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Interactive Multimedia t-Learning Environments: Potential of DVB-T for Learning

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Abstract:

Through the past decades, television has been maintaining its predominant broadcasting, centralised transmission and programme production applications, whilst its role in education and training has been lagging behind. Other media have been much more successful in following the modern trends in education and training, helping them evolve and improve. Involvement of the media requires an enriched interaction between the participants, based on active cooperation of all the entities, including those involved in the production processes.

At interactive t-learning in DVB-T environment, the learning material cannot be accessed on demand and the adaptation of content can be accomplished within a limited scope and in a specific way only. Potentials and drawbacks of the DVB-T environment for multimedia-enriched learning are outlined, focusing on the delivery of a personalised multimedia-content to an environment with a limited capacity and availability of the Return Channel.

Key words: *e-Learning, t-Learning, DTV, Learning environment, DVB-T*

1 Introduction

Worldwide, media technologies impact and re-contextualise the media practices of all generations, whether at local or global level, which are fostering the engagement in cultural and social diversity. Ever since the 1990s, we have been facing the technological potential of digitising the sound, text and images, and of converging the infrastructure, transportation, management, services and data types. The process of mediated interactive communication is taking place in the technically advanced forms of two-sided or multilateral communication that is multiform and rich in content (integrating sound, text and images). The quality of interactivity depends on:

- two-sided or multilateral communication within certain space dimensions; people interacting in proximate space or by a transmission link;
- degree of synchronicity – the synchronous or asynchronous;
- extent of control by interactors, described by sender and recipient, on switching at any given moment;
- understanding of context and meaning (Van Dijk, 1999).

How are the potentially empowered media facing challenges in education, and what are the predominant media practices, particularly within the context of television? Television (TV) plays a major role in the society as a reliable consumer device. The TV impacts practically everyone, in the light of information, entertainment or education. Historically, TV viewing

used to be linked with entertainment only. TV viewing styles have evolved from the early group viewing, through the individual viewing that included several TV-sets in a house, to the modern-day viewing involving the user's multitasking activities. Along with technology development, viewers are gaining control over their viewing experience (Lu, 2005).

Television has been maintaining its predominant broadcasting, centralised transmission and programme production applications. For this reason, its role in education and training has been lagging behind in the past decades. By introduction of interactive digital television, space has been opening for the potential development of its new applications, and thus, for reinforcing its role in education and training.

The integration of communication patterns according to the model of four information traffic patterns (consisting of allocution, consultation, registration, conversation). The new media shift from allocution towards consultation, registration and conversation. They foster communication among local units with the centre and communication among local units (Van Dijk, 1999).

Contemporary systems and approaches in education regarding pedagogical aspects of interaction demand the following dimensions to be considered:

- communication relationships among communicators,
- direction of communication (from teacher/trainer to learner/learners, among learners, from learners to teacher/trainer),
- degree of self-control by interactors to switch at any given moment,
- degree of mutual understanding and collaboration.

Interactivity can be described in different forms according to the property of media and interfaces, source location, according to the user's perception of interaction and user skills.

With recent advances in consumer electronics we are more and more interactive media users searching for challenging computer games, mobile games, interaction and networking via the Internet. Similar multimedia interaction can also be present in interactive digital television. From learning perspective, we are witnessing a new way of e-learning via television, known also as t-learning (Aarreniemi, 2005; Mayer, 2005).

Amongst these applications, t-learning is gaining the momentum. Interaction possibilities have brought computer capabilities into the television domain. On the other hand, large viewing distance, smaller resolution of the screen and limitations of the remote control with few buttons as user interface remain the main characteristics of the DTV, compared to the traditional e-learning device, the computer.

Video remains in the centre of the TV content. People link television with the high quality video, which is also a powerful educational tool. Video rich content captures the viewers' attention and helps them comprehend the complex and interconnected problems.

2 Background to learning in television environment

Personalisation of learning environment attempts to reverse the traditional learning settings in the TV domain, where the system conforms to the learner, rather than the learner to the system. Television has been a well-accepted educational device since its early beginnings.

