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# An investigation of the educational applications of interactive television

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## **UNIVERSITY OF WOLLONGONG**

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**AN INVESTIGATION OF THE EDUCATIONAL APPLICATIONS OF  
INTERACTIVE TELEVISION**

A thesis submitted in partial fulfilment of the  
requirements for the award of the degree

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## **Abstract**

The research reported here is an investigation into the educational applications of interactive television (ITV). It was prompted by the need to address the problem of lack of engagement of learners in more “traditional” pen and paper learning environments. The report comprises a multiple case study, consisting of 2 cases of ITV production units, and one case of an ITV research institute. Socio-constructivist theories of learning, coupled with the theory of technological determinism, have provided the theoretical framework. The methodology is predominantly qualitative. Data collection methods include reading appropriate literature, observing ITV production units, and carrying out interviews. Eight participants were interviewed, including ITV practitioners, ITV researchers, and experts in the field of education delivery using technology. Unique characteristics and affordances of ITV have been explored, and documented. Results indicate that ITV is a potentially useful technology for the purpose of delivering engaging educational experiences. Implications include the need for teachers to be adequately trained in the use of ITV technologies, in order to facilitate use, and that funding is a potential obstacle to the implementation of ITV in educational settings. A key objective of the current study, to provide a list of guidelines for the design and development of ITV applications and programs, has been met in the final chapter.

## **Declaration**

I, Jann Roberts, declare that this thesis, submitted in fulfilment of the requirements for the award of Master of Education, in the Faculty of Education, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. This dissertation has not been submitted for qualifications at any other institution.

Jann Roberts

11<sup>th</sup> March 2013

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# Chapter 1

## Introduction to the Study

### 1.1. Background: a pedagogical problem

The problem of lack of active engagement of learners within 'traditional' learning environments may be addressed, to some extent, by the utilisation of new technologies (McInerney & McInerney, 1998). Interactive television (ITV) is one such technology that can provide a vehicle for learning experiences that can have interactive, collaborative, constructivist, situated, and authentic features. As such, ITV may have the potential to enhance learner engagement but little is known about its use in formal education settings (Interactive Television Research Institute, 2003).

Interactive television "merges computing power, broadcast, mobile technologies and broadband Internet, providing users with on demand interactive content and applications" (Bora, M.J., 2012, p.9). Chamberlain describes contemporary television interfaces as consisting of three parts: a "*physical means of interacting with a screen-based display driven by dedicated software.*" (2010, p. 85)

Interactive television is changing the way viewers 'consume' television content, by giving consumers more choice (more channels), greater viewing control (when and how people watch), more portable media (where people watch), and greater ability to interact with content (Fallahkhair, Pemberton & Griffiths, 2007). However, the development, continuing expansion and deployment of interactive television in popular culture, has not been accompanied by a corresponding resolve to understand the nature and potential of its use in educational contexts. And yet, ITV has the potential to impact significantly on teaching and learning.

The introduction of any new technology in learning contexts has a typical pattern of adoption, where teachers often revert to old pedagogies as they come to terms with the capabilities of the new technologies, referred to by Mioduser, Nachmias, Oren and Lahav (1999) as "one step forward for the technology, two steps back for the pedagogy" (p. 758). Part of the problem is that technological advances are not accompanied by the kinds of research needed to determine the constraints and affordances of the new system. Further, the absence of defined conventions and procedures makes it difficult for teachers and students to see beyond the

technology itself to the learning opportunities. While many studies have been conducted generally on the use of information and communication technologies (ICT) in education, to date, very little research exists on the use of current generation ITV in education (Interactive Television Research Institute, 2003). According to the Interactive Television Research Institute (ITRI) at Murdoch University:

Enormous investment is being made in the iTV industry without adequate understanding of what consumers really want and how they will use the new technology. As yet, there are no established conventions that content developers can utilize in order to design effective iTV content. (2003, p.1)

Furthermore, in Australia, the highly risky and expensive practice of testing ITV solutions over existing delivery systems, without noteworthy preceding research, is being carried out (ITRI, 2003). These issues need to be addressed, and practitioners, including teachers, need pedagogically sound models for an ITV-based learning environment.

#### **1.1.1. Addressing the issues**

The process of developing understandings of how people can learn from ITV needs to provide practical solutions that are grounded in an appropriate theoretical framework. This should involve research that contributes to the continued development of a theoretical framework designed to guide successful interactivity-based learning with ITV. Furthermore, it is necessary to consider the theoretical approach that Hiltz (1994) labels *technological determinism*, in which the features of a hardware-software system “determine user behaviour and the degree of success of a computer application” (p. 66). Gallant (2000, cited in Finley & Hartman, 2004) asserts that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics. While this is a pedagogically-sound approach, technological determinism, in the guise of ITV affordances, is still relevant.

From a practical point of view, research needs to provide a comprehensive, research-based model for the implementation of ITV in educational settings, one that is able to guide the development of rich, interactive learning environments. Instructional design models incorporating a linear approach are not appropriate here, and should be replaced with non-linear, more constructivist-based models.

Such research has the potential to be significant for teachers and students because it may provide a current, research-based model for ITV pedagogy, utilizing ITV affordances to the maximum extent. It may be significant for educational designers of ITV because it may provide optimal guidelines for pedagogically-sound design. It may be significant for practitioners without teaching-related backgrounds, such as ITV broadcast producers, because it could provide pedagogically-sound guidelines for broadcast content.

#### ***1.1.2. Research into current generation ITV***

Some researchers are beginning to address the shortage of research into current generation ITV. For example, Evans, Stacey and Tregenza (1999) carried out a multiple-case study in Australia to investigate the “extent, nature and problematics of educational dialogue through interactive television (ITV) in primary and secondary schools” (p. 215). They suggest that:

[While] usage [of ITV] in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers – particularly in specialist areas such as languages other than English – points to ITV, and other communications and computer technologies, adopting a higher profile. (p. 214)

Themes which emerged from the first year of the study included the motivational importance of student involvement in the interactive elements of the ITV programs, management issues including the need for teachers to receive program notes early enough for them to incorporate them in their curriculum planning, and increasing integration of electronic communication with ITV media. Hopefully, as such themes have been explored further, an incidental outcome has been to address any existing negative attitudes towards ITV as outlined below.

#### ***1.1.3. Attitudes towards ITV***

Generally speaking, the previously investigated forms of ITV have been little more than modified or enhanced videoconferencing, in which, for example, lecturers and students located at various geographical sites have interacted at a distance through videoconferencing technology. This, coupled with uncoordinated and largely unsuccessful attempts to introduce less sophisticated ITV technology to the home market some years ago (Poole & Bradley, 2003), has led to the occasional problematic misconception that ITV is a flawed, expensive ‘white elephant’ which has largely failed.

Fortunately, with a surge of interest from various parties, notably IT companies such as Microsoft and Sun Microsystems, and companies in the position of benefiting financially from the development of ITV, such as cable and satellite television broadcasters, attitudes are changing. Three factors underpin these changes: the exponential growth of the World Wide Web from which a generation has learned how to use interactive techniques and tools, increasingly cheaper, smaller, and more affordable computer technologies, and the intervention of standards organizations such as the Advanced Television Enhancement Forum (Poole & Bradley, 2003).

#### **1.1.4. Use of current generation ITV**

Current generation ITV provides direct links from television programs to integrated Internet based content (Poole & Bradley, 2003). There are two basic formats, interactive overlays and reduced picture, which each have advantages and disadvantages. ITV development is similar to DVD Video development, with two exceptions: the video is continuous even while interacting with other content, and viewers are constantly linked to the Internet so permitting a wide range of interactive options (Poole & Bradley, 2003). These exceptions comprise part of the affordances of ITV.

The following image, Figure 1.1, shows a screenshot of an interactive segment from an ITV programme in Hull City, U.K. (BJHCIM, 2008). Interactive TV was used to provide personalised services and telecare for the over-65s. Figure 1.1 is an example of an ITV interface with a reduced picture.



Fig. 1.1 ITV interface from STREAM

For numerous other examples of ITV interfaces, visit the Broadband Bananas website (2013).

The following diagram, Figure 1.2, has been extracted from a report by the Canadian Radio-television and Telecommunications Commission (CRTC, 2002). It is a simplified diagrammatic representation of the physical setup of ITV.

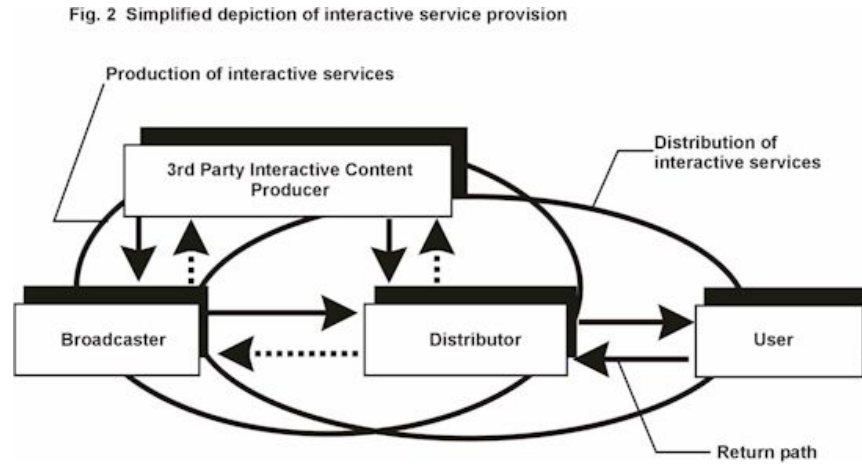


Fig. 1.2 Simplified depiction of interactive service provision

ITV has been used successfully in Victorian schools to deliver a range of educational content (Schools' Television, 2004). Live interactive programmes have been broadcast, utilizing telephone, fax and email in real-time, with website interactivity features sometimes included. Television networks are "tapping the deep educational potential by providing immediate links from programming to related content, such as background information and research" (Poole & Bradley, 2003, p. 414).

During the twelve months prior to commencement of the current study, BBC-TV in the UK broadcast two new series with sophisticated ITV applications, *Light Fantastic*, which provided historical, scientific and technological information about light (BBC-TV, 2005), and *Space Odyssey: Voyage to the Planets* (BBC-TV, 2004b). In conjunction with the broadcast of *Light Fantastic*, a real-time guide to the stars was offered (BBC-TV, 2004a). During the *Space Odyssey: Voyage to the Planets* broadcasts scientific information was also available via interactive TV and the web, and ITV technology enabled viewers to be "transport(ed)... to the heart of the European Space Agency's mission control room" (BBC-TV, 2004c). Viewers were also able to submit questions via their set-top box return path, email, or SMS (BBC-TV, 2004d). Experts such as rocket scientists, astronauts, and programme makers in a live broadcast answered the questions from the European Space Agency Mission Control (BBC-TV, 2004d).

Further evidence of the increasing profile of ITV has been its inclusion as a media type in the *British Academy of Film and Television Arts (BAFTA) Interactive Awards: 2004/5* categories for excellence including:

Best use of digital media to deliver factual information...the best e-learning work aimed at children under the age of 12...the best e-learning work aimed at life-long learning and not specifically for children...[and] the most creative and effective use of interactive TV across any genre or platform. (BAFTA, 2004, p. 1)

It is against this background that the research reported here has been undertaken. The reader is directed to Appendix 1, a glossary of terms, if further explanations are needed of any terminology used within the report. Pseudonyms have been allocated to each of the interviewees. A list of these pseudonyms is provided in Table 3.2.

## **1.2. Purpose**

The study has two main goals:

1. To provide an overview of the use of ITV in three innovative cases.
2. To contribute to literature that informs the application of ITV in educational contexts.

## **1.3. Research questions**

As a result, two research questions were formulated to guide the research.

1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?

There are many affordances associated with ITV but this study focuses on features that can support the design and delivery of socio-constructivist learning environments. Such learning environments are characterised by students working together within their social environment, which is the source of their ideas, concepts, attitudes, facts and skills (Finger et al., 2007).

According to Finger et al. (2007):



ICT tools that use the concept of scaffolding are based on this [socio-constructivist] model... Technologies like the internet and world wide web may be used, based on this theory, to facilitate the communication and collaboration which are essential elements of this theory. (p. 119)

As an ICT, interactive television facilitates such essential communication and collaborative elements inherent within a socio-constructivist learning environment. This research question places the focus on investigating what the ITV affordances are that enable such facilitation.

## 2. What are the critical pedagogical characteristics of ITV program design and broadcast?

The term 'critical pedagogical characteristics' refers to those features of program design and broadcast that are essential for engaging learners in constructivist-based learning. When technologies are introduced into the learning environment, there is often a risk that the technical capabilities will overshadow the pedagogical considerations. This research question seeks to look past this potential problem.

The research strategy is outlined in the following section.

### **1.4. Research strategy**

Yin (2003) suggests that a case study research strategy is appropriate in a study such as the current one, which is based on exploratory questions. The nature of data being collected, mainly interview data, lends itself to a qualitative approach to data collection, organisation and analysis.

Three cases were selected from the literature. One was an Australian ITV program provider, Schools' TV, in Victoria. The second was an Australian research institution that investigated the uses of ITV, the Interactive Television Research Institute (ITRI), in Western Australia. Finally, an innovative provider of educational ITV programs in the U.K., STREAM, was chosen for investigation.

For each of these three case studies, a number of persons with varying backgrounds, and various types of expert knowledge in the field of ITV, were interviewed. In addition to this, an ITV expert from ABC-TV in Sydney, Australia, was interviewed.

Chapter 3, the research methodology chapter, contains more detailed information relating to the research strategy. This includes the associated rationale, the data required, and the source of the data.

## **1.5. Theoretical framework**

### ***1.5.1. Overview***

A theoretical/conceptual framework may be defined as ‘the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs your research’ (Maxwell, 1996, quoted by Robson, 2002, p.63). Put more simply by Robson (2002), a conceptual framework is the ‘theory about what is going on, what is happening and why’ (p.63).

In order to identify the theoretical concepts underpinning this research project, the researcher drew on a range of theoretical resources including works by theorists, works on educational psychology, works on pedagogy, writings on educational research, as well as information from practitioners in the field. The focus was on learning theories, examples of what Punch (2006) calls ‘substantive’ theories, the role of which was to provide a framework for the descriptive aspects of the research.

A descriptive approach is appropriate when researching a new area (Punch, 2006) since the majority of readers will probably have little or no familiarity with the area. Since my research encompassed the innovative field of ITV, it was apparent that a descriptive approach was necessary, and that, furthermore, it would be ‘of great assistance in the development of more abstract concepts important in later theorizing’ (Punch, 2006, p.34).

### ***1.5.2. Personal theoretical base***

Mertens (1998) states that ‘(r)esearchers must be aware of their own personal theoretical base as well as that of the sponsors and the participants’ (p.50). My personal theoretical base has developed over a lifetime of personal experiences, including multiple educational and work experiences. In particular, completion of the Graduate Diploma of Education at the University of Wollongong and subsequent teaching experience has led me to advocate curriculum change and innovation, to make educational programs more enjoyable and relevant, and to produce improved outcomes through learning experiences.

I believe that the provision of collaborative, constructivist learning experiences is fundamental to achieving these aims. These principles align with how interactive television generally functions in an educational setting, as is demonstrated in the literature review in Chapter 2. However, it must be acknowledged that my educational principles may impact, consciously or unconsciously, on the current study. For example, I might view aspects of interactive television favourably, where other academics might not.

