Challenges and Possibilities
of Use of Augmented Reality in Education
Case Study in Music Education

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Abstract. This paper aims to discuss the difficulties and possibilities of using augmented reality in education, especially for musical education. Among the difficulties addressed are the following types of issues: physical, technological, sociocultural, pedagogical and managerial. The possible solutions presented involve the use of authoring tools that are easily usable by teachers. An augmented reality application to teach musical perception was developed using an authoring tool, and tests with children are presented and discussed.

1 Introduction

In recent years, computational resources have been increasingly present in the teaching–learning process. New technologies have provided advances in traditional teaching methods, which may make it easier for students to learn and also change the way that teachers share knowledge. In this new context, where educational issues are compelling and supported by technology in a basic and almost invisible way, educational applications should be simple to set up or adapt. They must also provide flexibility in their configuration, depending on the content generated or manipulated by the user. They must function with the minimal training that the potential user already has or that is in the domain of her/his social group, for instance, creating videos with mobile devices, manipulating videos in repositories such as YouTube, manipulating images and videos on social networks, using text editors, etc. These technological tools are dominated by users and can be mastered with ease, when those users have been exposed to environments where these technologies are naturally relevant [1].

The increasing use of these technologies in education has occurred primarily due to the lower costs of computers and the emergence of new software tools. However, some computer technologies, due to their peculiarities such as those involving Augmented Reality (AR), are not yet widely used. In a general analysis, we note that this is due to the disparity between the state of the art of these technologies and the time of

maturity at which they can be implemented effectively, that is, made available easily and affordably [2].

According to Azuma et al. [3] and Billinghurst [4], AR is a technology that enables the user to see the real world, with virtual objects superimposed upon or composited with the real world. An AR system has the following three characteristics: it combines the real and the virtual, it is interactive in real time and it is registered in 3D.

AR originated from another technology called virtual reality (VR). While VR can be defined as an advanced interface with computer applications, where the user can navigate and interact in real time in a 3D synthesized environment, using multisensory devices, AR simplifies its use. A nonconventional device is not required; just a webcam and markers are needed [5].

AR was indicated by the Horizon Report [6] as one of the technologies that will revolutionize education in the coming years. This is due to its fun and interactive features, among other reasons. The use of AR education applications is made possible by the cheapening and improvement of the hardware and the need for more user-friendly interfaces for interaction with nonexpert users along with the indispensability of working with other ways of teaching, using active practices. In this sense, using computers in the classroom may allow the simulation of situations not previously possible or imagined.

This article aims to discuss the difficulties and possibilities of using AR in education. A case study was developed in the musical education area, using an authoring tool. This choice was made because since 2008, music education has again become mandatory content in Brazilian schools (Law No. 11,769 of August 18, 2008); therefore, greater attention must now be paid to the use of technology in this area of knowledge, motivating students and allowing learning beyond the classroom. Another relevant factor is the small number of studies using AR and musical education [7] [8].

This paper is organized as follows. In sections 2 and 3 are discussed some of the challenges and possibilities of the effective use of AR in education. Section 4 presents the Music-AR application for music education using AR. Section 5 shows tests performed with the application, as well as the results obtained. Finally, the implications of this work are discussed in section 6.

2   Challenges for the Effective Use of Augmented Reality

The effective deployment of emerging technologies such as AR is still a challenge, because it requires the overcoming of various barriers. The first relates to physical and technological issues, dealing with the gap between the process of development proposed in software engineering for interactive applications [9, 10] and how these projects are being developed. The second relates to sociocultural issues. The last barrier is related to pedagogical and management issues. Although one of the areas most cited for the potential use of emerging technologies is education, very few projects are in fact implemented in schools to support learning in an effective way.