Learn and Play with Interactive TV

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Despite the criticism concerning the value of TV content, research reveals several worthwhile aspects -- one of them is the opportunity to learn. In this article we explore the characteristics of interactive TV applications that facilitate education and interactive entertainment. In doing so we analyze research methods and empirical results from experimental and field studies. The findings suggest that interactive TV applications provide support for education and entertainment for children and young people, as well as continuous education for all. In particular, interactive TV is especially suitable for (1) informal learning and (2) for engaging and motivating its audience. We conclude with an agenda for future interactive TV research in entertainment and education.

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1. INTRODUCTION

''The never-ending talk of present times as the Information Age is not necessarily misleading. However, what is usually over-looked is that the monumental capacity to generate, manipulate, and transmit information is likely to serve leisure as much as labor, if not more so.'' Zillmann [2000]

In modern societies the value of watching TV has been extensively criticized; some TV content is considered harmful, especially for youngsters. Still, one of the first successful noncommercial uses of TV in the 1960s was broadcasting educational content to homes and schools [Revelle 2003; Svoen 2006]. Indeed, many public broadcast stations are obliged to include educational programs such as documentaries in their schedules. As well as providing educational opportunities, TV is an entertainment medium [Vorderer 2001]. Entertainment and education in combination has received some attention from media researchers [Singhal and Rogers 2002] who have examined the attempts by broadcasters to entertain and educate at the same time.

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We will investigate the opportunities offered by interactive TV systems with a particular focus on education and interactive entertainment. Interactive TV consists of software applications that run on video and multimedia servers, advanced set-top boxes, home media computers, and mobile phones. Still, "interactive TV" is a buzzword, with as many supporters as opponents. The term has been used to describe a technological feature of the media as well as to characterize a way of using the media [Vorderer 2000].

"There is a rumor going around (...) that television as we know it is soon to be swept up and utterly transfigured by some digital-age thing they're calling interactivity. Pay it no mind. Television has always been interactive (...) Interaction lies at the heart of television as a cultural form – and always has. (...) TV would mean nothing without the active, organizing affections of its viewers; we shape it at least as much as it shapes us." In Bukowska [2001]

But What Is Interactive TV?

The answer depends on who is asked: an engineer would say a digital broadcast and return channel; a content producer would refer to interactive graphics and dynamic editing; a media professional would describe new content formats like gambling, interactive storytelling, and play-along quiz games; and a sociologist would focus on the interactions among people vis a vis TV shows. While none of the above answers seem to agree, all of them are right. Indeed, each article in the special section assumes one of the answers above.

We define interactive TV (ITV) as a user experience that involves at least one user and one or more audiovisual and networked devices. Previous definitions of ITV focused on the technological aspects and ignored the fact that even traditional TV is potentially interactive. For example, viewers compete mentally with quiz show participants or with colocated groups. Moreover, viewers react emotionally to TV content, they record and share it with friends and discuss shows either in real-time or later. ITV systems (such as digital video-recorders, digital broadcasts, electronic program guides, internet TV, and mobile TV) have the potential to offer support for established behaviors or support the emergence of new ones. In this sense, instead of a device, or a communication system, or a psychological/social behavior, ITV could be defined as an experience shared by people, devices, and audiovisual content.

An important implication of the definition above is that ITV applications and services are not limited to the traditional TV box and broadcast delivery. Alternative and complementary tools and distribution methods such as mobile phones and broadband networks come into consideration. In the rest of this article, we explore the role of ITV in learning and entertainment. We then present the state of the art, and conclude with directions for further research in this important area.

2. ITV IN LEARNING AND ENTERTAINMENT

ITV has (and continues) to transmit educational programming. Aarreniemi-Jokipelto [2006] provides a historical review of educational programming in Finland. As reported by Revelle [2003], the development of Finish educational TV is complementary to and runs almost parallel with that of the US. Both efforts were motivated by the wish to educate children in the home and in the classroom via TV.

The main rationale cited for adopting TV as a learning medium is its pervasiveness. Television is a familiar and reliable consumer device with more than 90% penetration in developed countries. Although computers and the web have become very popular in some developed countries too, they have not reached the pervasiveness of TV [Bates

2002]. Moreover, play can be a very useful teaching strategy [Draper 1999]. To give a historical example: the first ITV game was called Winky Dink; the goal was to create escape paths for the main character by having the audience draw on transparencies placed over the TV screen. The game was very successful, at least in terms of the number of drawing sets sold [Swedlow 2000].