In terms of my personal approach to the adoption of technologies in education delivery, while the literature would define me as a digital immigrant (Prensky, 2001), I identify more readily with what are frequently referred to as digital natives (Bennett, Maton, & Kervin, 2008; Brumberger, 2011; Prensky, 2001). At the very least, I identify myself as an early adopter of technologies. This could lead me to view ITV technologies in a more positive light than might otherwise be the case.

Attempts to counter any such potential biases have been described in Chapter 3, the methodology chapter, in sub-section 3.6: *Ensuring Validity and Reliability*.

### **1.5.3. Social constructivism and technological determinism**

While my personal theoretical base will have had some influence on my research, the theoretical framework that has largely informed the current study has comprised social constructivism and technological determinism. This has been described in more detail in the following chapter, the review of the relevant literature.

## **1.6. Limitations of the study**

There were two key limitations to the study:

1. The study was restricted to three very specific cases. This has resulted in some limits on the advisability of generalising the findings to other specific cases. However, this limitation has been mitigated to some extent by the wide range of participants interviewed, and the 'generic' nature of many of the findings.
2. The subjective nature of interview data analysis by the researcher. Attempts have been made to address this in a number of ways. A professional transcriber was employed to carry out initial transcription of the interview audio recordings. Subsequent paraphrasing and

analysis by the researcher was carried out with extreme care, over an extended period of time. In addition to this, the transcripts were sent to the participants to verify the content. Minor feedback provided, which mainly related to maintaining anonymity of a couple of respondents, was then incorporated, and the documents re-submitted to those couple of respondents for approval.

### **1.7. Structure of thesis**

This thesis is organised into five chapters, followed by the reference list, and appendices. The structure is:

#### *Chapter 1 – Introduction to the Study*

Chapter 1 is the current chapter. This chapter has outlined the background to the study, the pedagogical problem, the purpose of the study, the research questions, the research strategy, the theoretical framework, and the limitations of the study.

#### *Chapter 2 - Interactive Television: a Review of Relevant Literature*

The chapter deals with literature relating to the theories underpinning the research. It also briefly discusses some key themes from the literature.

#### *Chapter 3 – Methodology*

Chapter 3 contains a review of research methodology literature, and subsequent justification for the methods selected for the current study. The methodologies are then described. Ethical considerations are discussed, and strategies employed to maximise validity and reliability are outlined.

#### *Chapter 4 – Themes in Interviews*

Design, technology, and education are the three major themes focussed on in this chapter. These have been broken down into a number of sub-themes. The interview data has been organised into the sub-themes, together with appropriate direct quotes. Brief summaries of responses have also been included.

## *Chapter 5 – Discussion and Conclusions*

This final chapter has a number of functions. Firstly, the research problem is re-stated. Secondly, responses to the research questions have been sought within the collected interview data. Literature review findings have been drawn into this discussion of the problem. A list of guidelines for the design of ITV programs has been provided. Finally, conclusions, about how the research problem may be addressed, are proposed at the end of the chapter.

## *References*

A comprehensive list of reference materials used throughout the thesis.

## *Appendices*

The appendices comprise a glossary of terms and abbreviations, the information sheet provided to participants, the consent form signed by participants, a table summarising when the interviews occurred and the perspectives of the respondents, the interview schedule, and a document containing summary extracts from the thematic data analysis.

## **Chapter 2**

### **Interactive Television: a Review of Relevant Literature**

This literature review briefly deals with literature relating to the theories informing the research, in particular social constructivism and technological determinism. In addition to this, some key themes from the literature, concerning distance learning, ICT enhanced education, and interactive television, are briefly discussed.

#### **2.1. Social constructivism**

In a study such as the current one where the main focus is on interactive learning environments, it is clear that what is likely to underpin it is a social constructivist theory of learning, stemming from Vygotsky. Moll (1990) supports this view and stated:

to facilitate the development of learning embedded in the everyday world, teachers, students and peers must interact, share ideas and experiences, solve problems and be interdependent. This interdependence is central to a Vygotskian analysis of instruction. (Moll 1990, cited in McNerney & McNerney, 1998, p.40).

Furthermore, the current study is informed by concepts such as the Vygotskian zone of proximal development (ZPD). In 1935, Vygotsky described the ZPD as the distance between a child's actual development as indicated by the child's ability to solve tasks independently, and a child's potential development as defined by tasks solved by the child with the assistance of adults or more intelligent peers. Similarly, Koschmann (1996, p.12) stated that Vygotsky's ZPD 'represents the enhanced capabilities of a learner working in the presence of a more skilled coworker or teacher'. There are a number of examples of the manifestation of Vygotsky's ZPD in the realm of ITV. One such example is that of carers assisting the elderly with a care-oriented ITV programme (BJHCIM, 2008). Another example is that of teachers assisting students in developing artefacts for ITV broadcasts in Hull, U.K. (as discussed during interview with one of the current study participants, ITV Manager MJ\_Hull, 2006).

Numerous studies point to the importance of constructivism in the learning process (Duffy & Cunningham, 1996; Jonassen, Davidson, Collins, Campbell & Bannan Haag, 1995; Nicol, Minty, & Sinclair, 2003). In a review of literature relating to constructivism and communication in distance education, Jonassen and colleagues (1995) coined an interesting concept:

‘Constructivist instruction is an oxymoron’ (p.12). They assert that learning should occur with the use of constructivist tools, in environments that foster socially negotiated meaning, rather than sequential instruction.

Social constructivism allows learners joint construction of knowledge and distribution across learning communities, as referred to by Nicol, Minty, and Sinclair (2003), who draw on work by various social theorists including Salomon and Perkins. I have adopted their basic assumptions that ‘learners construct their own knowledge through active engagement with texts and through interaction and dialogue with others’ (Nicol et al., 2003, p.271). In other words, I have assumed that learners within the ITV learning environment construct their knowledge through engagement with the broadcasts and products available, and through talking to and interacting with other learners. This concurs with Thompson, Simonson and Hargrave’s (1996) assertion that constructivism ‘provide[s] a structure for investigating the teaching and learning process when media are involved’ (p.63).

A special type of learning community, the virtual community, exists in the realm of distance learning, which is one of the themes explored in the current study. There are theories that relate to distance learning which fall under the umbrella of social constructivism. Cavanaugh (2001) refers to one such theory:

Holmberg’s theory of distance teaching (1985) states that distance teaching will support student motivation and promote learning pleasure and effectiveness if learners are engaged in discussions and decisions, and the program provides for real and simulated communication to and from the learners. (p.75)

This relates to the current study since ITV involves distance teaching and often involves synchronous and asynchronous communication to and from learners.

In terms of data analysis, since my research is underpinned by socio-constructivist theories, it might be expected that I should be guided by the ‘canons of the constructivists, who believe that inductive logic should be used exclusively in analysing qualitative data and that themes should emerge from the data and not be determined a priori’ (Lincoln & Guba, 1985).

However, I am influenced also by Miles and Huberman (1994) who state that either inductive or deductive analysis can be carried out on qualitative data. They argue that 'the lines between epistemologies have become blurred' (p.5), and that 'social phenomena exist not only in the mind but also in the objective world – and that some lawful and reasonably stable relationships are to be found among them' (p.4). This reflects my epistemological position, which is the same as Miles and Huberman, and which is labelled 'transcendental realism' (Bhaskar, 1978, 1989, cited in Miles & Huberman, 1994). As a result, I have looked not only for themes which emerge from the data, labelled as 'immanent' issues by Jovchelovitch and Bauer (2000, p.62), but also for a priori themes, labelled as 'exmanent' issues by Jovchelovitch and Bauer (2000, p.62). These predetermined themes that I have investigated were built in, to some extent, in the interview schedule design stage, when questions were specifically worded to introduce the themes, for example, of design, barriers, and synchronous communication.

## **2.2. Technological determinism**

Technological determinism, for the purpose of this study, is a theoretical approach coined by Hiltz in 1994. The features of a hardware-software system 'determine user behaviour and the degree of success of a computer application' (p.66). At the extreme of this approach is the perception by 'system rationalists' that effectively and efficiently designed computer systems will generate effective and efficient behaviour in users (Kling, 1980, cited in Hiltz, 1994).

Gallant (2000) asserts that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics. While the current study has been framed by Gallant's assertion, technological determinism, in the guise of affordances, has been a major component of the research.

Hiltz (1994) suggests that, to some extent, user reactions to hardware will result in significant variation in success. She also suggests that it may be reasonable to predict significant correlations between level of benefits and use of a system with the level of satisfaction with the system, and that a technology should have the same impact, irrespective of the differences between classes it is used in. Hiltz (1994) asserts that '[t]he relative power of technological determinants can be assessed by examining the results to see if they support these predictions' (p.67).



## **2.3. Distance learning**

### ***2.3.1. Distance education***

Distance education originally consisted of the delivery by 'traditional' mail of instructional materials to learners. Currently, reference to distance education connotes delivery via some form of electronic means, involving various levels of interactivity. Simonson, Schlosser and Orellana carried out a review of distance education research literature in 2011. They concluded that "the research clearly shows that distance education is an effective method for teaching and learning" (p. 139). Interactive television (ITV) is one of the potentially innovative delivery technologies for distance education. While descriptive articles concerning the capabilities of ITV are readily available, empirical research on the applications of current ITV to distance education is sparse.

Cavanaugh (2001) carried out a quantitative meta-analysis of various studies, published between 1990 and 1998, of interactive distance education utilizing videoconferencing and online telecommunications. The effectiveness of the distance education was investigated in relation to K-12 academic achievement. Findings supported the use of distance education, except in foreign language studies. Cavanaugh cautioned that interactive distance education for K-12 is less proven and much newer than traditional instruction, pointing to the finding of only 19 suitable studies for her meta-analysis as evidence of this. This problem is amplified when searching for empirical research on the educational use of ITV. The appendix to Cavanaugh's report lists the studies included in the meta-analysis. Three mention ITV, but are dated 1991, 1992, and 1994. ITV technology has advanced considerably since then, so the findings are probably outdated. Finally, Cavanaugh's argument that, as interactive distance education usage increases and there is a development of expertise, an increase in academic gains can be expected, indicates the need to maximize such gains, including those potentially enabled by ITV. Possible academic gains may be facilitated by one of the benefits of distance learning, that close physical proximity is not needed to form effective learning communities (Cavanaugh, 2001).

### ***2.3.2. Virtual communities***

Within distance learning, learning communities are often virtual, meeting across cyberspace. According to Nicol, Minty and Sinclair (2003), social theorists such as Lave, Wenger, Resnick

and Mayes generally agree that knowledge is constructed jointly and is spread across learning communities. Research into learning online suggests that online environments differ from face-to-face environments on a range of counts/characteristics, including the creation of virtual communities consisting of students, teachers and experts. Pincas (2000), for example, claimed that the social features of learning within online environments differ inevitably from those in face-to-face environments. For example, she refers to teacher concerns that they will be “deluged by constant [online] availability to their students and a need to monitor information on the Internet in regular, exhausting ways” (p.77). However, Pincas concludes that these fears might be unfounded since, for example, learners might participate in collaborative learning enabled by online technologies.

Pincas’ conclusion was supported by the findings of Engstrom, Santo and Yost (2008). In 2008, Engstrom, Santo and Yost investigated an American student cohort in an online master’s program in instructional technology, seeking to understand how the participants constructed knowledge about instructional theories and practices. They found that collaboration occurred in a number of ways within the learning community. These included learner collaboration via an ITV system during the first semester, asynchronous discussions via online platform WebCT, and face-to-face study group meetings.

Nicol, Minty and Sinclair (2003) conducted research into the social features of learning online, in the context of the University of the Highlands and Islands Millennium Institute (UHIMI), a partnership of 11 further education colleges and two research institutions in Scotland. Experiences of students and tutors during delivery of an online module were evaluated. Asynchronous online discussions were held and analysed. Nicol and colleagues (2003) found confirmation that the social context of face-to-face learning differs qualitatively from online learning, and concluded that this has considerable implications for the design of online learning. For example, participating tutors reported needing to adjust their teaching methods in order to facilitate online learning for their students, and recommended the implementation of a face-to-face induction for students and tutors, prior to commencement of online discussions. Similarly, participating students stated that the face-to-face induction had been an essential experience during which they were able to share personal information with other participants, prior to subsequent stages of online learning. Furthermore, all of the students reported that the online environment by itself would not have provided sufficient social

information for them to build mental pictures of other participating learners, or their tutors. The implication of these findings appears to be that it is desirable to supplement the social experience of online learning by incorporating some face-to-face interaction(s), preferably in the very early stages of the learning experience.

Similar research needs to be carried out on the virtual communities of ITV learning environments, particularly since much of the interaction within these communities is synchronous, rather than asynchronous. Whereas the participants in the study of Nicol and colleagues could not see or hear each other, it is likely that research on virtual communities in ITV environments might indicate that the social context of face-to-face learning will not differ qualitatively to the same extent, since participants will be able to see and hear each other in real-time.

## **2.4. ICT enhanced education**

Research into the use of ICT to enhance education is an ongoing effort, particularly as technological innovations regularly emerge. Furthermore, educational authorities including those in Australia have committed in policy documents to the ongoing development of technology use in Australian schools. For example, one of the educational goals for young Australians, as specified by the Ministerial Council on Education, Employment, Training and Youth Affairs (2008) is that:

Successful learners have the essential skills in literacy and numeracy and are creative and productive users of technology, especially ICT, as a foundation for success in all learning areas. (p. 8)

The Australian Curriculum, Assessment and Reporting Authority (ACARA) is the independent authority that is responsible for the development of the Australian national curriculum. It produces numerous documents, including a key one that underpins the curriculum, *The Shape of the Australian Curriculum* (2010). In the technology-specific component of this policy (ACARA, 2012), various policy purposes are listed, including that students should ‘develop knowledge, understanding and skills in the discriminating, ethical, innovative, creative and enterprising use of a range of technologies’. (p. 3)

An impressive body of work exists relating to well-established aspects of ICT enhanced education, such as interactivity afforded by ICT, multimedia, Web-based learning, television, and videoconferencing.

#### **2.4.1. Interactivity**

Interactivity has a dual character in the context of the current study: the interactive features of the technology itself, and interactivity between users such as teachers, students and experts. The importance of understanding how interaction occurs in computer supported learning environments was studied by Newhouse and Rennie (2001), who completed a longitudinal study of school classroom environments. They found that:

changes were required to the teaching strategies employed by teachers, the types of activities required of students, the organisation of the school curriculum and assessment practices. Fundamentally teachers appeared to need to have a student-centred, constructivist pedagogical philosophy to implement authentic applications of the computers in classroom.  
(p.241)

It may be anticipated that participants will attempt to interact in ways in which they are used to, regardless of the more 'high-tech' means available to them in new technologies. In the Scottish study into the social features of learning online cited above (under sub-heading 'Virtual Communities'), Nicol and colleagues (2003) found:

Again a tension can be noted between 'normative' and emerging interaction patterns. When modes of communication are new then it is natural for both students and tutors to seek ways of anchoring new interaction patterns in the familiar (p.275).

According to Chamberlain (2010), key players such as TiVo, Google, Apple and Disney are involved in a "struggle to anticipate, define, and control the future of television". In relation to interactivity, he claimed that these struggles "quite pointedly reflect a specific challenge to our understanding of how viewers interact with the screen"(p. 85).

According to Chorianopoulos (2008), “contemporary research has identified the differences in the UI requirements between the PC and ITV, but there are still no design principles to address the idiosyncracies of ITV users and applications” (p. 557).