Recent digitalization of the television possibilities for learning has gained new potential. While the better video and audio quality result in better viewing experience, a real potential is in the interactivity between the user and end-user terminal, or end-user and content provider.

Digital television (DTV) is entering our homes (Arnold et al, 2007; De Bruin, 2006; Fisher, 2008). Countries in the EU will complete the transition from analogue to digital broadcasting by 2012. The transition to digital domain that is supported by governments worldwide is bringing services known in the computer and internet domains also on one of the most common domestic appliances, the television. Furthermore, with developments in broadband networks, video on demand (VoD) brings new frontiers in entertaining and education possibilities into our homes (Bates, 2003).

Digital television is bringing several benefits from the user point of view. For learning environment, the following advances show greatest potential:

- Higher image quality – better resolution, more colours and better contrast will make the reading easier. Smaller details can be included into the picture presented,
- Inclusion of data into broadcasted TV stream - data in combination with computational power of the STB (Set Top Box) allows simple games, multimedia rich teletext or multimedia applications,
- Access to additional content through interaction, where the local or global Return Channel is available,
- Interaction user TV – user can browse the data that is available to him. He can either request data through remote channel, or just interact with the data included in the broadcast stream,
- Personalisation of content – since there is more content available than one user can access, certain personalisation of the content is necessary. According to the user profile, the system makes recommendations on the content to access.

Though with digitalisation, the television in case of the DVB-T environment offers several new characteristics, some characteristics remain similar to those in the analogue domain. From the point of view of learning environments, we set out the two most evident ones. *Scheduled TV* – television programme is scheduled, and the content is broadcasted in a similar fashion as it had once been. Currently, services on demand are still restricted to urban areas only. *Remote control* – with rather similar functionality: adding 4 colour buttons cannot be considered a great functional improvement. The market has proposed some more advanced remote controls which, however, have never found the way into our homes, and are not expected to do so in the near future.

Simplicity of the t-learning course depends on user interface and requires user interaction. Remote control, as generally available and accepted elementary television device, is the prime user device in the t-learning environment.
TV applications need to be designed in compliance with the remote control interactivity limits. Standard remote controls facilitate the simple and limited interactivity only with the TV applications. As compared to a PC, its users miss its interactivity of a mouse and keyboard. Though certain more advanced remote controls have been available on the market, they have not reached our homes as yet.

A traditional remote control normally includes the 0–9 number buttons, 4 arrow keys, and an OK button. With the advent of digital television, manufacturers have added 4 colour buttons (red, yellow, blue and green).

By transition to digital television, Set Top Box (STB) is the core element on the user side. Its main purpose is to decode the broadcasted MPEG stream, and for this operation, the STB needs a computing power that may be used for other multimedia services as well. An important functionality of the STB is the data warehouse, facilitating the saving of interactive multimedia data.

Application developers find the limited STB functionality and the diversity of STB devices as the principal obstacles. Though the market offers a variety of STBs, with the most advanced STBs offering functionalities comparable to modern computers, most homes are stuck with the relatively entry-level devices for the time being. This constraint needs to be considered when applying DTV as a learning environment.

2.1 Interactivity and Return Channel

Today, interaction television domain refers to the use of remote control to request information over and above the show that is being broadcasted. The end-user is able to control and influence the subject of communication.

According to Bates (2003), interactivity may be divided into the local and global interactivity, where *local interactivity* is the interactivity limited between the user and the interactive content broadcasted and stored on the STB.

Modern DTV systems are able to provide interaction between the end-user and broadcaster or service provider, which is referred to as *global interactivity*.
In the DVB-T environment, this is facilitated by the Cross Media Return Channel, i.e. the mobile phone (Aarreniemi, 2005).

