

## Chapter 3

# Mathematics Learning With Augmented Reality in Early Childhood Education

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### ABSTRACT

*With the rapidly developing technology, the use of AR applications in the educational process is becoming widespread as a new field of study. When the literature was examined, there were no studies investigating AR applications and evaluating them as a mathematics education tool in early childhood. In this context, this study aims to determine the AR applications that can be used in the early childhood mathematics education process and to examine the content, mathematical skills, and functionality of these applications.*

## **INTRODUCTION**

Early childhood is a critical period in which many skills, attitudes and competencies are acquired. For this reason, in order to support development at an optimal level, the content of the education to be given at this age should be planned in an appropriate way for their age, level of development and needs of children, contains rich stimuli, and ensures school-family-environment cooperation. Nowadays, the spread of technology often causes children to encounter technological tools in the environment they live in. In this context, it has become important to equip children with the competencies to handle these tools and integrate technology into their educational processes. Teachers will be provided with convenience in terms of time, effort, and economy as a result of materials and activities for mathematics to be developed with augmented reality (AR) technology, having been on the agenda quite a lot lately. Although there are some educational applications, these applications may not address the needs of every child, and constantly doing the same activity may limit the learning outcomes of children. This section provides explanations and application examples about mathematics education in early childhood and the use of technology in this process, AR technology, early childhood usability principles, and the use of AR technology in early mathematics education.

### **The Importance of Mathematics Education in Early Childhood**

From the first moment they interact with objects and their environment, children are introduced to various mathematical contents, such as numbers, spatial perception, and patterns and acquire basic mathematical skills over time (Clements & Sarama, 2014). Children progress in mathematics in line with their individual interests and development; thus, different methods and techniques may be needed for them to form positive emotions toward mathematics, and to actively participate in the educational process (Cross et al., 2009; Fuson et al., 2015). Negative mathematics experiences and failure to provide qualified mathematics environments (Guss et al., 2022) may decelerate the tendency towards mathematics and this may cause differences between them and their peers (Copley, 2004; National Association for the Education of Young Children (NAEYC) & National Council of Teachers of Mathematics (NCTM) 2010; Rittle-Johnson, 2017). Instead of direct instruction in mathematics education, when educational environments and teaching processes are created to support children's thinking, questioning, and discovering mathematical procedures and discovering, children may have surprisingly flexible, complex, and critical mathematical thoughts and develop their own way of thinking (Clements, & Sarama, 2016).

Children become more effectively involved in the mathematics process in an educational environment prepared according to their own interests and needs. The NAEYC and NCTM (2010) emphasized that quality mathematics education provided before school is the basis for future mathematics teaching. They consider it necessary to present programs and teaching practices that are effective on children in this process, leading children to research and discovery. High-quality mathematics education in the early years also forms the infrastructure of children's academic skills in their future lives (NAEYC, 2010; Rittle-Johnson, 2017).

Technology is one of the important opportunities that can be used to support mathematical skills in early childhood, enrich the educational environment, and ensure the active participation of children in the educational process. Children need opportunities to think and learn mathematics in depth and comprehensively. It can be difficult to find quality technology-based early math experiences for children. For this reason, there is a need for studies about how the content of technology-based resources should

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