The current study examines how interaction occurs in ITV supported learning environments, and uses the findings to inform the development of the proposed guidelines for ITV use by educators.

#### **2.4.2. Multimedia**

Research has shown that multimedia use can radically improve student learning (Facciola, 1997, cited in Evans & Sabry, 2003; Wallace, 1997).

Abrams and Streit (1986, cited in Thompson, Simonson & Hargrave, 1996) compared the effectiveness of interactive video to linear video, for teaching basic photography to students majoring in education. The study found that interactive video use had a larger impact on attitude than on achievement. Significantly greater achievement gains by the interactive video group were indicated, with researcher speculation that this was due partly to attentiveness level required of the learner, with “tuning out” more likely in the case of linear video. The lack of opportunities for practice and review were cited, by the linear video group, as shortcomings of the linear video. Anandam and Kelly (1981, cited in Thompson, Simonson & Hargrave, 1996) asserted that interactive video transforms the student from being a passive observer to being an active participant. Findings such as these have implications for ITV, due to some of its features being comparable to those of multimedia. Consequently, the findings have also had implications for the current study, since they have helped to inform its recommendations.

#### **2.4.3. Web-based learning**

Numerous authors have discussed the disadvantages and the advantages of the Web for educational purposes (Bodomo, 2006; Pozzi, 2008; Woo & Reeves, 2008).

Chang (2003) evaluated a distributed web-based learning community (DisWBLC) at the National Taipei University of Technology in Taiwan. User-based evaluation was carried out by the student participants, as well as evaluation by interviewing the teacher, online assistant,

and Web-based teaching and learning expert involved in the study. While most students responded positively, the negative responses prompted Chang to advocate the need for improved Web-based learning and further research. Two of the under-utilized functions were the expert consultation and the synchronous conference room. These functions can be mirrored in ITV, raising the question, of course, of whether they would be under-utilized in this context also. Students also indicated that many learning resources could be more effectively delivered via audio and video media that the DisWBLC did not adequately provide. ITV, on the other hand, does have the capability to deliver resources such as video-on-demand and hypervideo.

#### **2.4.4. Television**

According to Thompson, Simonson and Hargrave (1996), '[t]he teaching effectiveness of television has been well documented by over forty years of research' (p.35). It is apparent that this figure stems from the fact that the authors were reviewing the literature on one-way instructional television, beginning in the 1950s, as well as two-way instructional television. It is unclear whether their use of the term "two-way instructional television" is actually interchangeable with the term "videoconferencing". This was further confused by their use of the abbreviation "ITV" for "instructional television".

Four case studies carried out by the department of vocational and technical education at the University of Minnesota investigated how learners and teachers interacted in classes held in a two-way instructional television context (McClelland, 1987, cited in Thompson, Simonson & Hargrave, 1996). The researchers also investigated whether instructional television facilitated or constrained learning and teaching. Their findings included that the lesson flow did not appear to be significantly affected, teachers need training and practice to enable effective instructional television technology use, and a remote class may become invisible from the viewpoint of participation. In a study emanating from Iowa State University, high school students were surveyed about their attitudes towards satellite-delivered instructional television (Johnson, 1988, cited in Thompson, Simonson & Hargrave, 1996). Findings were that students mostly held positive attitudes, but did tend to prefer traditional instructional methods. In the context of the current study, these findings have been important, because they lend weight to the idea that it cannot be taken for granted that technology use

automatically enhances the learner experience. This has contributed towards a more balanced view of the educational value of ITV technology within the findings of the current study.

#### **2.4.5. Videoconferencing**

Videoconferencing has some use in the field of distance education, but it does have its limitations in terms of capabilities and broadcast quality, for example (Gillies, 2008). Another limitation is the need for users to be in a specific location at a particular time (Dudding, 2009). In Cavanaugh's 2001 quantitative meta-analysis of the effectiveness of interactive distance education, 68% of the studies involved two-way audio-videoconferencing. While the overall effect size for the studies was a small positive result of 0.147, the average effect size for videoconferencing was -0.011. It could be hypothesized that ITV would gain better results than videoconferencing if the research was replicated for ITV, since ITV has more professional broadcast quality than videoconferencing and more advanced interactivity features.

### **2.5. Interactive television**

As documented above, an impressive body of empirical research exists relating to the older, "established" technologies such as television and Web-based learning. In contrast, the rapid development of the innovative technology of current-generation ITV, and its subsequent use in learning environments, has not been adequately informed by empirical research into its uses in the field of education (ITRI, 2003). In recent years some researchers are beginning to address this shortcoming. For example, Evans, Stacey and Tregenza (1999) carried out a multiple-case study in Australia to investigate the 'extent, nature and problematics of educational dialogue through interactive television (ITV) in primary and secondary schools' (p.215). They suggest that

[while] usage [of ITV] in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers – particularly in specialist areas such as languages other than English – points to ITV, and other communications and computer technologies, adopting a higher profile. (p.214)

Themes which emerged from the first year of this study included the motivational importance of student involvement in the interactivity elements of the ITV programs, management issues

including the need for teachers to receive program notes early enough for them to incorporate them in their curriculum planning, and increasing integration of electronic communication with ITV media.

Fallahkhair, Masthoff and Pemberton (2004) studied the approaches and attitudes, to language learning and its supporting technologies, of independent adult learners at a UK university. They state that 'TV offers a rich multimedia experience, where learners can immerse themselves in authentic materials from the target language and culture' (p.4337). This experience can be further enhanced by interactivity, which facilitates communication and new ways of retrieving information (Gawlinski, 2003, cited in Fallahkhair, Masthoff & Pemberton, 2004).

A number of interesting findings emerged from Fallahkhair, Masthoff and Pemberton's (2004) study. One finding was that usability of the technology was a problem, specifically mentioning usability of the remote control; this problem could conceivably be overcome by user training, if the user was willing. Participant suggestions included the greater exploitation of the potential of subtitles, labels being attached to screen objects, the development of interactive language learning games, and the use of built-in communication facilities to enable 'post-programme conversations in the target language with other learners or native speakers' (p.4342). Conclusions reached by the researchers included that interactivity enhancements should be added to existing programs rather than developing TV programs specifically for language students, various levels of multimedia support could be provided according to the viewer's choices, fixed program timeslots help motivate users to learn, and learner contact with other people increased motivation. Finally, the authors asserted that an essential component of learning software design should be familiarity with learner behaviours, attitudes and beliefs. While the current study has not done any empirical investigation into this area, it has considered these issues by analysis of existing literature.

A number of other studies have been found relating to the use of ITV, including ones relating to training, supporting teachers' professional development, student interaction, interfaces, and management of broadcast communication style. However, none have been found as yet which duplicate the research carried out in this current study.



## 2.6. Recent developments

A snapshot of current literature, relating to ITV and education, follows in the next few paragraphs. A comprehensive literature review of the literature for the last several years is beyond the scope of this Master's thesis. Such a review will be left to future studies of the place of ITV in education.

When the current study was initiated, the researcher subscribed to a number of regular online ITV-related serials or newsletters, including *informitv*©. Since then there have been significant advances in ITV technology, and its applications, as documented in the literature. For example, Dr William Cooper, the Chief Executive of *informitv*©, stated that "there has certainly been an acceleration of broadband and broadcast convergence since we started *informitv* nearly seven years ago" (2010).

Furthermore, while seven years ago ITV was a peripheral emerging issue in most IT&C circles, now it has more dedicated forums. For example, in March 2011 the IP&TV World Forum 2011 was held in London, with a number of key speakers such as Vincent Dureau, Head of TV Technology, *Google* (Beach, 2011).

An increasing number of companies, such as Google and Apple, have invested time and money in developing new generation ITV technologies. Google TV products have received mixed reviews (*informitv*©, 2010), but are still in the ongoing developmental phases, so a gradual reduction in the amount of negative criticism may possibly occur. This would particularly be expected since a considerable number of major television manufacturing companies, such as Sony and Toshiba, have an interest in seeing Google TV succeed, so that they can integrate it into their television sets prior to sale (*informitv*©, 2010).

Another recent news article by *informitv*© (2011) predicted that

2011 will be the breakthrough year for connected television, with all the major manufacturers offering wired or wireless network-connected displays and any number of different boxes aiming to connect the television screen to the internet. Television will never be the same again.

Fallahkhair, Pemberton and Griffiths (2007) researched the development processes for a cross-platform language learning service (TAMALLE: television and mobile phone assisted language

learning environment) via interactive television and mobile phone. They adapted a learner-centred design methodology. A multiple method strategy was used to evaluate TAMALLE. Despite some text and on-screen display reading problems that were reported by language learners, the study revealed a generally positive response from participants.

According to Roberts and Herrington (2005), interactive television “can provide a vehicle for interactive, collaborative, constructivist, situated, and authentic learning” (p.577). One potential barrier to this is the level of adoption of new technologies. Drawing on Greek mythology, Straub (2009) stated that:

Technology adoption has become a Sisyphean task. As Sisyphus was condemned to eternity of pushing a boulder up a mountain, only to have to roll it back down again, the average individual is doomed to a cycle of continual technology implementation. About the time an individual adopts a technology, a new one is developed and marketed, requiring a new adoption cycle. (p.643)

This is indicative of the enormity of the task of educators who try to implement new technologies such as interactive television.

## 2.7. Summary of themes

The following Table 2.1 lists the major themes present in the literature review. The purpose of the table is to provide a summary of the themes in the literature, by listing the authors and their key ideas in relation to the themes. It provides a synthesis of the literature.

Table 2.1: The major themes present in the literature review

Theme	Who mentioned it	Brief summation
Design	Nicole et al (2003)	Claimed that the social context of face-to-face learning differs qualitatively from online learning, and concluded that this has considerable implications for the design of online learning.
	Thompson, Simonson & Hargrave (1996)	Many researchers have focussed on finding effective ways of designing computer-based learning experiences.
	Criswell (1989, cited in Thompson, Simonson & Hargrave, 1996)	Issues studied include student-computer interface design, lesson sequencing, interactions, evaluation, and revision.
	Fallahkhair, Masthoff and Pemberton (2004)	The authors asserted that an essential component of learning software design should be familiarity with learner behaviours, attitudes and beliefs.
	Chorianopolous (2008)	Stated that “contemporary research has identified the differences in the UI requirements between the PC and ITV, but there are still no design principles to address the idiosyncracies

		of ITV users and applications” (p. 557)
Problems	Evans, Stacey and Tregenza (1999)	The authors carried out a multiple-case study in Australia to investigate the ‘extent, nature and problematics of educational dialogue through interactive television (ITV) in primary and secondary schools’ (p.215).
	Fallahkhaier, Masthoff and Pemberton (2004)	One finding of their study was that usability of the technology was a problem, specifically mentioning usability of the remote control; this problem could conceivably be overcome by user training, if the user was willing.
	Becker (1990, cited in Thompson, Simonson & Hargrave, 1996)	He cited attitude of teachers, and lack of teacher education, as major barriers to appropriate and effective computer use. He also suggested that inadequate hardware seriously limited software uptake.
	Straub (2009)	One potential barrier is the level of adoption of new technologies. Drawing on Greek mythology, the author stated that: <i>Technology adoption has become a Sisyphusian task. As Sisyphus was condemned to eternity of pushing a boulder up a mountain, only to have to roll it back down again, the average individual is doomed to a cycle of continual technology implementation. About the time an individual adopts a technology, a new one is developed and marketed, requiring a new adoption cycle.</i> (p.643)
Affordances	Gallant (2000)	Gallant (2000), asserts that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics.
Collaboration	Roberts & Herrington (2005)	The researchers stated that interactive television could “provide a vehicle for interactive, collaborative, constructivist, situated, and authentic learning” (p.577).
	Engstrom, Santo and Yost (2008)	The researchers investigated an American student cohort in an online master’s program in instructional technology, seeking to understand how the participants constructed knowledge about instructional theories and practices. They found that collaboration occurred in a number of ways. These included learner collaboration via an ITV system during the first semester, asynchronous discussions via online platform WebCT, and face-to-face study group meetings.
Communication	Jonassen et al (1995)	In a review of literature relating to constructivism and communication in distance education, Jonassen and colleagues (1995) coined an interesting concept: ‘Constructivist instruction is an oxymoron’ (p.12).
	Cavanaugh (2001)	Cavanaugh (2001) refers to one such theory: <i>Holmberg’s theory of distance teaching (1985) states that distance teaching will support student motivation and promote learning pleasure and effectiveness if learners are engaged in discussions and decisions, and the program provides for real and simulated communication to and from the learners.</i> (p.75)  This relates to the current study since ITV involves distance teaching and often involves synchronous and asynchronous communication to and from learners.
	Cavanaugh (2001)	Cavanaugh (2001) carried out a quantitative meta-analysis of various studies, published between 1990 and 1998, of interactive distance education utilizing videoconferencing and online telecommunications.
	Nicol et al (2003)	Nicol and colleagues (2003) found:  <i>Again a tension can be noted between ‘normative’ and</i>

		<i>emerging interaction patterns. When modes of communication are new then it is natural for both students and tutors to seek ways of anchoring new interaction patterns in the familiar (p.275).</i>
	Evans, Stacey and Tregenza (1999)	<p>They suggest that</p> <p><i>[while] usage [of ITV] in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers – particularly in specialist areas such as languages other than English – points to ITV, and other communications and computer technologies, adopting a higher profile. (p.214)</i></p> <p>Themes that emerged from the first year of the study included the increasing integration of electronic communication with ITV media.</p>
	Gawlinski (2003, cited in Fallahkhair, Masthoff & Pemberton, 2004)	The TV experience can be further enhanced by interactivity, which facilitates communication and new ways of retrieving information.
	Fallahkhair, Masthoff and Pemberton (2004)	Suggestions from participants in the authors' study included the greater exploitation of the potential of subtitles, labels being attached to screen objects, the development of interactive language learning games, and the use of built-in communication facilities to enable 'post-programme conversations in the target language with other learners or native speakers' (p.4342).
Constructivism	Duffy & Cunningham, 1996; Jonassen, Davidson, Collins, Campbell & Bannan Haag, 1995; Nicol, Minty, & Sinclair, 2003	Constructivism is important in the learning process.
	Jonassen and colleagues (1995)	In a review of literature relating to constructivism and communication in distance education, they coined an interesting concept: 'Constructivist instruction is an oxymoron' (p.12). They assert that learning should occur with the use of constructivist tools, in environments that foster socially negotiated meaning, rather than sequential instruction.
	Nicol, Minty, and Sinclair (2003)	Social constructivism allows learners joint construction of knowledge and distribution across learning communities, as referred to by the authors, who draw on work by various social theorists including Salomon and Perkins.
	Nicol, Minty, and Sinclair (2003)	The authors state assumption that 'learners construct their own knowledge through active engagement with texts and through interaction and dialogue with others' (p.271).
	Thompson, Simonson and Hargrave (1996)	Claimed that constructivism 'provide[s] a structure for investigating the teaching and learning process when media are involved' (p.63).
	Engstrom, Santo and Yost (2008)	The researchers investigated an American student cohort in an online master's program in instructional technology, seeking to understand how the participants constructed knowledge about instructional theories and practices. They found that members of the cohort drew on each other's strength, and participated in informal study groups in order to construct their own knowledge.