It is argued that a significant proportion of leisure time is spent on entertainment, and especially on watching TV [Zilmman 2000]. The focus of this article is on ITV learning and entertainment, but its scope is not restricted to traditional television. Although traditional TV is still the most important source of home entertainment, the growth of user interactivity with audiovisual content via alternative distribution channels and devices has become a significant part of ITV research. Traditional TV is watched in a passive mode; however, there is research that reports on multitasking (e.g., sending text-messages, browsing the internet) while watching TV [Wallis 2006]. Hence the educational content of traditional TV can be enhanced with interactivity (e.g., instant messaging, interactive content, and game playing). In particular, ITV systems provide many opportunities for improving distance learning (messaging among students, for instance, which may result in online learning communities that are interlocked with TV content).

It is a common fallacy that entertainment on the web must be highly interactive and participatory, following the model of video games and chat rooms. But 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. According to Karat et al. [2002] "watchable" web experiences can be enjoyed simultaneously by a group of people; Vorderer et al. [2001] found that certain categories of TV viewers prefer less rather than more interactivity. On the other hand, Draper [1999] argues that video games teach us that engagement could be offered through interactive experiences. He suggests that software that matches the skills of the user (learner) with the challenges offered by the (educational) activity should be developed.

3. STATE OF THE ART

Here we examine the contribution of each article in this special section, in the following areas: the application domain; the research issue; and the methodology. Given the broad definition of what interactive TV is, we believe it is appropriate to consider a broad range of themes, issues, and methodologies. Accordingly, the articles in this special section are representative of the diversity of research in the ITV field.

Application Domain

Bernhaupt et al. [2006] investigate a number of ITV applications like email, news, weather, ticket-ordering, and text-messaging. This was the original set of applications proposed for Digital TV (DTV) systems, in order to offer the benefits of the information society to all. Indeed, it is a worthwhile endeavor to give citizens, unable or reluctant to adopt personal computers and the internet, equal access to basic information, communication, and transaction services.

Although the initial vision for information services that run over DTV systems has not been widely adopted, there are some ITV systems that are popular with consumers (e.g., the digital video recorder, the DVR). Darnel [2006] examines the differences in behavior between people who use traditional TV and those who use the Electronic Program Guide (EPG) and the Digital Video Recorder (DVR); the latter offer enhanced control of TV channels without expecting the viewer to adopt new TV behaviors. Svoen [2006] investigates the comparative use of TV and the new media like the internet and the

Table I. Research in Interactive TV has a Wide Variety of Applications

Article	Application domain
Bernhaupt et al.	Email, news, commerce
Darnel	TV channels, DVR,ads
Jokipelto	Instant messaging
Kallenbach et al.	News
Lopez et al.	Informal learning
Svoen	Children and media

mobile phone. This research, which is focused on children, reveals that new and old media alike serve basic needs such as building identity and socializing, but the children also show an increased desire for media participation.

The increasing use of digital TV systems means that, besides video, there are many opportunities to enhance TV displays with dynamic text information. In this context, Kallenbach et al. [2006] examines the opportunities for integrating print and TV media. Since TV viewers are, for the most part, familiar with audiovisual material, it is worthwhile measuring viewer response to an increase in textual information and to assess its impact on enjoyment of the TV experience.

Educational TV programs are part of many broadcasting schedules, but do not offer mechanisms for personal communication among learners. In this context, the integration of text messaging with TV is an established and successful ITV application. It has become very popular to offer mobile phone text-messaging along with analog TV channels. An integrated instant-messaging ITV application is a worthwhile service, especially in support of learning programs [Jokipelto 2006].

Educational activities take place in a wide variety of situations in which informal learning is as important as formal learning, and continue life-long. In this context, Lopez et al. [2006] propose that learning opportunities should be offered by most types of TV content, and that the content could be exploited as a learning resource in t-learning applications. The authors focus on the design of an ontology for choosing the appropriate technology for the given content Broadband technologies allow the transfer of rich content both to and from learners and educators, which provides opportunities for interactivity on an extended scale and adds considerable depth to the notion of lifelong learning.

Research Issues

Bernhaupt et al. (2006) evaluate the usability of many different ITV services that support transactions, entertainment, information, and communication. According to their study, the major issue facing early adopters of ITV systems is the uncertain robustness of the technology. Unless ITV systems become as trustworthy as traditional TV systems, ITV

Table II. Research in Interactive TV Explores Diverse Issues

Article	Research issue
Bernhaupt et al.	Usability
Darnel	Viewer behavior
Jokipelto	Children and learning
Kallenbach et al.	Information capacity
Lopez et al.	Ontology
Svoen	Participation in media

services will be limited to early adopters and highly educated end-users. Yet the original goal of ITV was to offer the benefits of the information society to all.

Technologies for changing channels and recording videos and attitudes towards advertising are the most common issues in contemporary ITV research. Darnel [2006] investigates the use of established TV technologies such as traditional TV and DVR. The most popular behavior among DVR users is to fast-forward past ads while watching prerecorded or delayed TV. Besides skipping ads, users employed rewind to correct for skipping. The second most popular behavior was to pause the video in order to pay attention to something else. Most notably, DVR users begin their TV watching sessions by selecting a prerecorded program instead of a broadcast.

