T-Learning Technologies

Stefanos Vrochidis
Informatics and Telematics Institute, Centre for Research and Technology Hellas, Greece

Francesco Bellotti
ELIOS Lab, University of Genoa, Italy

Giancarlo Bo
Giunti Labs S.r.l., Italy

Linda Napoletano
O.R.T. France, France

Ioannis Kompatsiaris
Informatics and Telematics Institute, Centre for Research and Technology Hellas, Greece

INTRODUCTION

Television (TV) is a ubiquitous consumer electronics device representing the traditional information and entertainment medium for the majority of the people.

Following the rapidly growing technology, TV started to switch-off from the analogue world to the modern digital technologies of broadcasting. Digital technology has the potential to offer the audience a variety of services apart from the common audiovisual stream. Many of the new services are inherited from the Personal Computers (PC) world, including on-demand features, games, transactions, and other interactive options.

Television has had a long history of performing an educational function for the mass audience, typically by broadcasting culturally-relevant movies, documentaries and news, as well as educational programmes. The idea of Distance Learning through a TV blossomed extensively in particular as a complementary educational option besides PC-based e-learning and traditional analogue TV educational programs. In particular, TV-based interactive education promises a huge potential due to its ability to support interactivity while compensating for the low penetration of Internet-enabled computers in comparison with the penetration of a TV in a household.

"T-learning" was the new term, which prevailed for the definition of TV-based interactive learning (Aarreniemi-Jokipelto, 2005).

BACKGROUND

The first forms of learning with interactive Digital TV (iDTV) have been little more than modified or enhanced videoconferencing. Today, iDTV platforms for learning provide a big amount of audiovisual and educational contents to the viewer through interactive and content personalization. iDTV is considered as the convergence of television and computer technologies by encompassing three important features typical of computer-based technologies (Lytras Lougos, Chozos, & Pouloudi, 2002):

- **Interactivity:** The control of the whole activity and of the elements of a single activity can be placed into the hands of the potential consumer (Watheieu & Zoglio, 2002);
- **Personalization:** Use of technology and viewer information, to tailor interactive content to each individual viewer profile (Lekakos & Giaglis, 2001); and
- **Digitization:** Technological advancements that allow better quality of sound and picture (Kenyon, Miles, & Rose, 2000).

In particular, considering the use of the media by its audience, TV has some features that make it different from PCs. First of all, TV is usually watched by more than one person (co-viewing), and usually triggers social interactions that are very useful for a more effective experience and interiorization of the contents. Secondly, the logic of broadcasting to a wide population enables social mass mechanisms that typically enhance the impact of the broadcast program.

Nowadays, there are signs that the TV providers are moving to interactive education by broadcasting educational programs that exploit the interactivity of iDTV. A characteristic example is the BBC channel, which offers a learning portal (BBC learning) that provides interactive learning services and covers all the most widespread media, such as radio, TV, iDTV, Web and broadband. Some of the Web interactive services of BBC are also available in BBCi Interactive TV as the ones devoted to preschool children (BBC CBeebies) and support "Learning through play"[1]. Although t-learning as a rather new concept has not been applied so widely in interactive TV, there is a number of projects that support and investigate the future penetration of t-learning as the Enhanced Learning Unlimited (ELU) project which is currently dealing with the iDTV technologies for the design and the implementation of an integrated t-learning system[2].

The article is organized as follows: the pedagogical aspect of t-learning is presented in the next section while the part "Technologies Involved in T-learning" is dedicated to a description of the available technologies and standards of iDTV which are exploited in an education-effective way by t-learning.

PEDAGOGICAL ASPECTS OF T-LEARNING

In defining a t-learning pedagogy it is crucial to deal with an active learning model, the constraints imposed by the actual development of the technology and the nature of the allowed interactions. Related research acknowledges active learning as an exceptionally effective teaching technique (Clark, Nguyen, & Sweller, 2006). More specifically, active learning strongly relies on the learners' interactions with their environment that lead to mental actions through which they construct ideas about what they are encountering.

In this context, the challenge is to exploit the added value of providing an interactive learning environment and the potential of allowing people to access learning activities and contents directly in their house, at distance, through media easy to access and simply to use.

This reflection produces a twofold vision that aims at balancing learning and teaching strategies:

1. Leave the control to the learner.
2. Guide the learner.

Thus, to draw a pedagogy for t-learning experiences, two dimensions have to be explored and taken into account as the drivers of the design process:

- The context where learning happens and the behaviour of learners in this environment;
- The specific features of the medium.

The interactivity, audio/video-based experiences, narrative learning environment and informal learning/edutainment are the key points that emerged from this exploration.

TECHNOLOGIES INVOLVED IN T-LEARNING

T-learning exploits in an educational manner the available technologies and standards for iDTV such as the broadcast technology, the supported middleware for applications and the variety of related tools.

Interactive Digital TV

iDTV has been pushed into the marketplace by the broadcast industry and the network operators in the last decade, introducing two major features, which will be presented in this section: the digitization of the broadcasting and the availability of interactive programs (Baker, Pulles, & Sasno, 2004).

Audio Visual and Data Broadcast Technology

Digital television mostly relies on the Digital Video Broadcasting (DVB) standard, characterized as DVB-T for terrestrial, DVB-S for Satellite and DVB-C for Cable transmissions. DVB has been defined by a consortium of public and private organizations in the iDTV sector[3].

In the DVB schema, the digital TV signal is transmitted as a stream of MPEG-2 data known as a transport stream. This stream consists of a set of substreams (elementary streams), where each substream can contain MPEG-2 encoded audio, MPEG-2 encoded video or data encapsulated in MPEG-2 stream. The elementary stream which carries the application data is constructed using a Digital Storage Media-command and Control (DSM-CC) Object Carousel. Subsequently, the transport stream is passed to the multiplexer and then to a Radio Frequency (RF) transmitter in order to be broadcast. The overall broadcasting system for digital TV is illustrated in Figure 1.

The received signal is demodulated and afterward it has to be decoded appropriately. The common TV sets are manufactured to deal with analogue signals. Hence, a device called Set Top Box (STB) is used to transform the digital signal. Moreover, it also provides a middleware, based on an embedded Operating System (OS), which is an execution environment for running the interactive applications that are broadcast in a channel together with the main audiovisual stream. Execution environments are standard and the most common are: the European Multimedia Home Platform