Delivery	Nicol and colleagues (2003)	During a Scottish study, experiences of students and tutors during delivery of an online module were evaluated. Asynchronous online discussions were held and analyzed. Nicol and colleagues (2003) found confirmation that the social context of face-to-face learning differs qualitatively from online learning. The implication of their findings also appears to be that it is desirable to supplement the social experience of online learning by incorporating some face-to-face interaction(s), preferably in the very early stages of the learning experience.
	Chang (2003)	In a study relating to a Taiwanese distributed web-based learning community [DisWBLC], students indicated that many learning resources could be more effectively delivered via audio and video media which the DisWBLC did not adequately provide. ITV, on the other hand, does have the capability to deliver resources such as video-on-demand and hypervideo.
	Johnson (1988, cited in Thompson, Simonson & Hargrave, 1996)	In a study emanating from Iowa State University, high school students were surveyed about their attitudes towards satellite-delivered instructional television. Findings were that students mostly held positive attitudes, but did tend to prefer traditional instructional methods.
	Simonson, Schlosser and Orellana (2011)	The authors carried out a review of distance education research literature in 2011. They concluded that "the research clearly shows that distance education is an effective method for teaching and learning" (p. 139)
	Dudding (2009); Gillies (2008)	While videoconferencing does have its limitations, it still has its place in certain educational contexts.
Future	Thompson, Simonson and Hargrave (1996)	The authors state that "[d]etermining effective ways to teach students how to learn in hypermedia [or multimedia] environments will be an important research agenda for the future" (p.53).
	informitv© (2011)	Another recent news article predicted that <i>"2011 will be the breakthrough year for connected television, with all the major manufacturers offering wired or wireless network-connected displays and any number of different boxes aiming to connect the television screen to the internet. Television will never be the same again"</i> .
Interface	Thompson, Simonson and Hargrave (1996)	The authors cite the division of the computer screen into functional areas as a means of avoiding clutter on the screen.
	Chorianopoulos (2008)	Author states that "contemporary research has identified the differences in the UI requirements between the PC and ITV, but there are still no design principles to address the idiosyncrasies of ITV users and applications" (p. 557).
Learning	Moll (1990, cited in McInerney & McInerney, 1998)	<i>"to facilitate the development of learning embedded in the everyday world, teachers, students and peers must interact, share ideas and experiences, solve problems and be interdependent. This interdependence is central to a Vygotskian analysis of instruction."</i> (p.40).
	Koschmann (1996)	The author discussed the Vygotskian zone of proximal development, which 'represents the enhanced capabilities of a learner working in the presence of a more skilled coworker or teacher' (p.12).
	Vygotsky (1935)	Described the zone of proximal development (ZPD): the difference between a learner's existing independent ability, and potential ability when assisted by more highly skilled others.
	Cavanaugh (2001)	The author refers to a theory which relates to distance learning, which falls under the umbrella of social constructivism:  <i>'Holmberg's theory of distance teaching (1985) states that distance teaching will support student motivation and promote learning pleasure and effectiveness if learners are engaged in discussions and decisions, and the program provides for real and simulated communication to and from the learners.'</i> (p.75)
	Cavanaugh (2001)	The author carried out a quantitative meta-analysis of various studies, published between 1990 and 1998, of interactive

		distance education utilizing videoconferencing and online telecommunications. Cavanaugh's argument that, as interactive distance education usage increases and there is a development of expertise, an increase in academic gains can be expected, indicates the need to maximize such gains, including those potentially enabled by ITV. Possible academic gains may be facilitated by one of the benefits of distance learning, that close physical proximity is not needed to form effective learning communities.
	Nicol, Minty and Sinclair (2003)	Social theorists such as Lave, Wenger and Resnick generally agree that knowledge is constructed jointly and is spread across learning communities.
	Pincas (2000)	The author claimed that the social features of learning within online environments differ inevitably from those in face-to-face environments. One of her conclusions was that the risk of teachers being inundated by student enquiries might be offset by the enhanced possibility of collaborative learning provided by the Internet. This conclusion was supported by Engstrom, Santo and Yost (2008).
	Nicol, Minty and Sinclair (2003)	The authors conducted research into the social features of learning online, in the context of the University of the Highlands and Islands Millennium Institute (UHIMI), a partnership of 11 further education colleges and two research institutions in Scotland. Experiences of students and tutors during delivery of an online module were evaluated. Asynchronous online discussions were held and analyzed. The authors found confirmation that the social context of face-to-face learning differs qualitatively from online learning, and concluded that this has considerable implications for the design of online learning. For example, participants strongly supported the use of an actual face-to-face social interaction of learners and tutors prior to the commencement of online learning.
	Newhouse & Rennie (2001)	Newhouse and Rennie completed a longitudinal study of school classroom environments. They found that: "changes were required to the teaching strategies employed by teachers, the types of activities required of students, the organisation of the school curriculum and assessment practices. Fundamentally teachers appeared to need to have a student-centred, constructivist pedagogical philosophy to implement authentic applications of the computers in classroom." (p.241)
	Facciola (1997, cited in Evans & Sabry, 2003); Wallace (1997).	According to the authors, research has shown that multimedia use can radically improve student learning.
	Abrams and Streit (1986, cited in Thompson, Simonson & Hargrave, 1996)	The authors compared the effectiveness of interactive video to linear video, for teaching basic photography to students majoring in education. The study found that interactive video use had a larger impact on attitude than on achievement. Significantly greater achievement gains by the interactive video group were indicated, with researcher speculation that this was due partly to attentiveness level required of the learner, with "tuning out" more likely in the case of linear video. The lack of opportunities for practice and review were cited, by the linear video group, as shortcomings of the linear video.
	Anandam and Kelly (1981, cited in Thompson, Simonson & Hargrave, 1996)	The authors asserted that interactive video transforms the student from being a passive observer to being an active participant.
	Thompson, Simonson and Hargrave (1996)	The authors state that "[d]etermining effective ways to teach students how to learn in hypermedia [or multimedia] environments will be an important research agenda for the future" (p.53).
	Flori (1997); Papert (1997);	The authors discussed the disadvantages and the advantages of the Web and multimedia for learning and teaching.

	McClelland (1987, cited in Thompson, Simonson & Hargrave, 1996)	Four case studies carried out by the department of vocational and technical education at the University of Minnesota investigated how learners and teachers interacted in classes held in a two-way instructional television context. The researchers also investigated whether instructional television facilitated or constrained learning and teaching. Their findings included that the lesson flow did not appear to be significantly affected, teachers need training and practice to enable effective instructional television technology use and a remote class may become invisible from the viewpoint of participation.
	Fallahkhair, Masthoff and Pemberton (2004)	The authors studied the approaches and attitudes, to language learning and its supporting technologies, of independent adult learners at a UK university. A number of interesting findings emerged from their study. Participant suggestions included the greater exploitation of the potential of subtitles, labels being attached to screen objects, the development of interactive language learning games, and the use of built-in communication facilities to enable 'post-programme conversations in the target language with other learners or native speakers' (p.4342). Conclusions reached by the researchers included that interactivity enhancements should be added to existing programs rather than developing TV programs specifically for language students, various levels of multimedia support could be provided according to the viewer's choices, fixed program timeslots help motivate users to learn, and learner contact with other people increased motivation.
Synchronous / real-time	Cavanaugh (2001)	The author refers to Holmberg's theory of distance teaching (1985). [This relates to the current study since ITV involves distance teaching and often involves synchronous and asynchronous communication to and from learners (Jann Roberts)].
	Chang (2003)	Chang (2003) evaluated a distributed web-based learning community (DisWBLC) at the National Taipei University of Technology in Taiwan. Two of the under-utilized functions were the expert consultation and the synchronous conference room. [These functions can be mirrored in ITV, raising the question, of course, of whether they would be under-utilized in this context also (Jann Roberts)].
Technology	Hiltz (1994)	One theoretical approach that underpins the current study was labeled by Hiltz (1994) as technological determinism, in which the features of a hardware-software system 'determine user behaviour and the degree of success of a computer application' (p.66).
	Gallant (2000)	Gallant asserts that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics.
	Hiltz (1994)	Hiltz suggests that it may be reasonable to predict significant correlations between level of benefits and use of a system with the level of satisfaction with the system, and that a technology should have the same impact, irrespective of the differences between classes it is used in.
	Hiltz (1994)	Hiltz asserts that '[t]he relative power of technological determinants can be assessed by examining the results to see if they support these predictions' (p.67).
	McClelland (1987, cited in Thompson, Simonson & Hargrave, 1996)	University of Minnesota researchers investigated whether instructional television facilitated or constrained learning and teaching. Their findings included that teachers need training and practice to enable effective instructional television technology use, and a remote class may become invisible from the viewpoint of participation.
	Evans, Stacey and Tregenza (1999)	They suggested that <i>[while] usage [of ITV] in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers – particularly in specialist areas such as languages other than</i>

		<i>English – points to ITV, and other communications and computer technologies, adopting a higher profile. (p.214)</i>
	Fallahkhair, Masthoff and Pemberton (2004)	They studied the approaches and attitudes, to language learning and its supporting technologies, of independent adult learners at a UK university. They state that ‘TV offers a rich multimedia experience, where learners can immerse themselves in authentic materials from the target language and culture’ (p.4337).
	Fallahkhair, Masthoff and Pemberton (2004)	A number of interesting findings emerged from Fallahkhair, Masthoff and Pemberton’s (2004) study. One finding was that usability of the technology was a problem, specifically mentioning usability of the remote control; this problem could conceivably be overcome by user training, if the user was willing.
	Cooper, W. (2010)	The Chief Executive of informitv®, stated that “there has certainly been an acceleration of broadband and broadcast convergence since we started informitv nearly seven years ago”.
	Fallahkhair, Pemberton and Griffiths (2007)	They researched the development processes for a cross-platform language learning service (TAMALLE: television and mobile phone assisted language learning environment) via interactive television and mobile phone. They adapted a learner-centred design methodology. A multiple method strategy was used to evaluate TAMALLE. Despite some text and on-screen display reading problems that were reported by language learners, the study revealed a generally positive response from participants.
	Ministerial Council on Education, Employment, Training and Youth Affairs (2008)	Stated that one of the educational goals for young Australians is that:  Successful learners have the essential skills in literacy and numeracy and are creative and productive users of technology, especially ICT, as a foundation for success in all learning areas. (p. 8)
	The Australian Curriculum, Assessment and Reporting Authority (ACARA) (2010; 2012)	ACARA produces numerous documents, including a key one that underpins the curriculum, <i>The Shape of the Australian Curriculum</i> (2010). In the technology-specific component of this policy (ACARA, 2012), various policy purposes are listed, including that students should ‘develop knowledge, understanding and skills in the discriminating, ethical, innovative, creative and enterprising use of a range of technologies’. (p. 3)

The summary of the themes in the literature provided in the table above performs a number of functions. Not only does it highlight contributions by various authors to the research area, but the relative amount of emphasis placed on the various themes is readily observable from the table. It must be noted, however, that this table reflects the research areas focussed on by the researcher, and it is possible that unconscious bias occurred during the search process.

The theme occupying the greatest percentage of the table is that of **learning**. This is appropriate in an education-related study such as the current one. The theme that occupies the next largest percentage of the table is that of **technology**. This is also appropriate in terms of the focus of the current study being on the potential applications of ITV technology in the



area of education. Furthermore, as may have been anticipated prior to the data collection and analysis for the current study, the volume of learning-related data is greater than that of technology-related data. This conforms with the pedagogical premise that technology is subordinate to the act of learning itself.

The findings of the literature review above have been incorporated into the final chapter of the thesis, where they have been critically engaged with, and compared/contrasted with the data emanating from the current study. This procedure has been carried out in an attempt to assist in the provision of appropriate answers to the research questions.

This literature review has identified gaps in the literature relating to the educational use of interactive television. For example, there are numerous studies relating to distance education, but very few relating to distance education using ITV. Based on these gaps in the literature, the two research questions were formulated for the current study. These are discussed further in the following chapter.

## Chapter 3

### Methodology

This chapter begins with a re-statement of the purpose and the research questions, a brief review of research methodology literature, incorporating justification for the choices made in the current study. The methodologies of the study are then described. This is followed by a discussion of ethical considerations. The chapter concludes with a summary of the strategies used to maximise validity of the research and reliability of measures.

As stated previously the purpose of this study was to investigate the educational applications of interactive television, and the main research questions were:

1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?
2. What are the critical pedagogical characteristics of ITV program design and broadcast?

The purpose of this chapter is to address the methods used to investigate the research questions stated above.

#### 3.1. Justification of research methodology

Researchers may use various methods of collecting data, such as accessing primary sources, experiments, self-completed questionnaires, observations, video and audio taping, logging of computer actions and interviewing. Theoretical issues which inform the research determine the general methodology of the researcher: qualitative, quantitative or mixed, and also the specific data gathering and data analysis technique(s) employed (Foddy, 1993).

For example, a researcher may come from a postpositivist theoretical position based on a 'rationalistic, empiricist philosophy' (Mertens, 1998, p.7) which specifies that it is possible to study the social world in the same way as the natural world, in a value-free way, with provision of causation explanations (Mertens, 1998). Such a researcher may choose to use survey questionnaires with closed questions with scaled responses or fixed option responses which enable quantitative analysis of the resultant data (Robson, 2002). If a researcher comes from a paradigm such as constructivism, qualitative methods may assist in obtaining multiple perspectives (Mertens, 1998).

While the research questions appear initially to be candidates for a survey strategy, since they are asking ‘what’ (Yin, 2003 p.6), Yin does go on to suggest that a variety of research strategies, including case study, is appropriate if the question is exploratory. Furthermore, there was no control required over ‘behavioural events’ and there was a focus on ‘contemporary events’ in the study, which is a relevant situation for the case study research strategy (Yin, 2003, p.7).

A multiple-case design has been used, since the ‘evidence from multiple cases is often considered more compelling [than a single case], and the overall study is therefore regarded as being more robust’ (Herriott & Firestone, 1983, cited in Yin, 2003, p.46). Yin (2003) states that a common example of multiple-case study is a study of school innovations, such as new technology; this is analogous to the current study. Issues of validity and reliability have been further addressed by a number of procedures described in Table 3.5, on page 47 of the current report.

### 3.2. Ensuring no duplication of effort

In the literature review given in Chapter 3, a limited number of research studies have been described which have investigated the educational use of interactive television. It is important to ensure that the present research does not replicate this previous research, but instead offers a fresh perspective to the current knowledge on the use of interactive television in learning environments. Table 3.1 provides a summary of three research studies focused on ITV, chosen as relevant to the present study, to facilitate the comparison of the characteristics of each. The first column provides the key characteristics of the present study, while the other columns contrast the features of the comparative studies. This comparison process was carried out with all studies reviewed in the literature, with the aim of avoiding unnecessary duplication of effort.

Table 3.1: Comparison of present research to other research in the field

	Current Study	Jääskeläinen (2001)	Nicol, D., Minty, I. & Sinclair, C. (2003)	Chang (2003)
Title of thesis/paper:	<i>An investigation of the educational applications of interactive television (ITV)</i>	<i>Strategic questions in the development of interactive television programs [PhD thesis]</i>	<i>The social dimensions of online learning</i>	Towards a distributed web-based learning community
Broad aim of research	To explore characteristics and affordances of ITV broadcasts and programs,	To identify questions that a person developing interactive television	To research the social features of learning online.	To investigate the effectiveness of a distributed Web-based

	Current Study	Jääskeläinen (2001)	Nicol, D., Minty, I. & Sinclair, C. (2003)	Chang (2003)
	in the context of socio-constructivist learning environments	programs could ask himself or herself.		learning environment.
Technology, media or technique examined	Previous and current generation ITV, including Internet Protocol television	ITV technologies available at the time.	Online learning.	Web-based.
Methodology	Qualitative: interviews.	Knowledge brokering and the Zetterberg's method. Used a web-based survey tool called Infopoll, with quantitative features.	Qualitative.	Qualitative and quantitative.
Contexts investigated	Primary school: Australian and UK, tertiary research institute, commercial broadcasting.	Surveyed large variety of ICT experts in 13 countries, which included UK, but not Australia.	Scottish partnership of 11 further education colleges and two research institutions.	University in Taiwan.
Guidelines for ITV use developed	Yes	Yes	No	No

As these three comparative cases show, the design and methodology of the present research is different in both scope and focus. The guidelines for educational use of ITV presented here are also unique, since the researcher worked with users of ITV, who were the most experienced at the time. It appears that no other study has examined the same variety of ITV environments as selected for this research study. Furthermore, the qualitative methods used by the present study are designed to help preclude replication of results (Schofield, 1990) since even similar studies would have the potential to provide further insights.

