Investigating the added value of interactivity and serious gaming for educational TV

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ABSTRACT

TV is a medium with high penetration rates and has been suited to deliver informal education in several aspects since years. Thus, interactive TV may play a significant role in the current Life-Long Learning challenges, provided that meaningful applications are implemented. In this research work, we have explored the added value of interactivity in digital TV, with a particular focus on Serious Games (SGs), given their growing relevance in technology-enhanced learning. We have followed an evolutionary rather than revolutionary approach, in particular given the still traditional use of TV by a large audience. The approach preserves a media-driven strategy and the role of the author/director in proposing contents (storytelling), as in the TV tradition. We argue that interactive SGs may help the viewer to better contextualize/understand the video stream and go more in depth about the touched items at the end of the stream. This also enables new iTV applications, in particular to support weaker users (i.e. users that could not view the video without a help). This paper presents the results from user tests based on an interactive enhancement of a clip from the Disney's Snow White movie, that challenged the authors in addressing a dynamic, high-value document. Qualitative and quantitative results show the potential of the system for informal education. The tests also stress the importance of good solutions (e.g., development languages, display modalities, metaphors) for synchronizing video and overlaid interactive elements. To the best of our knowledge, this research work is the first one discussing user test results about the usefulness of a class of iTV SG applications that can be instantiated serially in several different contexts.

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1. Introduction

Life-long learning has become an ever more relevant aspect of current education policies (Field, 2006; Lifelong-Learning EC, 2010). Since life-long learning involves a variety of users, styles, contents and situations, a number of tools, products and services have been developed in order to meet different needs and opportunities.

In this context, PC-based e-learning has been extended with other technological supports, leading to mobile learning (m-learning) (Quinn, 2000; Sharples, 2000), and t-learning (Aarreniemi-Jokipelto, & Kalli, 2006), which exploits interactive Digital TV (iDTV, or iTV) (Lee, 2007).

(PJB, 2003) provides a global analysis of the challenges concerning the development of digital TV-based interactive learning at home. The report makes recommendations for policy and decision makers, broadcasters and other players as to devise and exploit iTV solutions to increase learning opportunities at home, in particular addressing issues such as widening participation to learning and overcoming the digital divide.

(Chorianopoulos & Leakos, 2007) report that the main rationale cited for adopting TV as a learning medium is its pervasiveness, as television is a familiar and reliable consumer device with more than 90% penetration in developed countries.

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The dominance of television is being challenged by other media forms and means of distribution, that allow for interactivity and mobility: in particular, Web information and entertainment and games (Ursu et al., 2008a). Young people between 16 and 24 years of age are the most avid adopters both of new technologies and forms of media consumption (Forrester, 2006; KPMG, 2007).

According to (Chorianopoulos & Leakos, 2007), "some researchers have identified a strong desire on the part of audiences for storytelling experiences, similar to the short documentaries commonly broadcast on TV today". For instance, (Vorderer, 2001) found that certain categories of TV viewers prefer less rather than more interactivity. The Cognitive Load Theory (CLT) stresses that information needs to pass through the working memory in order to be learnt and stored in long-term memory. This requires explicit teaching because of the limitations of the working memory (Sweller, 1988). So, interactivity should be carefully proportioned, in order not to overload the learner capabilities, in particular for beginners (Kirschner, Sweller, & Clark, 2006). iTV, combining traditional storytelling with some light forms of interactivity, looks promising to continue the historical TV education service. The issue is still debated. However, it is acknowledged that TV has had an important educational role (Chu & Schramm, 2004), which is being continued also through iTV (Aarreniemi-Jokipelto, 2005; Chorianopoulos & Leakos, 2007; Revelle, 2003).

In this context, it is important to investigate the fundamental question of what the added value of interactivity is for TV-supported education and, then, how to support authors in concretely and effectively exploiting this potential (Chorianopoulos & Leakos, 2007). The main contribution of the paper consists in this investigation, with a particular focus on education.

