Chapter 64
Mobile Game-Based Learning in STEM Subjects

Marcelo Leandro Eichler
Universidade Federal do Rio Grande do Sul, Brazil

Gabriela Trindade Perry
Universidade Federal do Rio Grande do Sul, Brazil

Ivana Lima Lucchesi
Universidade Federal do Rio Grande do Sul, Brazil

Thiago Troina Melendez
Instituto Federal Sul-Riograndense, Brazil

ABSTRACT

The acronym STEM (science, technology, engineering, and mathematics) has entered the agenda of educational policies. The development of mobile game-based learning has been seen as a new line of research and technological development in the field of educational technology, STEM education, and game design. These fields are rather new and intrinsically multidisciplinary, making it even more exciting. There is a growing interest in mobile game-related research, whether strictly technological or applied in social contexts. In this chapter, the authors thought a nice way to connect this data and depict the current scenario would be to break the subject into pieces: game design; affection and play; mobile learning; games for learning; science and mathematics education; and lastly, summarizing it in the games for STEM education section. The conclusions point to the fact that we are taking the first steps in a digital game development process for teaching mathematics in the school environment and the acceptance of smartphones as tools that add value to education.

INTRODUCTION

The acronym STEM – Science, Technology, Engineering, and Mathematics has entered the agenda of educational policies. Particularly remarkable is the Horizon Report by Johnson et al. (2013), which identified the most notable and emerging issues, trends and digital technology challenges in STEM education for the coming years.

DOI: 10.4018/978-1-5225-7365-4.ch064

In today's schools, teaching about STEM may take place in many general education and career and technical education subject areas such as agriculture, science, health, technology and engineering, and family and consumer science. Learning about the attributes of STEM and how they connect can help promote innovation. At the collegiate level, STEM education encourages students to pursue STEM careers in order to meet the growing demand for trained professionals in these areas (Reeve, 2015).

The concept of STEM education is being discussed differently by different nations. Whereas some deem STEM education as the improved teaching of the separate STEM subjects, others believe STEM should be taught through an integrative subjects approach. Many believe it is a combination of both of these approaches. Different countries are exploring STEM due to political and economic pressures and because some believe it is a means to improve the delivery of such knowledge (Ritz & Fan, 2015).

We acknowledge the strategic role of science and mathematics learning. But how to foster it? "Games" might be a promising answer. Games are successful at making people spend time trying to reach goals via a well structured set of rules - and STEM domains are also bound by well structured rules. Thus, if we could make games that would embed the rules of those domains into their gameplay, well, maybe our students would enjoy learning science and mathematics. Rapini (2012) points out that games are now being revisited as educational tools by several leading organizations, i.e.: MIT's Education Arcade and Games-to-Teach project; Woodrow Wilson Foundations' Serious Games Initiative; University of Wisconsin's Games Learning Society; the Federation of American Scientists; the Bill and Melinda Gates Foundation; and the U.S. Department of Education. Some of them - markedly those from MIT's Education Arcade project - have been developed with mobile devices in mind.

Regarding mobile device widespread use in STEM education, Johnson et al. (2013) indicated the relevance of games and gamification in STEM learning and teaching: a) discovery-based and goal-oriented learning is inherent in educational games and this strategy offers opportunities for collaboration and development teamwork skills; b) educational games can be used to teach interdisciplinary concepts in many complex scientific issues in a more appealing way than traditional methods; c) simulations and serious games allow students to recreate difficult situations to try new answers or pose creative solutions.

And, lastly, our choice to narrow the focus of this paper down to mobile devices is due to the impressive influence they have over our lives and to the amount of time we spend on them. The revolution of mobile devices + wide internet access is so deep that it is making the very action of "making a phone call" obsolete. We have been using mobile devices for a myriad of tasks - so how can we use them for learning purposes? These are the concerns presented in this paper.

BACKGROUND

The development of mobile game-based learning has been seen as a new line of research and technological development in the field of educational technology, STEM education and game design.

These fields are rather new and intrinsically multidisciplinary, making it even more exciting. Regarding the use of mobile devices for teaching and conceptual learning, we can highlight the work of John Traxler. He is the Director of the Learning Lab at the University of Wolverhampton and a Founding Director of the International Association for Mobile Learning, among many other academic attributions related to m-learning.

Due to their role as pioneers on Multimedia Studies, we cite professor Richard Clark – from the University of Southern California – and professor Richard Mayer – from the University of California –