The research methodology for the current study was guided by the general principles of qualitative inquiry, and specifically of case study inquiry, as outlined by researchers such as Yin (2003), Robson (2002), Miles and Huberman (1994), and Patton (1990).

### 3.3. Preparation for data collection

In order to maximize the proficiency of the case study methodology, four stages of preparation should be carried out (Yin, 2003). These are skill development, training, protocol development, and a pilot case study. The researcher needs the skills of asking good questions and interpreting the answers, being a good listener, being flexible and adaptive, having a full understanding of the issues being investigated, and being unbiased by prior ideas (Yin, 2003). Throughout my academic career, and working life as a teacher, I have attempted to develop

these skills as much as possible. I continue to do so, partly by completion of Masters coursework topics such as *Case Study Research*, *Questionnaire Construction* and *Interviews as Research Method*, and partly by completion of other appropriate academic courses relevant to my specific fields of interest, such as a Graduate Diploma of Education and a Diploma of Information Technology.

As the sole investigator on this multiple-case study, my training has largely been addressed during problem definition, and case study design development (Yin, 2003). A case study protocol 'contains the instrument as well as the procedures and general rules to be followed in using the protocol...it is essential if you are doing a multiple-case study' (Yin, 2003, p.67). Hence, a comprehensive protocol was developed for the current multiple-case study, as a guide for carrying out the study, and as a tactic in increasing the case study reliability (Yin, 2003). Sections included were a project overview, field procedures, specific case study questions, and a reporting guide (Yin, 2003). The case study questions section also included empty table shells (Miles & Huberman, 1984, cited in Yin, 2003).

Yin (2003) recommends a pilot case study as the final stage of preparation for data collection, with the main criteria for case selection being access, convenience, and geographic proximity. A full-scale pilot case study was not carried out, mainly due to the very limited number of sites being available, and the ones that exist not fulfilling the criteria of convenience, access, or geographical proximity. However, efforts were made to be as prepared as possible, by carrying out an ongoing literature review, so that 'the final research design was informed ... by prevailing theories' (Yin, 2003, p.80).

### **3.4. Research design**

The data types, data collection methods, and data analysis methods used were selected from case study methodology, as described in the literature by research methodologists such as Yin (2003), Robson (2002) and Luo (2011).

#### **3.4.1. Data collection justification**

The data collection methods of accessing documents, non-participant observation, and interviewing were employed. According to Yin (2003), document review has the strengths of stability, unobtrusiveness, exactness, and wide coverage, while observation has strengths such as real-time coverage of events, and coverage of event context. Luo describes how, for example, interview and transcript data can be used to 'create rich narrations of perceptions, attitudes, reactions, relations and environments' (2011, p. 8). Interviewing has the strength of being an adaptable and flexible way of gathering data, with advantages such as the possible

use of non-verbal cues to help in understanding verbal responses (Robson, 2002). An additional justification for selection of these methods was that triangulation of data would occur (Maxwell, 1996). Indeed, according to Hitchcock and Hughes (1995), 'case study researchers will inevitably become involved in the triangulation of data sources' (p.323).

The in-house documents, mainly in the form of information accessible on associated websites, helped to determine the affordances of ITV. The policy documents, such as the *Melbourne Declaration on Educational Goals for Young Australians* (Ministerial Council on Education, Employment, Training and Youth Affairs, 2008), helped to identify the desirable features of enhanced learning environments, from the point of view of educational authorities. In addition to such document analysis, the literature relating to socio-constructivist pedagogy was reviewed, in order to determine appropriate features to be incorporated into an ITV learning environment model. For example, Thompson, Simonson and Hargrave (1996) recommend *Constructivism and the Technology of Instruction: A Conversation* by Duffy and Jonassen (1992), since it includes chapters about the relationship between educational technology and constructivism.

It was planned to access videotaped data of archived broadcasts, since Loizos (2000) asserts that 'the image...offers restricted but powerful records of real-world, real-time actions and events' (p.93).

The observations and the interviews provided data about the affordances of ITV that facilitate the design of enhanced learning environments.

### **3.4.2. Research processes**

The research processes followed were:

1. Suitable interview candidates were determined from staff contact details on ITV broadcast related websites. This was publicly available information, which included the roles undertaken by the candidates.
2. Contact was made with the potential participants by email, as this was considered to be the least intrusive method of contact. Permission was sought to interview the candidates, as well as to visit the sites (in the case of the 2 Australian sites). Advice was sought as to the optimal time to visit the Australian sites, preferably when a broadcast was taking place. Interview times suitable for both the interviewees and the researcher were set. It was planned that semi-structured interviews would be carried out with 2-3 expert practitioners from each site, such as managers, instructional designers, or producers. However, due to various factors the number of interviewees at each site ranged from one to five. All of the Australian

interviews were carried out face-to-face on site, or close to the site. The UK interview was carried out by telephone. For a copy of the interview schedule, see Appendix 5.

3. Where appropriate, each informant was asked to nominate 3 ITV programs that they considered to be the most innovative. Where possible, the ITV programs nominated by the interviewees were examined to ascertain their affordances. The ones that were accessible were asynchronous archived recordings sourced from the Internet. While archived video of broadcasts from the Victorian site was available, it did not include the actual interactive features that were integrated when the live broadcasts had gone to air. Hence, during discussions with the broadcast producer, it was ascertained that there was nothing to be gained from viewing the archived video.

4. Prior to the site visits, it had been planned that non-participant observations would be carried out, of the ITV production units and any concurrent broadcasts. Observational notes were made at two of the sites, about the affordances of the technology, but it was not possible to observe concurrent broadcasts. Lofland's (1971, cited in Cohen, Manion & Morrison, 2000) recommendation that a minimum of two typed pages should result from every hour of observation was used as a general guide for the observational notes. However, the notes taken related more to physical environmental features of the ITV sites and technological hardware. These observational notes were subsequently deemed by the researcher to be of little value in terms of contributing to the current report.

5. Websites relating to the ITV case study sites were examined and documented. This action was taken mainly because other documents were not accessible, so it was intended to help address the problem of limited data availability.

6. The collected data was analysed, with a priori and emergent themes being explored and documented, including the affordances of ITV.

7. Based on the findings from the data collection and analysis, a discussion of the findings was carried out. Subsequent conclusions were stated, and recommendations for further research made.

### ***3.4.3. Selection of cases***

Three heterogeneous ITV sites, specifically school, university, and commercial, were selected by a purposive sampling method (Cohen, Manion & Morrison, 2000), to allow 'planned comparisons along certain potentially important dimensions' (Schofield, 1990, p.213). Specifically, critical cases were selected from the literature to permit 'logical generalization and maximum application of information to other cases' (Miles & Huberman, 1994, p.28).

Optimal, fully-operational, state-of-the-art examples of each case were selected, constrained by the limited availability of sites to be sampled due to the lack of existing ITV facilities. The use of 3 cases allows for literal replication, in which similar results are predicted (Yin, 2003). The two Australian cases selected were Schools' TV in Victoria, and the Interactive Television Research Institute (ITRI) at Murdoch University, Western Australia. The UK case was a schools-based ITV operation in Hull, managed by a local company with ties to the Hull Council.

#### **3.4.4. Interviews**

For the purposes of this study, the main types of interviews carried out were semi-structured (Robson, 2002). However, where possible, the interviewer allowed the respondents to talk as freely as possible, and only prompted where necessary. Research methodologists such as Fontana and Frey (2000) endorse the use of semi-structured interviewing, asserting that it can result in an increased breadth of data as opposed to use of the more structured interview types.

It is recognised that interviews as a research method have various strengths and weaknesses. Interviewing has the strength of being an adaptable and flexible way of gathering data, with advantages such as the possible use of non-verbal cues to help in understanding verbal responses (Robson, 2002). However, Robson (2002) does indicate concern about reliability due to the possible resultant lack of standardization. Disadvantages include the possibility of biases, and the amount of time consumed in data gathering, transcription and data analysis (Robson, 2002). Three other issues are: respondents misinterpreting the questions (Foddy, 1993), ethical considerations concerning interview questionnaire development (Jackson & Furnham, 2000), and respondents answering questions when they do not fully understand the topic (Foddy, 1993).

The current research was designed to minimise any possible weaknesses inherent in interviewing methodology. For example, during the research process the responses were audio-recorded and later transcribed and analysed. Sometimes the respondents asked the researcher to restate questions. For further details, see Table 3.5 in the research report section on ensuring validity and reliability.

##### **3.4.4.1. The participants**

Table 3.2 provides a summary of the eight participants in this study. In order to maintain a level of anonymity, a mononymous [single-name] pseudonym has been allocated to each participant. Brief details regarding the expertise and experience of each respondent have also been included.



Table 3.2: Table of participants

Participant	Pseudonym	Expertise	Experience
1	MG_SchoolsTV	ITV producer/manager	Manager of Schools' TV Victoria, Australia
2	MJ_Hull	ITV manager	Manager of STREAM in Hull, United Kingdom
3	DV_ITRI	ITV research centre manager	Manager of Interactive Television Research Institute [ITRI] at Murdoch University, Western Australia
4	AT_SeniorAcademic	ITV and education	Academic at Murdoch University, Western Australia
5	HM_ResFellow	ITV use in education of children	Post Graduate Fellow at Murdoch University, Western Australia
6	CW_ABCTV	Television manager	Manager of ABC2 in Sydney, Australia
7	Anon1_EdExpert	Education and ITV	Academia, educational research
8	Anon2_ITV_Expert	ITV and tourism, advertising	Academia, post-doctoral research into ITV

The participants were eight experts connected in some way to the field of interactive television. The majority of the interviewees were located at the actual ITV case study sites. The others were interviewed because of their expertise in the field generally. While it was intended to interview separate ITV managers and producers for each of the three sites, circumstances dictated that this did not happen in two of the cases: the Victorian site and the UK site. This was partly due to varying roles held by those persons contacted by the researcher. For example, the Victorian interviewee, MG\_SchoolsTV, fulfilled both the role of

manager and the role of producer, so had broad knowledge of the data being sought. In the UK case, the interviewee was the manager, MJ\_Hull. Since ethics approval had not been granted to request potential interviewee names from the initial contacts, it was not deemed appropriate to request the name of a producer. Fortunately, the manager had a very broad knowledge of ITV issues including management and production ones.

Three of the other experts were from ITRI. These were the manager of ITRI, DV\_ITRI, an associated academic, AT\_SeniorAcademic, and a post-doctoral research fellow, HM\_ResFellow. The manager of ABC2 in Sydney, CW\_ABCTV, was another of the interviewees. Two other participants wished to remain anonymous. One was a university academic with an interest in education and ITV. The other was a post-doctoral researcher interested in ITV and advertising.

#### **3.4.4.2. The interview questions**

Patton (1990) has constructed a table matrix generating 18 different types of questions. The matrix consists of six basic kinds of questions with permutations of past, present, and future tense. The six fundamental kinds of interview questions recognised by Patton are:

1. Experience or behaviour questions relating to what respondents do, or have done;
2. Opinion or values questions designed to understand the respondent's interpretive and cognitive processes;
3. Feeling questions designed to understand the emotional responses individuals have to their thoughts and experiences;
4. Knowledge questions relating to factual information the respondent has;
5. Sensory questions about what the respondent has seen, heard, touched, smelled and tasted; and
6. Background or demographic questions concerning the identifying characteristics of the respondents such as age, occupation, and education (pp. 290-293).

The interview questions asked of the ITV experts are presented in Table 3.3 below, accompanied by a description of the question's type (according to Patton's classification) and a reason for its use. Some flexibility in the interview schedule allowed follow-up questions tailored to address individual responses. Most of the questions are Type 2: opinion questions. There are some experience, knowledge, and background questions (Types 1, 4 and 6) but no sensory or feeling questions (Types 3 and 5). It was not considered appropriate or necessary to elicit sensory or feeling information.

Table 3.3: Schedule, classification and rationale of interview questions

Question	Type of question				Rationale
	1 Exp	2 Opin	4 Know	6 Back	
<p><i>Thank you for being willing to take part in this interview. Firstly, I wish to assure you that, if you have requested anonymity, your participation is anonymous and your name will not be attached to any interview records. Please consider the following questions in your professional capacity of (manager/producer/instructional designer, etc.), in the context of learning environments within your organisation.</i></p> <p>Explain right to withdraw and ask permission to audio-record the interview.</p>					Introductory and explanatory comments.
<i>What sort of ITV work have you been involved in?</i>				X	Background question to ascertain level of experience with ITV.
<i>What are the affordances of interactive television that you have found useful for education (will need to tell participant what is meant by affordances<sup>1</sup>)? Why is it better than simply video conferencing?</i>	X				Open-ended question encouraging respondent to provide lengthy, descriptive answer. Presupposes (Patton, 1990) that there are affordances, and that ITV is better than video-conferencing.
<i>Do you think that synchronous (real-time) communication is an important feature of ITV in an educational setting? Why?</i>		X			Closed opinion question requiring 'yes/no' answer, followed by 'why?' in an effort to elicit a more complete opinion from the respondent
<i>Are any methods employed to provide resources in an asynchronous (outside broadcast time) manner?</i>			X		While this could potentially lead to a closed 'yes/no' answer, it was hoped that by this stage the interviewee would have developed a habit of giving more comprehensive responses. If not, prompts, or 'detail-oriented probes' (Patton, 1990), would have been used.
<i>Which of the affordances you have mentioned do you consider unique to ITV? [Interviewer will also have a list of unique affordances gleaned from the literature, and raise any previously unmentioned]</i>		X			This opinion question pre-supposes the existence of affordances unique to ITV. This pre-supposition is based on researcher's review of pertinent literature
<i>Do you think these affordances are transferable to a tertiary/school/commercial broadcasting educational setting?</i>		X			Again, while this could potentially lead to a closed 'yes/no' answer, it was hoped that by this stage the interviewee would have developed a habit of giving more comprehensive responses
<i>What are the barriers to the use of ITV? Is there anything else that you can think of that would be a barrier? [Prompts: Are there any technological problems, administrative difficulties, or pedagogical problems?]</i>			X		Knowledge question with probe to try to encourage respondent to think further and delve more deeply for answer.
<i>What impact on education can you see ITV technology</i>		X			Projective question which seeks to build a

<sup>1</sup> Affordances are the fundamental properties that determine how something can be used. A chair is for support and, therefore, affords sitting (Norman, 1998, p.9). 'The computer system, with its keyboard, display screen, pointing device ([such as] mouse) and selection buttons ([such as] mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the display screen' (Norman, 2010, p.1)

