Science Learning Games for Mobile Platforms

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INTRODUCTION

Games for mobile platforms are software intentionally designed to convey learning activities. In this paper, we will focus on STEM games for smartphones and tablets - not portable consoles such as the Nintendo DS or notebooks. In this paper, we shall be using the same definition Neil et al (2005, p. 460) used for games: "rules that describe allowable player moves, constraints, privilege and penalties for illegal actions."

The focus on science learning is because it is strategic; investments in Science and Engineering education are highly correlated with a nation's technological development. However, talents in these areas are hard to cultivate. Mayo (2007), for example, points to several US reports which indicate that the performance of North American students, from K-12 to universities, can be largely improved. Asian nations largely encourage students to pursue a career in Science and Technology, Nobel Laureate (Chemistry) Rick Smalley estimated that by 2010, 90% of the world's Ph.D. scientists and engineers will be Asians living in Asia. In Brazil - which lags far behind the US and Asian nations on international tests like PISA - the government has been attempting to foster scientific development in Science and Technology through a support program called "Sciences without borders," which, in 2013, had already distributed more than 49 thousand scholarships for graduates and post-graduates to study abroad for 6 months; a $2 billion investment.

We acknowledge the strategic role of Science 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 Science and Technology domains are also bound by well structured rules. So, if we could make games which would embed the rules of these domains into their gameplay, well, maybe our students would enjoy learning science. 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 - were developed with mobile devices in mind. Regarding mobile device widespread use, according to Nielsen Research (2013), by 2013 53% and 61% of citizens in the US and UK owned a smartphone. This report also indicates over 80% of ownership of mobile devices in Australia, Brazil, China, India, Italy, South Korea, Russia, Turkey, United Kingdom and United States. Regarding application type, this report states that only in Australia, Turkey and India less than 50% of users play games.

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. It has been 6 years since Apple released the 1st generation iPhone in 2007, creating a brand new market. 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.

OVERVIEW

The development of science learning games for mobile devices has been seen as a new line of research and technological development in the field of educational technology, science education and information design.

It is difficult to name pioneers or leading scholars in these fields (Games and Learning; Mobile Learning; Science Education and Game Design), not because it is rather new but because it is intrinsically multidisciplinary. One pioneer on Games For Learning studies is certainly professor James Paul Gee, from the University of Wisconsin-Madison. In 2003, he wrote the [perhaps] most influential book on the subject: *What video games have to teach us about learning and literacy?* He could also be pointed out as a leading scholar, since he is a prolific author. Another author who could also be named as a pioneer and leading scholar is MIT professor Eric Klopfer, director of Scheller Teacher Education Program and of The Education Arcade project. Professor Klopfer's main contributions are in the field of Mobile Learning.

Regarding Science Learning, we would like to cite a landmark paper instead of pioneers. The 1978 paper *Pupils and Paradigms: a Review of Literature Related to Concept Development in Adolescent Science Students*, cited over one thousand times, consolidates the findings of a pulsating new area of research and sets the grounds for the raise of the "alternative conceptions movement."

Professor Rosalind Driver (1941-1997) was a lecturer at the University of Leeds and was awarded several academic distinctions. She wrote many influential books such as *Pupil as Scientist?* from 1983. Jack Easley, professor at the University of Illinois, was professor Driver's mentor and also wrote a large number of papers and books. The "alternative concepts" movement is no longer a main area of research, but its methods and results are of primary importance for Science Education research.

As to Design and Multimedia Studies, we would cite as pioneers professor Richard Clark – from the University of Southern California - and professor Richard Mayer - from the University of California - since they are on both sides of the scale: Clarks says instructional design is all that matters; Mayer says multimedia design is also a key for effectiveness. Professor Robert Kozma - currently (2013) emeritus director and principal scientist of the Center for Technology in Learning - could be pointed out as a leading scholar. His numerous publications focus on the potential of IT in learning contexts, as well as Science Education (he is a multidisciplinary researcher).

And lastly, regarding Game Design, we would highly recommend our readers the work of Staffan Björk, Göteborg University, Sweden, who is certainly one of the leading scholars in the field.

CURRENT SCIENTIFIC KNOWLEDGE IN SCIENCE LEARNING GAMES FOR MOBILE PLATFORMS

There is a growing interest in Mobile Game related research, whether strictly technological or applied in social contexts. We thought a nice way to connect this data and depict the current scenario would be to break the subject into pieces: Game Design; Mobile Learning; Games for Learning; Science Education and lastly summarizing it in the Games for Science Education section.

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