test. The validity of the questionnaire instrument used correlation, while the questionnaire instrument reliability used Cronbach Alpha with a significance level of 5%. There were 19 items is valid because they had a correlation coefficient greater than  $r_{table} = 0.361$ . Alpha Cronbach coefficient was obtained = 0.912 which means the questionnaire instrument is reliable. Questionnaire sheets were given to 155 respondents, but 148 respondents (95.48%) responded. The collected data were analyzed descriptively.

## **RESULTS AND DISCUSSION**

There were 148 pre-service elementary school teachers in this study who responded to 19 statement items on the questionnaire instrument. Recapitulation of responses from respondents to questionnaire instruments is presented in Table 1.

**Table 1.** The Results of Pre-service Elementary School Teachers' Response

Aspect	Indicator	Agree		Disagree	
		F	%	f	%
Science learning for a pre-service elementary school teacher ("A" Aspect)	BCSC is important being taught in elementary school teacher education program	148	100.00	0	0.00
	BCSC provide basic knowledge about elementary school science	147	99.32	1	0.68
	BCSC is difficult	125	84.46	23	15.54
	Learning science needs to be supplemented by multimedia	144	97.29	4	2.71
Science learning process in elementary school teacher education program ("B" Aspect)	Attractive	63	42.67	85	57.43
	Interactive	82	55.41	66	44.59
	Trained to solve problems	89	60.14	59	39.86
	Use media based on ICT	70	47.30	78	52.70
The importance of interactive multimedia based on Augmented Reality ("C" Aspect)	Help pre-service elementary school teacher to achieve learning goals	141	95.27	7	4.73
	Using various types of media supports the effectiveness of learning	138	93.24	10	6.76
	Provide opportunities to participants in the form of responses from users	125	84.46	23	15.54
	Presenting 3D objects	144	97.30	4	2.70
	Supporting pre-service elementary school teacher learning independence	136	91.89	12	8.11
Pre-service elementary school teachers' need for interactive multimedia based on Augmented Reality in science learning ("D" Aspect)	Engaging various media (visual, audio, audiovisual)	148	100.00	0	0.00
	Interactive	145	97.97	3	2.03
	Presenting objects are more real	147	99.32	1	0.68
	Complete instructions	131	88.51	17	11.49
	Attractive appearance	140	94.59	8	5.41
	Easy to use (friendly)	135	91.22	13	8.78

Table 1 showed that pre-service elementary school teacher responses in "A" aspect indicate that science learning is still indispensable in elementary school teacher education programs; in "B" aspect shows that science learning in elementary school teacher education currently takes place less interactive and has not integrated technology and media into learning; in the "C" aspect, it is known that interactive multimedia based on AR was necessary and it has a strategic role for effective science learning in elementary school teacher education, and in "D" aspect can be seen that the development of interactive multimedia based on AR was urgent for science learning in elementary school teacher education.

The response of the pre-service elementary school teacher on "A" aspect indicates that all students agree that the BCSC is very necessary being taught in elementary school teacher education (100%); 147 pre-service elementary school teacher agreed that BCSC could provide them with basic knowledge about science in elementary school (99.32%); 125 pre-service elementary school teacher considered that the BSCS in elementary school teacher education was difficult courses (84.46%); and 144 pre-service elementary school teacher agreed that learning science in elementary school teacher education needs to be supplemented with multimedia to help students achieve competencies (97.29%). These results show that science learning in elementary school teacher education program was considered important by a pre-service elementary school teacher to equip them being ready to teach science at elementary school.

Most elementary school teachers rely on discussion and lectures, lack of confidence, and lack of preparation in teaching science (Fulp, 2002)Murphy et al., 2007). The implementation of science learning through BCSC in elementary school teacher education is a preventive effort to overcome these problems.

In “B” aspect, researchers try to uncover pre-service elementary school teacher responses to the science learning process that has been going on in elementary school teacher education. There are 85 out of 148 pre-service elementary school teacher assessing that the learning process of science in teacher education is not attractive (57.43%). In addition, the learning process of science in elementary school teacher education is considered not to have taken place interactively (only 54.41% of a pre-service elementary school teacher who rated it were interactive). Interactivity is based on reciprocal relationships and refers to an active learning process where students process information to turn it into something new (Oprea, 2014). This explanation shows that interactivity is very important in the learning process, so interactivity in science learning in elementary school teacher education still needs to be improved.