Question	Type of question				Rationale
	1 Exp	2 Opin	4 Know	6 Back	
<i>having in the future? What do you think the affordances of new ITV technologies will be? In other words, what do you think they will make possible which would not otherwise be possible?</i>					picture of ITV's potential future capabilities.
<i>What would you like to do with ITV if you could?</i>		X			Opinion question which seeks recommendations for potential use of, and improvements to, interactive television.
<i>In its ICT Strategic Vision, DET states that '[s]tudents will use technology to communicate with peers, regardless of location, and work collaboratively on learning programs' (2002, p.15). What is your opinion of this statement?</i>		X			Open-ended opinion question which does not seek any specific response.
<i>Can you please name 3 ITV programs, connected with your ITV unit, which you consider to be the most innovative?</i>		X			Seeks to elicit more detailed information to build on previous more general answers.
<i>Can you describe each program generally, and how viewers interact during the broadcast?</i>			X		Speculative question which can be compared to the transfer study in Part E of the research.
<i>What do you consider to be the strengths of each program? What do you consider to be the weaknesses of each program?</i>		X			Questions pre-suppose that there are strengths and weaknesses in each program.
<i>How many times has each program run? Are figures available for number of viewers/participants?</i>			X		Closed knowledge questions to seek focussed quantitative response.
<i>Why was each program developed? Was it an existing program which was adapted for ITV delivery or was it created specifically for ITV? If the program existed as a face-to-face or distance unit, what factors influenced the way it was adapted for ITV delivery?</i>			X		Seeks more detailed knowledge data to reinforce and elaborate on previous data from opinion questions.
<i>Were there any problems or difficulties that arose during the design and development stages?</i>			X		Seeks information to assist researcher in developing guidelines for addressing problems in the design and development stages.
<i>How effective do you think each program is? What have been the outcomes of the program, generally for the students?</i>		X			Seeks summary comments, and reinforcement of previous answers.
<i>Can you compare each program's impact to an earlier version of the program that may have been in a different mode?</i>		X			Seeks to find out more about the unique affordances of ITV, as compared to other technologies.
<i>In your opinion, what are the important characteristics of the design of ITV programs?</i>		X			Opinion question seeking to reinforce previous answers, and provide researcher with clear data for producing guidelines for ITV program design.
<i>How willing would you be to be involved in the design of another ITV program using similar principles and strategies?</i>		X			While this question does have underlying elements of all six question types defined by Patton (1990), in terms of the respondent's experiences leading to this point in time, the researcher has categorised it as an opinion question in this context, since the

Question	Type of question				Rationale
	1 Exp	2 Opin	4 Know	6 Back	
					respondent is basically making a judgement on whether the principles and strategies are acceptable,
<i>What advice would you offer other practitioners who might be just starting out to design an ITV program using similar principles?</i>		X			Projective question which asks the interviewee to assume the role of 'expert'.
<i>Do you have any further comments which you would like to make?</i>					Final open-ended question to obtain any further comment.
<i>Thank you very much for helping me and giving up your time.</i>					Closing remarks and thanks.

The ITV experts were interviewed separately, using the interview questions given in Table 3.3 above. In 2005, the face-to-face interviews with DV\_ITRI (ITRI) and MG\_SchoolsTV (Schools' TV) were partly carried out while touring their ITV-related premises, and then the interviews were completed in an office, and a couple of rooms, respectively. The majority of the other face-to-face interviews were carried out in quiet rooms in July 2005. One interview, in June 2005, was carried out in a café, as the interviewee CW\_ABCTV was extremely busy and had not had a chance to eat lunch. In 2006, the UK interview with MJ\_Hull was carried out over the telephone, via speakerphone, with the researcher in a University of Wollongong Faculty of Education office. The interviews were recorded on a small digital audio recorder.

Four methods were used during the interviews in an effort to elicit comprehensive answers:

1. Giving the interviewee enough time to think
2. Providing appropriate stimuli, such as recognition and support comments and encouraging gestures, to 'maintain the flow of communication' (Patton, 1990, p.330)
3. Using conversational 'detail-oriented probes' with follow-up questions beginning with words such as 'what' and 'how' (Patton, 1990, p.325)
4. Attempting to establish rapport, for example, by making questions as understandable as possible (Patton, 1990)

The interviews lasted for 20-75 minutes each, with the approximate average length being 60 minutes. The interview recordings were generally audible, and readily transcribed, with one exception – the interview in the café. Parts of this were indecipherable, in particular some of the questions. Table 4.2 provides a summary of themes and the corresponding interviewees

who discussed them. In addition to this, a partial audit trail is provided in Appendix 4, by the provision of a table summarising from whom the data was collected, and when.

### 3.4.5. Data planning matrix

According to LeCompte and Preissle (1993), a data planning matrix is useful when planning research. Table 3.4 (presented below) was developed as part of the case study protocol. It provides a summary of the relationship between the research questions and the research methodology. It should be noted that this was the data **planning** matrix. It ensued that not all planned data collection, for example observation of interactive broadcast content from case study sites, was possible.

Table 3.4: Data planning matrix (Table headings adapted from LeCompte and Preissle, 1993)

Research question	Rationale	Data required	Source of data
1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?	To investigate and document the technical and educational features of models of ITV production, as currently defined.	~ Literature describing ITV production and broadcasts ~ Interview data ~ Observational recordings ~ Broadcast content	Multiple case study: ~ Interviews with: • Managers of ITV programs • Producers of ITV programs  ~ In-depth document analysis of ITV production units and broadcasts ~ Broadcast content analysis, including types of interactions required from viewers
2. What are the critical pedagogical characteristics of ITV program design and broadcast?	To develop a refined set of guidelines for the production and use of ITV in educational settings	~ Literature describing ITV production and broadcasts ~ Interview data ~ Observational recordings ~ Broadcast content	Multiple case study ~ Interviews with: • Managers of ITV programs • Producers of ITV programs • Other independent ITV experts  ~ In-depth document analysis of ITV production units and broadcasts

### 3.4.6. Data analysis

Data from all sources—the interview transcripts, the literature review, and other documentary evidence—were analysed using qualitative data analysis techniques recommended by Yin (2003), Robson (2002), Miles and Huberman (1994), Wiersma and Jurs (2005) and Bell (2005).

These techniques included categorising the data, describing the data and synthesising the data.

Reducing the data, by means of coding by themes and sub-themes, enabled the 'description and interpretation of the phenomenon under study' (Wiersma & Jurs, 2005, p. 207). As recommended by Bell (2005), the researcher 'look[ed] for similarities, groupings, clusters, categories and items of particular significance' (p. 227). Tables were used as organisational devices and a means of presenting findings (Bell, 2005). Triangulation was part of the data analysis process, by comparing and considering data from multiple sources (Wiersma & Jurs, 2005), such as various expert respondents, and the literature.

As prescribed by Wiersma and Jurs (2005), the results emanating from the data analysis were then used to make inferences. These inferences were expressed in the form of conclusions provided in the final chapter of this research report.

### **3.5. Ethical considerations**

It was essential to conduct the research in a reasonable and unbiased manner, in particular by following the stringent ethical guidelines specified by the University of Wollongong to guard the rights of participants. Ethics approval was granted by the Human Research Ethics Committee (HREC) of the University of Wollongong. The key ethical issues that have been addressed are those of informed consent, confidentiality of records, possible risks to participants, and payment for participation.

#### ***3.5.1. Informed consent***

Each participant received an information sheet outlining the scope of the research before commencing the study (see Appendix 2). Consent forms, modified slightly from the standard consent form provided by the HREC, were subsequently provided (see Appendix 3). Some of the information included was notification of the participant's right to withdraw at any time, and to remain anonymous if desired.

The intention was to reassure participants as much as possible about the trustworthiness of the research procedures and researcher intentions to avoid causing any harm to the participants. Miles and Huberman (1994) indicate that if respondents feel mistrust they will be guarded: 'Weak consent usually leads to poorer data' (p. 291).

### ***3.5.2. Confidentiality of records***

The only identifying feature of any of the interview recordings or transcripts was the filename generated by the digital audio recorder. Participants were labelled as “P” in each of transcripts, and any person’s name they referred to during the interview was deleted, and replaced with the initial of the first name. No other identifying data was included.

Only the researcher, and one transcriber for a brief period of time, had access to the audio recordings. The digital audio files were, and continue to be, stored securely on a password-protected computer in the researcher’s office at the UOW Campus. The transcripts are also stored securely.

### ***3.5.3. Possible risks to participants***

There were no perceptible risks to participants in the study. Interviews were carried out during normal business hours, and kept to as brief a time as possible. Every participant was aware of his or her option to withdraw at any time. Not only were they aware that they had the right to choose to remain anonymous at the time of interview, but the researcher gave them the option of choosing to remain anonymous after having had the opportunity to read the actual interview transcripts.

One potential ethical issue arose in the fact that generally speaking there are a limited number of ITV experts and sites available, and that specifically the three sites were named in the study (with the permission of the managers of each). This could have led to an issue of persons who wished to remain anonymous being inadvertently identifiable. However, this possibility was determined to be negligible, since some interviews were carried out with persons not directly connected to the three sites, and the interviews were not restricted to Australia.

### ***3.5.4. Payment for participation***

Incentive payments for participating in the study were never considered. Apart from anything else, no participants were financially disadvantaged as the interviews were carried out during normal business hours.

## **3.6. Ensuring validity and reliability**

In an attempt to inspire as much confidence as possible in the current research, a number of techniques were used to maximise validity and reliability of the research methods, inferences and conclusions. The techniques employed are listed in Table 3.5.



Table 3.5: Procedures to ensure validity and reliability in qualitative research (table modelled on Table 5.10 in Herrington (1997, p.33))

Procedure	Implementation
Use of multiple data sources to enable triangulation of data (Maxwell, 1996; Miles & Huberman, 1994)	Corroboration by varying sources of data (various ITV site cases and experts), and by data collection method, (interview, observation, documentation)
Enabling an external observer to follow the steps from research questions to conclusions and vice-versa (Yin, 2003).	Establishment of a chain of evidence. Together with the use of multiple evidence sources, this is intended to reinforce construct validity (Yin, 2003).
Establishing internal validity (Yin, 2003).	Since, according to Yin (2003), internal validity is only an issue for causal or explanatory studies, it does not need to be addressed in the current exploratory, descriptive study.
Consensus among other researchers that the research is robust.	Research proposal reviewed by academics as part of University Masters requirements  Formal review of research proposal at a public forum as part of University Masters requirements  Preliminary study findings reviewed through conference presentation and publication (Roberts & Herrington, 2005) which enabled public scrutiny and appraisal of the research during the thesis preparation stage
'Looking for <i>disconfirmation</i> of what [the researcher] think[s] is true' (Miles & Huberman, 1994)	Detection of negative instances followed by careful consideration of the ratio of negative to positive evidence (Miller, n.d., cited in Miles & Huberman, 1994)
'Avoiding biases stemming from researcher effects on the site' (Miles & Huberman, 1994, p.266)	Low profile adopted by researcher and intentions made clear to informants. One interview was carried out offsite, in 'a congenial social environment...by way of reducing both [the researcher's] threat quotient and [their] exoticism' (Miles & Huberman, 1994, p.266).
'Avoiding biases stemming from the effects of the site on the researcher' (Miles & Huberman, 1994, p.266).	Avoided "elite" bias by interviewing informants of "lower" status, included a person with different points of view from mainstream, maintained conceptual thinking rather than sentimental, and kept research questions firmly in mind (Miles & Huberman, 1994).
Strengthening the quality of the data (Miles & Huberman, 1994)	Careful planning and monitoring of circumstances of data collection by methods such as firsthand reporting, and respondent being alone with field-worker rather than being in a group (Miles & Huberman, 1994).
Obtaining confirmatory feedback from the informants themselves (Miles & Huberman, 1994)	During the interviews respondents were asked to verify that the perceptions and conclusions being drawn by the researcher were correct.
Checking reliability of interview questions. According to de Vaus (2002), a question is reliable if it is answered in the same way on repeated occasions by the same respondent.	This was verified by respondents checking their original responses in the written transcripts and notifying the researcher if there were any errors. Only one change, in one answer, was requested by one of the respondents.
Checking validity of interview questions. If a question measures what the researcher expects it to measure, then it is deemed valid (de Vaus, 2002). Seale and Filmer (1998) refer to this as measurement validity, which they state can be improved by several methods; these include face validity, criterion validity, and construct validity.	The following implementation methods were obtained from Seale and Filmer (1998). Face validity was checked by the researcher deciding whether the question referred to the correct concept, Criterion validity was checked by comparing question results with existing correlated information. Construct validity involved checking whether the measure conformed to theoretical expectations.
Adopting other procedures to maximise validity of	Techniques were adopted from other researchers such as Wolcott (1990), who recommends steps such as the researcher

Procedure	Implementation
interview data	focusing on listening rather than talking when interviewing participants, doing accurate recording, writing as early as possible, and full, candid reporting.
Deepening preliminary conclusions by use of an extreme case outlier (Miles & Huberman, 1994).	Some months after data collection had taken place, one of the three case study sites unexpectedly (as far as the researcher was concerned) closed down. The researcher followed the recommendation of Sieber (1976, cited in Miles & Huberman, 1994) to look at possible antecedents of the apparent failure of the educational innovation.
Ruling out spurious relationships between variables present in the study context (Miles & Huberman, 1994).	Searched for additional variables, in an effort to support or disaffirm apparent causal relationships and/or correlations (Miles & Huberman, 1994).

### 3.7. Conclusion

This chapter has described the methods used to gather data with the potential to offer answers to the current research questions. The data analysis, accompanied by discussion of the findings, is presented in the next two chapters.

## Chapter 4

### Themes in Interviews

Three major themes were determined a priori from the literature. These were design, technology, and education. These major themes were then broken down into sub-themes, some of which were determined a priori by the researcher, also from the literature, and others that emerged from the data. In the thematic analysis, which follows, interview data has been categorised and distributed into each sub-theme. Pertinent quotes have been included, as well as brief summaries of what each interviewee contributed to the researcher's exploration of these themes. Where appropriate, the literature has been referred back to. Finally, Table 4.2, that summarises the locations of the sub-themes within the interviews, has been included at the end of the chapter.

#### 4.1. Re-statement of research questions

1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?
2. What are the critical pedagogical characteristics of ITV program design and broadcast?

The following Table 4.1 maps the two research questions to the major themes and sub-themes of the study.

Table 4.1: Relationships between research questions and themes

Relevant research question	Major theme	Sub themes	How sub-themes determined
1, 2	Design considerations	Design	From literature
1		Problems	From interview data
1	Technology considerations	Affordances	From literature and interview data
1, 2		Communication	From literature
1		Delivery	From literature
1		Future	From interview data
1		Interface	From literature
1		Problems	From case study and interview data
1		Synchronous	From literature
1		Technology	From literature
2		Assessments	From interview data
1, 2		Collaboration	From literature
2	Education	Constructivism	From literature
2		Learning	From literature
2		Pedagogy	From literature

## 4.2. Note about definitions

The definitions adopted below related to the context of this study. It is recognised that there are many alternative definitions, but this is beyond the scope of this study.

## 4.3. Findings

**Please note:** the findings below have been organised alphabetically by sub-theme.

The findings emanating from the data are detailed below. They are listed under the corresponding sub-themes, which are in alphabetical order. Firstly, a definition is provided for each sub-theme, and then the key comments by each participant are listed. Sometimes, where relevant, references are made back to the literature review. Finally, a section summary is included for each sub-theme.

### 4.3.1. Affordances

**Definition:** Affordances are the fundamental properties that determine how something can be used. “A chair affords (“is for”) support and, therefore, affords sitting (Norman, 1998, p.9).