Users of traditional TV also avoided ads by changing channels [Darnel 2006]. While browsing channels in the EPG, users navigated to particular channels and then browsed in their vicinity. Similar observations were reported by Ferguson [1992], who describes such behavior with the term "mindful channel repertoire." Thus, to start a TV watching session, viewers recall only a small number of channels (fewer than a dozen) and make their selection from them. The findings of Darnel [2006] confirm that users of contemporary ITV systems (e.g., DVR, EPG) do the following three things: start watching a program; avoid ad breaks; and select a new program.

According to Brown and Barkhuus [2006], the television lifecycle includes the growth of personal collections of TV shows, and sharing and discussing them with others. Both of the qualitative studies above reach conclusions that could inform the design of new TV systems. Most notably, that new TV systems should provide ways to explore large collections of TV content distributed through hybrid channels.

A conceptual model, the virtual channel model, for navigating easily through TV content was proposed by Chorianopoulos and Spinellis [2004]. Its main advantage is that it is independent of the content delivery mechanism. The virtual channel system exploits local storage to assemble dynamic, thematic TV channels on the fly. Virtual channels provide a simple means for navigation (e.g., a music TV channel includes the familiar skip-track, repeat buttons, allowing seamless transfer from CDs, iPods, etc.).

Edutainment has been a popular buzzword in education research; it stands for educational content based on entertainment values. In contrast, Ray-Lopez et al [2006] propose an *enteraction* experience, which exploits entertainment content to offer learning opportunities. The authors describe ITV content classified into an ontology that consists of learning objects, defined as "any digital resource that can be reused to support learning." The main idea is to break educational content into self-contained modules that can be reused in various learning environments. Learning objects are tagged with descriptive information, known as metadata, which makes them easily searchable. Metadata provides a means for finding learning objects, including those that may not be text, such as video clips.

Thus, virtually any type of TV content could become a source of educational material or a gateway to formalized educational resources. Ray-Lopez et al proposal has implications for the design of t-learning services. For example, for a user who wants to learn everyday expressions in a foreign language, a movie in that language could be the entrance point to learning. Furthermore, once an end-user starts using a t-learning service, popular TV content could provide engaging and complementary support for it. In both cases, the employment of a learning ontology and metadata leverages the value of engaging and ubiquitous TV content.

Interpersonal communication is another way to learn. By talking to their classmates, children may become aware of things that they may not have observed as individuals.

Papa et al. (2002) explain that sharing stories about responses to past events helps people learn. Thus interactive educational TV programming is likely to encourage collective cooperation and enhance learning. Aarreniemi-Jokipelto [2006] describes the design and evaluation of an instant messaging service that supports educational TV programs. The objective of the service is to form a community of users and to support it, as well as utilize the interactions among the members of the community. Instant messaging is a popular interpersonal communication medium, especially among children and young adults. Instant messaging over ITV was investigated before [Chuah 2002], but not in support of educational content. Aarreniemi-Jokipelto discusses the development of a novel MHP application, the role of the moderator, and the use and usability of the service by children. Overall, the instant messaging application shows potential in engaging children via traditional educational TV programs.

In the context of entertainment, it is usually assumed that interactivity provides increased entertainment. Yet there is evidence that this is not always so [Vorderer et al. 2001]. In this section, Kallenbach et al. [2006] investigate the impact of adding more information to TV programs. While children and young adults reported multitasking as their preferred mode [Wallis 2006], there is an established body of research that shows that the human brain does have limits on its processing power [Lang [2000]. Indeed, the findings by Kallenbach et al. [2006] confirm the common sense view that text, and especially lengthy text, has a negative effect on the ability to process mediated messages.

Previous longitudinal studies have established that styles in media consumption during the introduction of new information technology in the home have changed [Kraut et al. 1996]. Indeed, Svoen [2006] reports that children have an interactive relationship with old and new media alike. Furthermore, children actively develop and maintain online identities, through web sites, blogs, forums, and so on. TVs have also been enhanced by text messaging capabilities and through participation in local events via live broadcast. In addition, an increasing amount of time is spent watching TV online. Nevertheless, it is not clear whether the effects of new media will completely replace the old media, since only the group of people who use new media very actively report a decrease in the use of old media [Kaye and Johnson 2003]. Besides ITV systems, there are many other uses of traditional and new media, as described in Svoen [2006].

Methodology

The diversity of methodologies employed in ITV research is representative of the diversity of application domains and research issues. Most researchers employ qualitative research methods such as ethnography and usability testing, but there are also quantitative approaches such as experiments and surveys. In terms of data collection, researchers employ a variety of techniques like the questionnaire, observation, and physiological sensors. The advantages of using different research methods to study the wide variety of ITV effects have been suggested in previous research [Eronen 2000]. The

Table III. The Methodology for Each Article

Article	Methodology
Bernhaupt et al.	Usability engineering
Darnel	Ethnography
Jokipelto	Discount usability
Kallenbach et al.	Physiological
Lopez et al.	System architecture
Svoen	Survey

articles in this special section provide an overview of the research methodologies for ITV.