There was 89 pre-service elementary school teacher agreed that science learning in elementary school teacher education has involved them in problem-solving (60.14%). However, as many as 78 pre-service elementary school teacher responded that the use and access to technology-based learning media were still lacking (52.70%). This finding is in accordance with Rusdiansyah's reserach (2014) showed that lecturers are not using the media in science learning in elementary school teacher education. Meanwhile, The National Science Education Standards (National Research Council, 1996) revealed that teachers who are good at teaching science must create an environment in which they and students work together as active learners. Thus, interactivity and science learning activities in elementary school teacher education program need to be improved. Moreover, prospective elementary school teachers need to have the ability to teach science effectively and are able to use technology (85%).

Then, “C” aspect provides information about pre-service elementary school teachers’ perception of the importance of interactive multimedia based on AR in science learning in elementary school teacher education. As seen in table 2, there were 141 pre-service elementary school teacher agreed that the use of interactive multimedia based on AR could help them achieve learning goals (95.27%); 125 pre-service elementary school teacher agreed that the use of interactive multimedia based on AR in science learning can provide opportunities for participation in the form of responses from users (84.46%), as well as being able to present 3D objects, so that they are more real and interesting (97.30%). These results indicate that interactive multimedia based on AR is considered capable of helping pre-service elementary school teacher to gain knowledge and skills in teaching science. Relevant to previous research found that teachers need rich content knowledge to teach as a knowledge base that teachers use to teach content (Loewenberg Ball et al., 2008; Davis & Boerst, 2014).

Related to the effectiveness and independence of learning, there was 138 pre-service elementary school teacher agreed that the use of various types of media had positive implications for the effectiveness of science learning in elementary school teacher education (93.24%), and supporting pre-service elementary school teacher learning independence in science learning (91.89%). In accordance with the research of Hadiyanti's research (2015) concluded that pre-service elementary school teacher has a good or positive perception of the use of multimedia in science learning. This analysis also shows that the use of interactive multimedia based on AR can facilitate students to use technology in science classes in elementary school teacher education.

The “D” aspect of the questionnaire instrument aims to uncover the needs of -service elementary school teacher students for interactive multimedia based on AR in science learning. All respondents agreed that interactive multimedia based on AR must involve various media or multimedia (visual, audio, audiovisual). In addition, more than 90% of respondents said that they agreed that there were other conditions that were interactive (97.97%), presenting objects that were more real (99.32%), equipped with usage instructions (88.51%), and friendly (91.22%). The interesting appearance was still needed in the development of interactive multimedia based on AR in science learning at elementary school teacher education program (94.59%). The development and implementation of innovative pedagogic technologies, especially interactive, in student learning are needed (Abykanova et al., 2016). These results indicate that the characteristics required by pre-service elementary school teacher in science learning are in accordance with the characteristics of interactive multimedia based on AR technology, as combining real and virtual environments, interactive in real time, integration in three dimensions, not limited to media with visual sense only, but hearing (audio), and touch (Azuma, 1997; Liang & Roast, 2014).

## CONCLUSION

The conclusion of this study was (1) Pre-service elementary school teachers' had a good perception of interactive multimedia based on AR for improving science learning quality; (2) the science learning media was needed to involve various media (multimedia); interactive; presents more real objects; attractive design; friendly; and equipped with instructions. The results show that the learning process of science in Pre-service elementary school was less interactive without interactive multimedia. Development of interactive multimedia-based AR was urgent for science learning in elementary school teacher education. Good media development is fulfilling pre-service elementary school teachers' need for media products as potential users. The results of this study are very useful for the development of interactive multimedia based on AR, effective and according to the needs of a pre-service elementary school teacher in science learning.

## ACKNOWLEDGMENTS

This article is one of the outputs of research funded by the Ministry of Research, Technology and Higher Education of the Republic of Indonesia. Thank you to the Research, Technology and Higher Education of the Republic of Indonesia who provided funding for the entire organization of this research.

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