‘The computer system, with its keyboard, display screen, pointing device ([such as] mouse) and selection buttons ([such as] mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the display screen’ (Norman, 2010, p.1). This concept is fundamental to the current study, since one of the aims of the study is to investigate the educational affordances of interactive television.

**AT\_SeniorAcademic:** AT\_SeniorAcademic was an academic at Murdoch University in Western Australia, with expertise in ITV and education. He discussed the affordances of PVRs, such as storing broadcast materials, including different streams, which could then be accessed later, at a more convenient time. This could help avoid missing interactivity opportunities in an ITV broadcast. AT\_SeniorAcademic also stated that there could be information available in multiple places, and a “hierarchy of information” where further details could be accessed by “drilling down” or “telescoping”, either delivered by ITV or DVD. Drilling down or telescoping refers to the options of accessing additional information by such means as clicking on menus and sub-menus to narrow topics down into sub-topics, or via links moving laterally or outwards to more general information. Regarding assessments, AT\_SeniorAcademic alluded to the ability of ITV to afford both explicit and implicit assessment processes.

In terms of potentially unique affordances of ITV, the conclusion AT\_SeniorAcademic reached was that, “in some sense”, the act of watching television might be seen as a different type of action psychologically and sociologically to using a website “or whatever”, so giving “some reasons why interactive TV might be different from other interactive applications which might embody the same functionality.”

Secondly, in terms of considering unique affordances of ITV, AT\_SeniorAcademic raised the concept of “potential of immediacy” in ITV use. He stated that real-time broadcast material could be stored on a PVR (personal video recorder), and considered to be **different or current** [emphases by respondent], in comparison with material previously placed on a storage medium such as a DVD. Furthermore, he stated that if a back channel was available, the interactivity with the broadcast initiator could be in real-time or in almost real-time compared with website or DVD related feedback. He stated that “back channel availability...might change the nature of the interactivity with ITV, as against activity with another medium.”

**Anon1\_EdExpert:** Anon1\_EdExpert was experienced in academia and educational research, and had expertise in education and ITV. In response to the question of which ITV affordances may be useful for education, Anon1\_EdExpert responded:

That’s an interesting question because I’d assume there are some. I’ve yet to be convinced that there are any... I guess I’m a bit cynical about it, using technology, I think it’s meant to be used for good reasons and I guess because I come from that point of view I sort of take the approach that it’s not necessarily better because it’s technology. And I also don’t want to, I mean there’s that phrase about using old pedagogies and just using new technology to teach the things the old way so I guess I’m really aware of that and I’m keen not to be sort of sucked in by the sexiness of using interactive television just because it’s there.

The respondent went on to say that he/she thought that there were “things unique to ITV in a negative way”. He/she acknowledged that he/she was speaking from the point-of-view of a teacher, not of a TV producer or media expert. One issue in projects familiar to the academic was the cost of producing the programs and the associated bandwidth requirements. He/she continued that compared to producing a linear program, an interactive program may require multiple scripts, multiple “shoots”, and extra time with actors or puppeteers, “so it becomes quite an expensive exercise and I think that’s one of the things that’s holding back ITV”. Furthermore, the respondent stated that the economic issues could inhibit the adoption of ITV by universities.

However, the academic stated that this negative perception of television-watching as being passive could actually point to one of the affordances of interactive TV, that it did allow the learner to be more active and a participant in the activity and to make some choices and decisions.

**MJ\_Hull:** MJ\_Hull was the ITV manager of STREAM in Hull, United Kingdom. In MJ\_Hull's view there were three critical affordances of interactive television in terms of education. Firstly, that video-based learning resources held within schools can be delivered to people within their homes, to be viewed at their convenience. This is particularly useful for learners with visual learning styles.

A unique affordance, according to MJ\_Hull, is that "people want to see themselves on television and there's a kind of gloss that television brings". This was incorporated into the change management process in Hull, in which pupils, parents and teachers collaborated to make learning resources to be broadcast on the interactive TV service. The fact that the broadcast would be seen by people encouraged focus in the collaboration, "so the whole broadcast element of user-generated content is something which really helps particularly with those disengaged groups who otherwise have no real interest in learning, so the broadcast element is critical".

The third affordance, according to MJ\_Hull, was that ITV is a learning resource that can engage people who have difficulty in connecting with other forms of learning resources that require higher demands on their literacy and numeracy skills.

When the researcher asked MJ\_Hull about possible future affordances of ITV technology, he stated that the critical thing would continue to be building systems capable of working across different platforms.

**MG\_SchoolsTV:** MG\_SchoolsTV was the manager of Schools' TV Victoria, in Australia, with expertise in ITV production and management. During a telephone interview with the researcher in 2003, MG\_SchoolsTV listed a number of affordances of ITV, including creation of a sense of ownership for the audience, the phone-in ability allowing programs to be active rather than passive, not having to bring guests into the studio, an opportunity to see what you see when you want to see it, and the feeling of "foot-to-board" during production. At the time of the current interview, MG\_SchoolsTV said that he thought a lot of these affordances were inter-related. For example, he said that an interactive component needed to be live to provide

ownership and instancy, so “the live management of that particular interaction is the pivotal part”. However, he pointed out that producers never really had total control over the live program, but that the program happened dynamically, due to the end user having input into the outcome of the program in terms of their phoned-in response, for example. MG\_SchoolsTV stated that these affordances were transferable to a commercial broadcasting educational setting, but that, unfortunately, at the time of interview, “the aspects of interaction and television [had] mainly rested in commercial and not education” related production. MG\_SchoolsTV continued that “where there is a big delineation is in the outcome – what is the outcome of the program – what’s the aim of the program?” and that the intended outcome was the key benchmark in terms of working out where the program really sat.

He said that another affordance was that of building a sense of community, due to an ITV program audience feeling like they were part of something which they could control, and not just a disparate audience passively watching a commercial or free to air TV program.

MG\_SchoolsTV then spoke about how ITV could be used to build a “dynamic community model” which facilitated a greater understanding about other cultures and ways of doing things. He said that, at the time of interview, his production unit was trying to implement a model capable of linking students from different cultures on a worldwide interactive platform. This would be intended to compare how Australian students create very different content to, for example, students from Japan or Greenland, so beginning with a shared platform of understanding, then creating what MG\_SchoolsTV referred to as a “cyber group of people”, that is, people separated by physical distance but still interacting quite strongly. MG\_SchoolsTV acknowledged that arguments existed that there were other technologies which could do that as well but that he would argue that the richness was very different, for example, compared to being in a chat room where there is no “visual reference”.

**Anon2\_ITV\_Expert:** Anon2\_ITV\_Expert was experienced in academia and post-doctoral research into ITV, and had expertise in ITV and tourism and advertising. Anon2\_ITV\_Expert stated that interactive activities could be carried out via ITV in a larger format than on the Web. A specific example given was that of the affordances of ITV for disabled people, such as bigger text on the screen than on a computer, high quality audio, and immediacy of access to content, offering a different medium to get information through.

**HM\_ResFellow:** HM\_ResFellow was a post-graduate fellow at Murdoch University, Western Australia, with expertise in the use of ITV to educate children. Important attributes for children's TV, and ITV, based on HM\_ResFellow's experience, were:

richer media, bigger, louder, more visually exciting experience[s] ... colourful ... Many of them may not be able to read so you're going to have to have it quite bright and vibrant and have as few words as possible ... you need animation, you need a sort of a tree branch style where if you choose one thing you will not see another.

HM\_ResFellow stated that there was another affordance of ITV, which was that it was "trackable". He said that this led to "an interesting paradox because ITV is supposed to be geared for more control to the audience but you actually retain greater control ... by giving them the choice you then can track what they choose". HM\_ResFellow clarified the point by explaining that information could be gathered about where the viewer was clicking, what they were choosing to do, and whether they were hesitating. This information, HM\_ResFellow stated, could then be used to revise the way things were done in future programs.

HM\_ResFellow also talked about some advantages of ITV, as opposed to the Internet, including the security of being in a "walled garden", as compared to the lack of security on the Internet. HM\_ResFellow stated that two other advantages, at the time of interview, were the stability of ITV compared to accessing the Internet via a computer that could crash, and the superior "rich multi-media experience" of ITV. A key point which HM\_ResFellow made was that "TV is trustworthy in the mind of the consumer", and that "the idea is to keep everything [in ITV] very stable and very believable and secure, just like normal TV is and then it will always have that power over and above the Internet". HM\_ResFellow stated that a useful characteristic of ITV in terms of education was the return path that enabled students to participate and send communications back, not just receive them.

He stated that ITV had not yet reached its enormous potential. Specifically regarding ITV in education, HM\_ResFellow stated that:

the interactive nature of it is perfectly poised for education. It allows someone to become an active participant, they don't sit back and absorb, they lean forward and participate, they can question, they can surmise, they can go down a path, they can understand the relationship between cause and effect ... by interacting you've caused something to happen and you can see the results of that.



HM\_ResFellow said that the latter concept was a very basic equation but that was “quite profound” for young children, by helping them to develop the ability to see outside themselves, and observe the consequences of their actions.

Finally, HM\_ResFellow re-iterated that “[ITV is] merely a tool, a tool that is developing in its sophistication but the most important thing is the quality of the product that you use this tool to create”.

**DV\_ITRI:** DV\_ITRI was the manager of the Interactive Television Research Institute [ITRI] at Murdoch University, Western Australia. The researcher asked DV\_ITRI what he thought were the affordances of ITV. DV\_ITRI’s response was couched largely in the context of children’s TV educational content, since ITRI carried out considerable research in that field. DV\_ITRI commented that educational television was “still caught in the old paradigm of education” and was “still curriculum centred”. He qualified this by saying that this largely had to be attributed to the nature of technology. However, DV\_ITRI continued that, as technology entered a domain where interactivity became feasible, this suddenly allowed television to “make that shift from being curriculum centred to being child centred and that’s a very exciting shift”.

Regarding any potential unique affordance(s) of ITV, DV\_ITRI suggested that it was mainly the “degree of the marriage with the content”, giving the example of being able to vote in the ITV space while viewing a broadcast, without needing to use a phone. He continued that it was the “proximity to the original content that’s [ITV’s] key advantage”.

**Section summary:** The interview responses concerning the affordances of ITV focussed on the key ideas of assessment or monitoring of user actions, engagement of users through a sense of ownership or control, and making the end user the focus rather than the content or delivery. One respondent also discussed potential advantages of ITV, resulting from its affordances.

Assessment and monitoring of user actions were referred to by AT\_SeniorAcademic and HM\_ResFellow. AT\_SeniorAcademic referred to an affordance of ITV of implicit assessment, in the form of logging viewer actions. This could be coupled with eye-gaze technology, such as that used at ITRI at Murdoch University, to assist in monitoring how viewers interact with the ITV experience, and thus the affordances of ITV in terms of the mechanics of the viewing experience. This reflects the current study’s theoretical underpinning of technological determinism. HM\_ResFellow described ITV as being “trackable”, which he said led to “an interesting paradox” of audience choice versus producer control.

MJ\_Hull, MG\_SchoolsTV, Anon2\_ITV\_Expert, and HM\_ResFellow discussed engagement of users. Indeed, the key affordance MJ\_Hull attributed to ITV was engagement of users.

MG\_SchoolsTV described affordances that supported MJ\_Hull's view, such as the creation of a sense of ownership for the audience, the user being able to see what they want when they want, and the creation of a sense of community. MG\_SchoolsTV also mentioned an affordance which did not apply to users, but to ITV producers, of a feeling during production, of "foot-to-board", which he said was inter-related to the need to facilitate the affordances of ownership and instancy to users. Anon2\_ITV\_Expert narrowed down the idea of engagement of users by enhanced interactive experiences to a smaller sub-set of users, those with special needs.

HM\_ResFellow emphasised the importance of engagement of the user, while referring to a different sub-set of users to Anon2\_ITV\_Expert's: the subset of children. Specifically, HM\_ResFellow attributed ITV affordances such as visual engagement, animation, the "quite profound" opportunity for children to see outside themselves, and to see the consequences of their actions.

DV\_ITRI also focussed on children's television in some of his comments, stating that ITV technology had the potential to shift the central focus from curriculum to the user – the child. He also stated that it was the "proximity to the original content that's [ITV's] key advantage".

Potential advantages of ITV discussed by HM\_ResFellow included security, stability, consumer perceptions, and the communication return path. He stated that ITV had not yet reached its full potential, including in the educational field. Finally, HM\_ResFellow emphasised that ITV was merely a tool to be used to provide what was really important: a good quality product.

In contrast to other respondents, Anon1\_EdExpert provided an alternative viewpoint about ITV, reflecting on the need to adopt a cautious approach to utilising unproven technologies such as ITV in attempts to enhance learning.

#### **4.3.2. Assessments**

**Definition:** Assessments are processes carried out in an attempt to determine the level of understanding of a person about a given topic. According to the Oxford English Dictionary, "the action of assessing someone" (Stevenson, 2010). Assessment is not a key focus in the current study, particularly since it did not emanate as a key focus in the data.

**AT\_SeniorAcademic:** The option of moving from information intake mode to assessment mode may be facilitated by interactivity, according to AT\_SeniorAcademic. He stated that in the educational or training context there is often assessment, either self-assessment or by someone else, which may be explicit or implicit. AT\_SeniorAcademic gave an example of explicit assessment, of where a question “pops up” which is relevant to material that has just been presented. In terms of implicit assessment:

there may even be potential for automated assessment of user’s responses by logging their interactive behaviour... implicit evaluations which can go on in terms of perhaps the student moves through the material, whether they did backtracking, whether they looked at interesting options or not. Then one has to be careful with anything that’s implicit like that but there is the potential for that.

One of the educational design questions AT\_SeniorAcademic raised included whether a lot of material should be presented to students, and then an associated assessment be carried out at the end of the semester.

**MJ\_Hull:** Typically, one lesson delivered within the STREAM model could comprise a learning objective, some video content that was stimulus material, then some assessments, or applications “or something to do as a result of watching that particular piece of content.”

**Section summary:** The interview responses concerning the sub-theme of assessments related to explicit and implicit assessment, and the placement of assessment tasks.

AT\_SeniorAcademic stated that interactivity enabled explicit or implicit assessment, such as by logging user behaviour.

AT\_SeniorAcademic and MJ\_Hull referred to the placement of assessment tasks.

AT\_SeniorAcademic raised the educational design question of whether assessments of students should be carried out after presentation of a lot of associated materials. MJ\_Hull’s description of a STREAM-delivered lesson tied in with AT\_SeniorAcademic’s question about students being assessed at the end of viewing materials, in that the lesson’s follow-up activity might be an assessment.

### **4.3.3. Collaboration**

**Definition:** ‘The action of working with someone to produce something’ (Stevenson, 2010). In the context of this study, collaboration refers not only to collaboration between students, but

also, for example, collaboration between teachers and students, and teachers and ITV producers.

**AT\_SeniorAcademic:** AT\_SeniorAcademic outlined an interactive project he had been involved in, Desert Knowledge CRC, which was a collaboration with academics from the University of Wollongong. It explored the potential of using interactive television broadcasts into remote Australian communities, with a particular focus on Indigenous communities. An Indigenous broadcasting group operating out of Alice Springs, IMPARJA, also collaborated in the study. Technical issues were investigated in relation to delivering ITV via a network such as IMPARJA and the Optus satellite. Other issues examined included the applications of ITV in a remote community, the objectives, the “value proposition” (a term AT\_SeniorAcademic attributed to Duane Varan, from ITRI), and what could be “done” for people.