Since TV is typically perceived as an entertainment medium (Chorianopoulos & Leakos, 2007; Pazos Arias et al., 2008; Vorderer, 2001) and given the growing educational importance of Serious Games (SGs) (Prensky, 2003; Prensky, 2010; Van Eck, 2006), we (i) propose a class of t-learning SG applications that enrich documentaries/movies with programmable interactive elements, (ii) discuss how to leverage the potential of informal education in iTV and (iii) verify better knowledge acquisition through interactive gaming in a real-world user test.

The term Serious Game is wide and encompasses a range of applications from cell phones to highly demanding 3D interactions (Klopfer et al., 2007). In our case, the peculiar challenge is to give value to the typically video-stream oriented nature of TV programs (Pazos Arias et al., 2008) and keep into account the limited hardware/software capabilities of iTV computing and interaction devices (Morris and Smith-Chaigneau, 2005).

The remainder of the paper is organized as follows. Section 2 provides an overview of the related research. Section 3 presents the interactive application class we have investigated for enhancing educational videos. User tests with a real-world iTV SG are shown in Section 4, while Section 5 discusses the lessons we learnt in designing synchronous iTV applications. The final section draws the conclusions on the work done.

2. Background

This section is organized in two parts. The first one provides an overall overview of iTV applications in the education domain (t-learning), while the second one focuses on interactive documentaries, that typically combine, in different ways, educational videos with interactive elements, with solutions closer to the application class we investigate in this paper.

2.1. t-Learning

Despite several mass studies have argued that t-learning is potentially a useful and profitable service (Chorianopoulos & Leakos, 2007; PJB, 2003), its development is still slow (Aarreniemi-Jokipelto, 2005). Several t-learning principles and applications have been inspired by e-learning services. But the TV medium has important peculiarities, as compared to the Personal Computer (PC):

- the predominant way to transmit information is through broadcasting
- iTV computing hardware (Central Processing Unit power, memory) is limited and several features (e.g., permanent storage, return channel for bidirectional communication) are not available in commercial Set-Top Boxes (STBs) or rarely used.
- user interaction modalities are quite different (remote control, low resolution screen, no windows, no mouse, no keyboards)
- the user is typically in a relaxed environment and attitude, and TV is typically perceived as an entertainment medium (Chorianopoulos & Leakos, 2007; Pazos Arias et al., 2008; Vorderer, 2001)

These features have determined a couple of important peculiarities of t-learning with respect to e-learning. First, the concept of edutainment (education + entertainment) has been considered as particularly suitable to developing models for less formal learning (Buckingham and Scanlon, 2002). Second, while e-learning typically involves user-driven strategies, in which the applications respond to user actions, media-driven strategies, where the video stream dictates the contents and the pace of the interaction, seem more suited for t-learning (Pazos-Arias et al., 2008).

The first aspect represents a strong motivation for investigating the exploitation of SG principles in iTV, but the second one poses a challenge on how to adapt the SGs' typically user interaction-driven philosophy to a media-driven environment such as the TV. A number of educational game titles already exist for iTV, but they mostly exploit TV as a mere display and computation medium, while we are interested in exploring the integration of SGs and AudioVisual (A/V) streams, that are the peculiarity of the TV medium.

ATLAS is a pioneering framework (runtime environment and authoring tool) to provide multiuser and distributed t-learning services over the Multimedia Home Platform (MHP) (Pazos-Arias et al., 2008). ATLAS provides a flexible solution for the development of t-learning objects and courses according to the Advanced Distributed Learning's Sharable Content Object Reference Model (ADL SCORM) standard [ADL-SCORM] to promote the reuse of learning elements (Pazos-Arias et al., 2008). The framework involves also a library of edutainment elements for user evaluation based on the Instructional Management Systems' (IMS) Question and Test Interoperability (QTI) standard [IMS]. Our work further stresses the gaming aspect and focuses on (SG) application development and real-world user tests to assess the validity of the approach.

(Rey-Lopez et al., 2008) propose the concept of entercation, in which entertainment content (but, in general, any type of TV content) is exploited to offer learning opportunities. In their view, the TV program "is not directly used for learning, but instead it acts as an entrance