

## Chapter 51

# Interactive Books in Augmented Reality for Mobile Devices: A Case Study in the Learning of Geometric Figures

**Ana Grasielle Dionísio Corrêa**  
*Universidade Presbiteriana Mackenzie, Brazil*

### ABSTRACT

*One of the methods of teaching that has brought significant contributions to the field of education is augmented reality. This technology transformed learning into a more motivating, enjoyable, fun, and interesting activity. This chapter contributes an augmented reality application for mobile devices that complements and supports the learning of geometric figures. The application, called AGeRA, consists of a geometry book and software capable of reading special markers inserted into the book's content. When this book is placed in front of the camera of a mobile device, 3D objects, sounds, animations, and other interactive elements leap from book pages making learning more fun and exciting. Preliminary tests were made with teachers and students and showed good acceptance of the application to support the teaching of geometry.*

### INTRODUCTION

Evolution of mobile devices such as laptops, Personal Digital Assistants (PDAs), mobile phones and tablets led to emergence of a new field called Mobile Computing. According to Guan et al (2011), Mobile Computing is treated as a new computing paradigm that enables users to manipulate digital information remotely from anywhere and at any time. It is a concept that involves processing, mobility and communication

through wireless network, which eliminates the need for users to be always connected to a fixed network structure.

Mobile applications demand for support of these technologies. Therefore, new solutions and services have grown exponentially with development of devices. Currently it is possible to find a variety of applications in various areas of knowledge, eg, economics (Giridher et al, 2009), banking (Ciurea, 2012), medicine (Merdes; Laux, 2002), education (Kun et al, 2011), among oth-

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ers. In particular, in education, the use of mobile devices for teaching and learning has expanded the area of computer education creating a new concept called “Mobile Learning” or “M-Learning” (Wei, Liqiang, 2011). This new educational paradigm enables the learner to access content and interact with teachers and classmates from anywhere.

One main factor for the spread of mobile devices in education can be explained, in a first analysis, by the significant number of users in all age groups (Mishra, 2009), (GSMA, 2010). According to Benedek (2012, pp.17), it is estimated that in 2013 there will be 4.5 billion mobile phone users worldwide using entertainment services, community information and social networking. The low cost of the devices and mobile services, in comparison with the values of computers and Internet services, increased demand for applications to support teaching and learning (Lane et al, 2010). The teacher should look to expand his/her potential for teaching and learning, since such devices are meant for communication between users, i.e. send and receive calls and messages.

Besides the low cost, technological developments in mobile telephony has enabled the development of increasingly powerful mobile devices, with greater processing power, multimedia features and loads of sensors such as compasses, accelerometers and cameras (Lane et al, 2010). These device characteristics caused the spread, in large-scale, of augmented reality applications (Olsson; Salo, 2011). This technology makes it possible to integrate the real world with 3D virtual elements (Azuma et al, 2001); which can arouse the learner’s curiosity and so makes the learning process more attractive, fun and motivating (Fotouhi-Ghazvini et al, 2009), (Balog et al, 2007), (Shelton, Hedley, 2002).

For all these reasons, this paper presents the research and development of an educational augmented reality application for mobile devices called AGeRA. This is an interactive book with augmented reality for teaching and learning of geometric figures. When looking at the book, it

seems like other conventional books. However, when the book is placed in front of a camera on a mobile device, 3D objects, sounds, animations, textual explanations and other interactive elements, leap from its pages. These features added to the physical book can increase student interest and motivates them to explore the topics presented, thus enhancing learning.

Besides this introductory section, the chapter provides, in section 2, benefits of mobile learning, and discusses how mobile computing can be used as a teaching resource in the classroom. Section 3 presents the concepts and fundamentals of augmented reality technology and brings a study of papers that show the development of books created with augmented reality. In Section 4 we present the methodology of the AGeRA application development, detailing the choices of topic, target audience, functional requirements, interaction design, content covered in the book and the results of tests with users (students and teachers). Finally, in section 5, the main conclusions of this work and proposal to future works are presented.

## **MOBILE LEARNING**

Use of mobile devices in education provided a new educational paradigm, called M-Learning, since no more learning occurs in formal locations like classroom (Wei; Liqiang, 2011). Particularly for children, it offers many opportunities for students to work their creativity, while at same time it becomes an element of motivation and collaboration.

This definition is consistent with the idea of pervasive learning “*In essence, pervasive learning concerns the use of a technology the apprentice has in his/her hands to create learning situations more meaningful and relevant, authored by student*” (Zanella et al, 2007, p.2). Furthermore, these types of devices utilize open platforms, allowing deployment of low cost educational applications with potential for expansion and replication in several places (Lane et al, 2010).

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