Chapter 14
Visualising the Invisible in Science Centres and Science Museums: Augmented Reality (AR) Technology Application and Science Teaching

Hannu Salmi
University of Helsinki, Finland

Sofoklis Sotiriou
Ellinogermaniki Agogi Foundation, Greece

Franz Bogner
University of Bayreuth, Germany

ABSTRACT
This chapter presents an implementation of augmented reality (AR) technology in science education. While this technology up to now mainly was used by very special users such as the military and high-tech companies it gradually converts into wider educational use. Specific research programmes such as CONNECT and EXPLOAR applied this technology with a specific focus on selected learning scenarios by a close co-operation of formal education and informal learning. Empirical effects related to intrinsic motivation and cognitive learning of students (n: 308) were encouraging. The implementation of augmented reality in the context of the “Hot Air Balloon” exhibit at Heureka science centre in Finland unveiled encouraging results. While the high achievers again did best in the post-knowledge test, low achievers again were clearly catching up with the others. The difference to between the treatment and the control group was clear. It seems like that visualising a very theoretical scientific phenomenon increased the individual understanding substantially especially for those students who otherwise had severe difficulties. This is an essential result which needs further analysis. The “new educational model & paradigms” was monitored for 182 teachers. The main focus, however, pointed to a feedback of in-service teachers and teacher students since they act as key players in the use and acceptance of any new educational technology or curriculum renewal. The main objectives were as follows: (i) From a teacher-controlled learning towards a pupil-orientated learning; (ii) connecting of ICT-AR with and between existing learning environments; and (iii) changes in roles and responsibilities of students and teachers.

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INTRODUCTION

Museums of the past sought artifacts, museums of the future will show facts

Otto Neurath
Museums of the future
Survey Graphic, 1933

Schools and the informal learning sector increasingly collaborate and provide an increasing value for lifelong learning combined as well as they contribute to the debate over values and utilities of digital resources. This debate includes an access to and a sharing of advanced tools, services and learning resources, whether it offers unique informal learning opportunities to visitors of science museums and science centers through its demonstration of a new method of interaction between a visitor and an exhibition. Over the last years digital media has increasingly entered the field of museums and science centers. Traditional media such as illustrated charts and audio guides together with interactive exhibits take the knowledge transfer to a complete new level of experience. The “Museums of the Future” of Neurath & Cohen (1973) focusing on facts rather on artifacts seems to come very close to this view. In their different ways, traditional science museums - with permanent collections, displayed in a historical context, and thematic exhibitions - and educational, interactive “science centres” are encouraging a more diverse range of people to explore the various fields of scientific knowledge - and their applications. Museums have an important role to play in facilitating lifelong learning, in terms of creative, cultural and intercultural activity beyond any merely vocational aspects. Lifelong learning, museums and digital technologies share many of the same attributes, with emphasis on learning from objects (rather than about objects) and on strategies from discovering information (rather than the information itself).

Since a few years, the number of virtual visitors to many museums’ websites had already overtaken the number of physical visitors on-site (Hin, Subramaniam & Meng, 2005; ASTC 2009). These developments, both within the walls of the institution and outside, provide a number of challenges for educators and curators, at the heart of which lie the questions – what is distinctive about learning in science museums and science centres, and how might this change or evolve through the increasing use of digital technologies? These questions go to the heart of significant debates in this sector – how does learning in museums differ from or complement learning in schools? How can museums fulfil their potential to support lifelong learning? Should effort and money be spent primarily on the visitors who will enter the walls of the institution or those who will virtually explore the site through the web? What is the role of objects in the process of learning with digital technologies? How does the relationship between museum educator and learner change as technologies are developed?

Augmented Reality (AR) is about to join the described developments. With AR it is possible to combine real objects with virtual ones and to place suitable information into real surroundings. The possibility of AR to make convergence of education and entertainment is becoming more and more challenging as the technology optimises and expands to other areas. Natural or historical events and characters, reconstructed monuments or archaeological sites could be simulated and augmented to the real world. AR is a booming technology which attracts more and more attention from HCI (Human Computer Interaction) researchers and designers. This allows the creation of meaningful educational experiences. As these experiences are grounded in a substantive subject area of knowledge, they focus on the intellectual and emotional development of the viewer; therefore, AR learning environments have possession of both, educational and entertainment value.
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