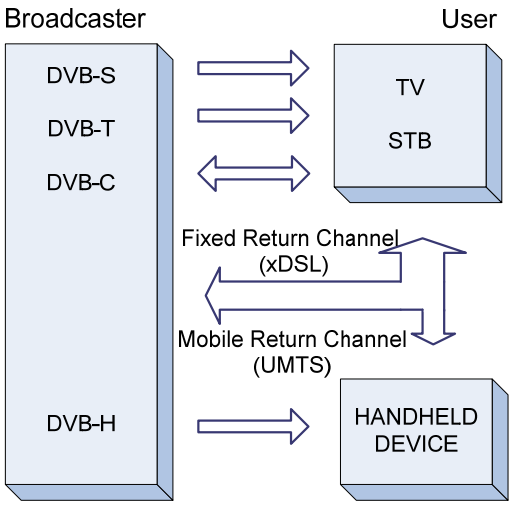

Figure 1: Interaction channels in DVB environments

The DVB standard provides for the Return Channel that facilitates the accessibility of additional content and/or user feedback collection. The Return Channel facilitates the interaction between the end-user and interactive service provider, or the user may interact with the content held on a STB only.

The Return Channel may be activated through the cross-media technology enabling the communication between the end-user and content provider (Aarreniemi, 2005), either through a fixed communication system, such as PSTN, ADSL or Ethernet, or through a mobile Return Channel, such as UMTS, GPRS or SMS (text messaging).

The Return Channel capacity influences the available interactivity and, as a consequence, determines the interactive multimedia content. Multimedia rich contents, such as pictures, video or animation, require high bandwidths. Personalisation is defined by the amount of content that may be accessed by the user through the Return Channel.

Table 1 summarises possible personalised activities in the case of absent Return Channel, or using the narrowband or broadband Return Channel.

Table 1: Availability of Return Channel directly impacting the feedback and personalisation in the learning process

Return Channel	Feedback	Personalisation
None	Local feedback only	Through STB - all the data is transferred to STB via the DVB stream; data is personalised on the STB
Narrowband	Local and remote feedback	Through STB - all the data is transferred to STB via the DVB stream; data is personalised on the STB; data is obtained through Return Channel as exception only
Broadband	Local and remote feedback	Distributed between DVB server and STB: through Return Channel, STB sends a request to DVB server to obtain personalised data. On the DVB server, the data is personalised and through Return Channel sent to end-user

3 DVB-T as t-learning environment

DVB-T (Digital Video Broadcasting – Terrestrial) is a supplement for the analogue terrestrial transmission. DVB-T as such brings interactive applications and better image and sound quality. The possibility of interacting with the content provider is not self-evident.

T-learning courses in the DVB-T environments pose for content creators the following limitations:

- one audio/video stream,
- course is scheduled, as are other programs,
- course cannot be interrupted,
- interactive applications and video stream need to be synchronised.

Creators of the above t-leaning content are facing new challenges if they are to gain general acceptance among users (ELU, 2007; Bellotti et al, 2008).

3.1 Personalisation in DVB-T environment

Highly personalised content may be offered to the end-user through the end-user – content provider interaction. End-users receive user-specific recommendations concerning the content, or they may freely browse and download the content according to their wishes and needs.

Personalisation is a powerful educational tool, where the content to support learners with the different backgrounds, interests and learning curves can be prepared. In learning environments, where the learning content cannot be accessed on demand, such as the DVB-T environment, the content can be adapted within a limited scope and in a specific way only.

Limited personalisation of the content can be achieved with the data included in the broadcasted stream. For learning purposes, various games (quiz, correct order, right place…), generic Multimedia pages and virtual teacher can for instance be delivered to end-users, regardless of the global interaction channel.

Content personalisation is based on user-profiles and on tracking the learners' achievements and choices. Based on entered learners' profiles and on profiles extracted from users' interaction, different personalisation approaches are possible, in the shape of personalised access to content, level access to games, quizzes, content, or access to complementary content chapters, information sources, etc. Thus, personalisation enables the viewer to customize his course, to attain the adequacy between his interests and his level of understanding, and to follow his learning curve.

Using the powerful educational tool of personalisation, a course may be customised so as to support learners with the different backgrounds, interests and learning curves. Moreover, personalisation is an instrument helping the learner in strengthening his understanding, enabling him to reinforce his comprehension with adapted educational content, games, etc.

Personalisation content structuring may be attained in any of the following modes or combinations of course structuring:

- in levels,
- by focusing on different interests,
- between the core and optional elements,
- by local and external content,
- along learning curves.