Darnel [2006] employed ethnographic methods; he obtained access to viewers' homes and placed recording equipment in strategic places. Next, he reviewed tapes of TV viewing with the viewers themselves, ensuring that correct inferences were made and avoiding the pitfalls of limited recall. Svoen [2006] used an online survey and a follow-up in-depth phone interview to explore the use of cross-media by youngsters. The online survey took place in Norway, where the diffusion of the internet is very wide. Hence online sampling does not leave out many TV viewers, and can be considered representative of the population.

In contrast to the qualitative, ethnographic, discount usability, and survey methods in the rest of the articles, Kallenbach et al. [2006] employ physiological measurement techniques to measure attention, message processing, and mental workload. In addition, Lopez et al. [2006] discuss the technical requirements for ITV applications that simultaneously educate and entertain (Table I).

Table IV. Overview of Article Contributions

Article	Application domain	Research issue	Methodology
Bernhaupt et al.	Email, news, commerce	Usability of services	Usability engineering
Darnel	TV channels, ads	DVR use	Ethnography
Jokipelto	Instant messaging	Children and learning	Discount usability
Kallenbach et al.	News	Information capacity	Physiological
Lopez et al.	Informal learning	Ontology	System architecture
Svoen	Children and media	Participation in media	Survey

Independently of the type of service on an ITV system, the most important factor is to ensure the usability of its features. While most of the work in this special section examines new systems that are experimental or still under development, Bernhaupt et al. [2006] evaluate the usability of a new system that has been deployed to end-users. So the findings of their research could be considered representative of the actual effects of ITV services. Finally, Aarreniemi-Jokipelto [2006] employs usability engineering methods like observation, interviews, questionnaires, and log files to evaluate the usability of instant messaging for ITV. Indeed, the usability engineering methodology is rather suitable for prototyped systems as well as for pretesting new systems in the lab.

4. RESEARCH AGENDA

The major open research question in ITV is when, and how much audiences want to interact with devices, content, and other people. On the one hand, there is the interactive use of media, by selecting from a great variety of programs and then modifying what is presented. On the other hand, there are situations, or users, who prefer to just look at what is offered to them. It seems that there is no single right solution to the above research question. Instead, there are many possible designs, depending on the situation, the application domain, user goals and user characteristics.

Learning and entertainment are important, but new issues arise when considering how to successfully support less task-oriented activities such as learning and playability. Then the emphasis is not necessarily on usability, but on engagement and fun. In this context,

Table V. Research Agenda for Future Work in Interactive TV

Application domain	Research issue
Learning	Informal and formal learning, classification of educational value of TV content, user contributed content and tags, sociability
Entertainment	Level of interactivity, support for co-located or distant group interaction

the traditional human–computer interaction (HCI) considerations on usability and usefulness need to be extended; indeed, HCI has grown to include learning and entertainment. Still, additional research is needed to examine the factors that enable ITV users to move from informal learning to more active learning.

Further research should investigate ways to combine distribution channels, consumer devices, and available audiovisual content to enhance learning opportunities. For example, a university-level course may involve broadcasting a TV program, but as most people taking a distant university course have a computer, it is likely easier to offer interactivity over the Internet. In addition, efficient peer-to-peer systems make the distribution of video material feasible through the Internet. So both audiovisual and interactive educational material could be distributed online and used at home with a PC and TV. In this way infrastructural convergence (online video distribution) facilitates the growth and impact of distance and informal education. Finally, research needs to be focused on tools that support the inclusion of metadata content that is based on emerging learning object standards and on user-contributed content and tags.

In terms of practice, public service broadcasters are in a favorable position vis-a-vis educational ITV. First, due to regulatory changes, they are encouraged by government to switch to digital format. Second, the vision statement of most public broadcaster includes the provision of educational material. Third, since they are funded through direct or indirect taxation, they are not constrained by the need to make a profit. Finally, they have experience in providing education programs.

On the other hand, Commercial broadcasters may not be financially motivated to develop and offer educational TV programs. However, they already provide access to a wide assortment of video content with potentially educational value, for instance thematic documentary channels and children's channels. So the development of ITV applications might be considered as adding value and providing a competitive advantage (e.g., a documentary channel might be enhanced with interactive browsing, games or multiple-choice questions). In conclusion, both public and commercial broadcasters have many opportunities to exploit their expertise and content in order to provide learning opportunities.

The articles that follow offer an overview of ITV research, its theory and methods, and demonstrate the potential of ITV in education and interactive entertainment.

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