From the user's point of view, content delivery within the DVB-T environment is rather limited. Adaptation of video-based content according to the user's needs and preferences is impossible in practice. Content personalisation may thus be attained through interactive applications only, or by delivering additional content through the narrowband Return Channel. Such content is therefore limited to text, small figures and simple animations.

4 Instruction elements

4.1 Pedagogic design

Pedagogic design of t-learning is focused on learning-experience medium selecting according to user group needs and preferences. T-learning has potential of attracting two opposed

learner groups, one including no active computer and/or internet users, and the other consisting of young people with reduced TV-viewing and increased computer and internet use, on the grounds of their respective need for interaction in TV-viewing, the first group on account of having mostly been a passive audience until the t-learning experience, and the latter group consisting of young and active computer users, who are constantly interacting with the computer and seeking to improve their experience, even by being attracted to the television.

With t-learning, the television as the living-room centre of family entertainment should finally be utilised for enhancing intergenerational learning. Research findings show that adolescents use more internet specs for peer collaboration, spending time with friends (Larson et al, 2005), than for TV-viewing with their family. T-learning can therefore foster learning in non-formal environments, in the spare time of families and individuals alike. T-learning brings non-formal learning environments closer to formal educational settings.

One of the main challenges in designing technology-assisted learning is providing a diversity of perspectives for the needs of a particular student, under the prerequisite of conveying adequate knowledge and using appropriate learning approaches. In addressing this learning requirement, t-learning shall provide for the multiple modes of presentation, as tools, contents, and activities.

Knowles (1978) describes the modes of learning by adults, based on 4 principal assumptions:

- change in self-concept – adults need to be self-directive,
- experience – mature individuals learn from their experiences as an ample source of learning, thus shaping their learning approaches,
- readiness to learn – adults want to learn in problem areas they are confronted with, and which they regard as relevant,
- problem-centred learning – by adults, who are less likely to be subject-centred in learning.

Autonomous learning and reflection: learner's control / self-directedness

The application of assumptions in learning and training focuses on understanding adults as autonomous and self-directed in their learning approaches, learning best from experiences, taking responsibility for the needs-assessment of their learning and competence development and transferring new knowledge learned to training or elsewhere. Adult learners shall plan, implement and evaluate learning by themselves (Tough, 1971). Arrangements for learning are in close connection with everyday and working life. Methods and ways of learning shall be applicable in the different formal and non-formal settings.

Personalisation / individualisation of learning

Considering cognition as intrinsic in the cognitive constructivist learning theory, individuals build their new knowledge in the process of relating new information to their existing knowledge structure – teaching approach needs to support students' meaningful incorporation of new concepts, principles and theories.

Sociocultural constructivist theories emphasize that human mental functioning is inherently situated in social interaction and cultural context (Resnick, 1996). Learning is understood as an interactive activity, taking place in social interaction. The quality of learning process strongly depends on the type and intensity of teacher-student and student-student interaction.

Motivation: fostering active learning

By building physical and social learning space, the holistic experience, integrating feelings and values, creates a good atmosphere and is the main condition, where the quality of learning process and its outcomes depend upon. The outcomes of learning process anticipated by students depend on their assessment of how well they will cope with tasks.

Self-efficacy (Bandura, 1997) is an assessment of a person's ability to organize and execute certain tasks. Self-assurance with which students will approach and manage tasks determines largely whether they will efficiently use their capabilities. Keller (Driscol, 1994) designed a model of Motivation, Performance and Instructional influence, based on the assumption that the students' performance in learning tasks depends on their motivation and their expectances. The model presented 4 conditions for motivation: attention, relevance, confidence and satisfaction (ARCS).

Teacher's role

A teacher's role is supportive - he or she does not transmit his or her own ways of understanding (knowledge constructions) to students. His or her role is rather to provide guidance needed by learners in order to bridge the gap between their current and desired knowledge level. The student-centred approach is required. The teacher's role at such an approach changes, the focus is shifted to the constructive role of the learner, which differentiates it from the teacher-centred model in which knowledge is transmitted from teacher to learner.

The following learning conditions shall be complied with: 1. Providing complex learning environments that incorporate authentic activity. 2. Providing for social negotiation as an integral part of learning. 3. Juxtaposing instructional content and including access to multiple modes of presentation. 4. Nurturing reflexivity. 5 Emphasizing student-centred instruction (Driscol, 1994).

4.2 Interactive edutainment: games and quizzes

Contemporary learning needs are defined with the expectations of young generations of students, who have grown up with immersive, computer-mediated experience as a norm (Lynch et al, 2008).

The main characteristics of educational game may be summarized as: player engages in a game on his/her own or in a group of players to construct his/her own knowledge, using various approaches: learning by doing, learning from mistakes, goal-oriented learning, role play, and constructivist learning (Prensky, 2002). Characteristics of the game are goals, rules, competition, chance and pleasure.

Games are the proper elements to enhance the learner's activities; especially game-based assessment can contribute to the intrinsic reinforcement and to the enhancement of knowledge retention. In situations, where the Return Channel is available, games can be used to support extrinsic rewards to the learner's successes (Bellotti et al, 2008).

For instance, if the user has reached a lower score, the system will provide him with easier questions. And the other way around, if the user is doing very well, more difficult questions

can be provided by the system. Still, the amount of questions and possible scenarios needs to be predefined by the content creator.

4.3 Instructional elements

The t-learning context has several specific features, as already discussed in the previous chapters: the possibility of using high quality video; limited interactivity, using the remote control as the only end-user tool; limited interactivity for users with low-end STB; limited possibility of personalisation.

For instance, in (ELU, 2007), 4 instructional elements were considered in the television environment in the absence of the Return Channel, or using the narrowband Return Channel:

- video stream,
- virtual teacher,
- interactive edutainment: games and quizzes,
- delivery subsystem.

Figure 2: Creation of multimedia cards in MHP applications with authoring tools

Video stream is the main content-element in the t-learning environment. A broadcasted video is most adequate for stimulating the perceptiveness and inquisitiveness, and for presenting real-life examples and tasks. However, the DVB-T environment does not facilitate using more than one video stream, and additional content differentiates between the documentary and t-learning programmes. As with analogue television, the same video is broadcasted to all the users, and thus, video content personalisation within this environment is rather limited (Zajc et al, 2007).

Additional content/data received by the MHP STB is considered as support to the t-learning process. Content personalisation is feasible through interactive applications only. Content creators shall therefore provide for the interactive content personalisation by the different learners using a particular course (Bellotti et al, 2008).

The Virtual Teacher is implemented as an avatar to provide help or encourage the user if the user is not responding. Different behaviours can be defined for different user models or also for different score achievements. Content creator can change the perception of the course with a virtual teacher even if different characters only are used.

Additional efforts can be made to enable the learner to get additional information and materials to those shown on the TV screen. Additional information is provided on the learner's request, by sending the request to the broadcaster/service provider back office server

during the presentation of the learning material, and the material is transmitted from there to the end-device (fax machine, mobile phone, e-mail, etc.) selected by the learner. The main instructional objectives are achieved using the additional delivery to enhance the capabilities of educational programme, by providing additional material to the user and thus improving the interactivity of the learner (Alic et al, 2008).

5 Conclusion

Pedagogical principles shall be followed in using and recognising the technology in organisational, institutional and system contexts. Are TV practices going to be successful in facing these challenges, so as to be implemented as efficient educational technology?

High-quality video remains the main advantage of TV, as compared to other media devices. For t-learning applications, such narrative formats need to be identified which are attractive and facilitating the incorporation of educational content. User interaction shall be moderate in cases, where the user is given the choice of selecting the level of interactivity. In this context, DVB-T has potential for nation-wide learning, rather than individual learning.

Potential educational benefits of ICT for learning rely on pedagogy as much as on technology. The potential of iDTV needs to be explored by delivering interactive learning into the home. New pedagogical approaches are necessary, taking into account the requirements of modern users and fully exploiting the potential of technology.

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