In terms of collaboration amongst students, AT\_SeniorAcademic raised the educational design question of whether ITV users were collaborating with other students.

**MJ\_Hull:** A unique affordance of ITV, according to M, is that “people want to see themselves on television and there’s a kind of gloss that television brings”. This is incorporated into the change management process, in which pupils, parents and teachers collaborate to make learning resources to be broadcast on the interactive TV service. The fact that the broadcast will be seen by people encourages focus in the collaboration.

**MG\_SchoolsTV:** In terms of aspects of ITV which could give support to enable correct pedagogy, such as enabling students to work collaboratively and constructively, MG\_SchoolsTV claimed that this drew on the “psychology of the screen, more on the way that television is designed as a mass communication tool and therefore, as a mass communication tool, it means that students accept that they’re part of a broader community”. He said that the effect of this was to cause collaboration and constructivism skills to be brought into force, and embellished, in the interactive community. MG\_SchoolsTV stated that Schools’ TV had three producers with education and media production backgrounds, who collaborated with the Victorian Office of Learning and Teaching in order to establish specific learning outcomes related to educational content being delivered. He said that this meant that any interaction would always be anchored back into the intended educational outcome, as part of the basic process of considering the aim, how it would be delivered, and how it would meet the educational objective.

**Section summary:** The interview responses concerning the sub-theme of collaboration focussed on the key ideas of collaboration between academics and broadcasters, student, parent and teacher collaboration, community-based collaboration, and professional collaboration.

AT\_SeniorAcademic described the collaboration of academics and broadcasters to investigate the delivery of ITV to a remote community. Regarding student collaboration, he raised the question of whether ITV users were collaborating with other students. MJ\_Hull answered AT\_SeniorAcademic's question, by describing how pupils, parents and teachers collaborated in making learning resources to be broadcast to other people.

Similarly, MG\_SchoolsTV claimed that the effect of students accepting that they were part of a broader community of TV viewers was to cause collaboration and constructivism skills to be brought into force in the interactive community. He also cited professional collaboration between ITV producers and a government educational office, resulting in any interaction being anchored back into the intended educational outcome.

#### **4.3.4. Communication**

**Definition:** The Oxford Dictionary of English defines communication as 'the imparting or exchanging of information by speaking, writing, or using some other medium: television is an effective means of communication' (Stevenson, 2010). Furthermore, it defines communicating as relating with socially, which is an interesting description, particularly in the field of education, where socio-constructivist theories of learning are quite dominant. This has relevance in the current study, since, as established earlier in the report, it is primarily underpinned by socio-constructivist learning theories.

**AT\_SeniorAcademic:** One interactivity-focussed project AT\_SeniorAcademic was involved in was for Emergency Management Australia. It investigated how to effectively send emergency messages to members of the public. While ITV was looked at as a potential mode of communication, the project was not predominantly ITV based. The main messaging systems looked at were telephone, fax and email. The project incorporated a pilot study involving the transmission of messages about bushfires and cyclones. According to AT\_SeniorAcademic, this pilot study was highly successful, and the West Australian Government decided to implement such a system.

Additionally, AT\_SeniorAcademic referred to his work involving a remote Indigenous community. He related that a back channel was not available so communication could not be carried out synchronously. He said that this raised the question of how things could be structured to allow users to communicate back asynchronously, possibly by a website, telephone call, postcard or other mechanism.

**Anon1\_EdExpert:** Anon1\_EdExpert recommended that “the learner should be encouraged to be critical about what they see and the choices that they make, to be able to reflect on that in some way and to communicate that”.

**MJ\_Hull:** MJ\_Hull describes video-conferencing as “simply a means of communication [without] a terrific impact in terms of educational experience”. He said it does not necessarily require much preparation prior to the conference, while ITV requires extensive work to develop a learning package wrapped in interactive features. Furthermore, the use of ITV

encourages the whole process of learning to go on behind the generation of content...pupils who actually go through that process learn more about their subject while learning important communication and development skills as well, at the same time. So again, it's about the process, not just the product, and that's where I think it has a massive advantage over videoconferencing.

**MG\_SchoolsTV:** MG\_SchoolsTV claimed that synchronous or real-time communication was definitely an important feature of ITV in an educational setting, because we were living in a media literate world where instant feedback was expected, and the rise of the digital age meant that students expected a certain response level from any application they interacted with, such as computer, phone, or game-based applications. He said that there was no excuse for television not to provide that response.

In terms of aspects of ITV which could give support to enable correct pedagogy, such as enabling students to work collaboratively and constructively, MG\_SchoolsTV stated that this drew on the “psychology of the screen, more on the way that television is designed as a mass communication tool and therefore, as a mass communication tool, it means that students accept that they're part of a broader community”.

**Anon2\_ITV\_Expert:** Synchronous communication was described as being an important feature of ITV in any setting, because “people don't want to wait nowadays, do they...people can talk or converse or communicate instantaneously with a person on the other side of the country in a face-to-face manner and have a more personal and more fulfilling experience that way.”

**HM\_ResFellow:** HM\_ResFellow stated that a useful characteristic of ITV in terms of education was the return path that enabled students to participate and send communications back, not just receive them.

**Section summary:** The interview responses concerning communication focussed on the key ideas of outward and inward bound communications, the technology involved, the pedagogy, and synchronous communication.

AT\_SeniorAcademic discussed outward-bound communication and inward bound communication, in the form of transmission of emergency public messages, and an Indigenous users' asynchronous back-channel, respectively. Similarly to AT\_SeniorAcademic's partial focus on the potential for back-channel use by Indigenous users, HM\_ResFellow drew attention to the usefulness of the ITV return path for student participation.

MJ\_Hull compared communicating via video-conferencing with communicating via ITV.

While AT\_SeniorAcademic's discussion centred more around the technicalities of communication, Anon1\_EdExpert focussed on the pedagogical idea of encouraging learners to communicate their critical reflections concerning their interactive experience.

The importance of synchronous communication was raised by MG\_SchoolsTV and Anon2\_ITV\_Expert. MG\_SchoolsTV claimed that TV should provide a response-level commensurate with living in a media literate world where synchronous feedback was expected. He referred to television as a "mass communication tool". Anon2\_ITV\_Expert's statement, that synchronous communication was an important feature of ITV because of contemporary expectations of immediacy in communication, was aligned with MG\_SchoolsTV's comment about current-day expectations of synchronous feedback.

#### **4.3.5. Constructivism**

**Definition:** According to McInerney and McInerney (1998), constructivism derives from cognitive psychology. They state (1998, p.5) that the latter has become:

very important in helping to explain effective learning and its relationship to effective teaching. Implicit in these cognitive views of learning is the notion that effective learning occurs when individuals **construct** their own understandings.

McInerney and McInerney (1998) elaborate on this idea by citing Poplin (1988), who asserted that, in cognitive theories, the active role of the learner was emphasised, in relation to the

processes of making sense of information and the building of personal meaning. In terms of the current study, the concept of constructivism is explored, for example, within the context of the STREAM ITV technology in Hull, U.K., which affords students the opportunities to collaboratively construct their own knowledge.

**Anon1\_EdExpert:** Anon1\_EdExpert questioned how effective ITV may be in terms of allowing users to construct their own knowledge, since the choices available could be from a limited range of options. Anon1\_EdExpert recommended that “the learner should be encouraged to be critical about what they see and the choices that they make, to be able to reflect on that in some way and to communicate that”.

Anon1\_EdExpert stated that if he/she got on the Internet he/she would not want to construct knowledge about how to build a chair. Anon1\_EdExpert stated that he/she could probably hit about 20,000 sites about chairs, but that when interacting with a broadcast program the producers have had to anticipate the kinds of things they think that the respondent would choose or be interested in, and those available choices were not going to fit everybody. Anon1\_EdExpert stated that, therefore, he/she might not be interested in the limited options provided, but would have to choose one irrespectively, so might be disengaged anyway.

**MG\_SchoolsTV:** In terms of aspects of ITV which could give support to enable correct pedagogy, such as enabling students to work collaboratively and constructively, MG\_SchoolsTV stated that this drew on the “psychology of the screen, more on the way that television is designed as a mass communication tool and therefore, as a mass communication tool, it means that students accept that they’re part of a broader community”. He said that the effect of this was to cause collaboration and constructivism skills to be brought into force, and embellished, in the interactive community.

**Section summary:** The two interviewees who raised the sub-theme of constructivism, Anon1\_EdExpert and MG\_SchoolsTV, expressed opposing views.

Anon1\_EdExpert questioned the effectiveness of ITV in allowing users to construct their own knowledge, since it might provide limited choices. On the other hand, MG\_SchoolsTV stated constructivism skills were brought into force in the interactive community, due to students accepting that they were part of a “broader [ITV] community”.



#### 4.3.6. Delivery

**Definition:** ‘Delivery entails the distribution of items to their destination’ (Stevenson, 2010).

Specifically, in the context of this study, it relates to the delivery of educational resources, and the technologies available for the delivery of interactive television.

**AT\_SeniorAcademic:** AT\_SeniorAcademic stated that one of the key characteristics for the design of any interactive program was that the delivery method should be appropriate. He proposed considering different delivery options such as multi-channels, or multiple on-screen use of materials, with various aspects being viewed simultaneously, either with or without overlays. After such consideration, according to AT\_SeniorAcademic, a decision would need to be made about which delivery option would meet required objectives, as well as matching the characteristics of users. An example he gave was that of delivering materials to Indigenous users. He suggested that there would probably be a lot less text than for non-Indigenous users, and that audio should be ‘in the local Indigenous language as well as or instead of English.’ In relation to developing interactive materials, according to AT\_SeniorAcademic, a task-based and user-centred methodology is needed, which he said raised the question not only of how to deliver the content, but also what the timing of the delivery should be.

According to AT\_SeniorAcademic, in remote communities, there was a need for job-related training materials. He described two options for onsite access to training materials. Firstly, there could be a person onsite facilitating delivery of the materials, or secondly, the trainees could be managing the process themselves.

AT\_SeniorAcademic stated that program delivery could be a barrier to the use of ITV.

AT\_SeniorAcademic also stated that thought should be given to producing a suite of materials such as video, website, ITV, and hard copy materials **together** for an objective, so that production effort is not duplicated. In doing so, AT\_SeniorAcademic stated that the following issues should be considered:

- How some content material might be developed.
- How it could be delivered in different ways.
- Why part of it might be delivered one way and/or another way.

**Anon1\_EdExpert:** Anon1\_EdExpert talked about a Western Australian instructional design unit in Leaderville called West One Services. Anon1\_EdExpert said that, at the time of the interview, the unit was considering the Western Australian curriculum and interactive modes of distance delivery. Anon1\_EdExpert elaborated that the unit had its own broadcasting capabilities, and was using TV, but had not used ITV at all. Rather, according to the respondent, the unit was using the Internet, a choice that the respondent attributed to the “economic issue”. Anon1\_EdExpert also asserted that persons taught via distance education “want material that they can touch and feel and turn pages”.

The respondent also claimed that distance education had a lot of money compared to standard government schooling and the parents who used those services were quite a powerful lobby group.

**MJ\_Hull:** Many of the people who pioneered the original IPTV station in Hull in 97, 98 were recruited to develop STREAM. They were familiar with the limitations of KIT, and understood exactly why it was to be superseded. They also had experience in video streaming, and in the delivery of various forms of ITV such as digital terrestrial, termed freeview in the UK. The service associated with KIT was little more than video-on-demand, which enabled delivery of certain resources, but not the ability to personalise the learning experience, assess individuals through it, or direct users to other resources.

According to MJ\_Hull, asynchronous delivery, particularly delivery on demand, caters for students who learn better in the evening.

When predicting what the future would hold, MJ\_Hull proposed that anything web-based or web-enabled will be capable of accessing ITV services “and it *should* be, because...web-based delivery of television is by far the way to go.” According to MJ\_Hull, the BBC reported its expectation that by 2015 50% of television in the UK will be watched via the Internet, compared to 95% currently through traditional means of broadcasting such as television. MJ\_Hull said that as a result of this expected trend, there needed to be a focus on facilitating this.

When asked to comment on any other problems or difficulties which may have arisen in the design and development stages, MJ\_Hull cited the issue of how to strike the best balance between providing users with a satisfactory depth and range of information, while only having a “relatively primitive” delivery system. So students had access using a television and a remote

control, as well as the use of an infrared keyboard so they could type and do homework through the TV, but this was a limited access system. MJ\_Hull claimed that it was difficult to get people to engage with a prime experience based around remote control.

When the researcher asked MJ\_Hull for any final comments, he gave a “word of warning.” He emphasized that ITV platforms in Hull were very different to ITV platforms elsewhere, so affording “an awful lot more interactivity” due to being an on-demand Internet-based service (IPTV) rather than a traditional satellite delivery of television. He stated that IPTV was currently being invested in “enormously” in the U.S., citing an example of AT&T investing four and a half billion dollars to make its entire network ready for IPTV.

**MG\_SchoolsTV:** MG\_SchoolsTV described how Schools’ TV, in addition to their satellite broadcasting, had a web service, to which real-time captures of the signal were directed, so users could download the information at the same time as the satellite broadcast. He said that interactive elements and live real-time could be utilised in both the web and the satellite environments. An example of this was on-line voting or polls, which could also be implemented via a satellite environment. He commented further that in comparing the web environment with the satellite environment, there was really no difference other than being different delivery methods, and pushing the products via a streaming codec or a satellite codec.

MG\_SchoolsTV described the interactivity features for web-based program delivery as not being embedded as part of the ITV broadcast, but as simple HTML-based applications, such as a form or email. The latter could include voting buttons that initiated a yes/no email response, sent directly to a central point, which could be monitored in the Schools’ TV studio, and then live feedback could be given. MG\_SchoolsTV said that this was virtually the “worm” used on TV election coverages, providing a real-time feedback loop of audience opinion, and a way of gauging audience reactions to various debatable topics. The audience feedback could then influence the content being broadcast. MG\_SchoolsTV described how, in that sort of environment, Schools’ TV produced two programs rather than one, in order to show content which was of greater interest to the majority of the audience, according to how the audience had voted. The decision of which content to broadcast could not be made in pre-production – it happened live as a direct result of audience feedback.

This following of a particular theme by tailoring content to audience reaction was, according to MG\_SchoolsTV, “an interesting type of dynamic too because it’s very rare that television is driven by its audience, it’s normally the other way round”. This approach meant that there would be material produced which might never make it to air. Interestingly, however, MG\_SchoolsTV stated that audience reaction could often be predicted according to the material presented, and extensive pre-production during which close attention was paid to exactly how information was displayed, and where it was displayed, in the program. MG\_SchoolsTV stated that this placement could influence audience decisions and “pretty much guarantee a result that we’re not going to be shocked by”. He said that this was related to the concept of “media truth” and how every person created their own realities.

While MG\_SchoolsTV had described how most opportunities for interaction came at the end of programs produced by Schools’ TV, there were a number of set formulas for delivery, and he emphasised that the delivery design depended on the audience, or the type of client being supported. MG\_SchoolsTV said that any incorporated interaction was considered to be another production standard, in the same way that production standards applied to how their programs were pre-recorded, how their products looked, and how standards were applied to their studio operations. He continued that, therefore, if he was going to make a live interactive program, it meant that he knew that he would need to have phone and web support integrated into the studio environment, and that their panels, hosts and guests needed to be made aware that there was a live component to the studio.

MG\_SchoolsTV pointed out that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes, including of a commercial model. MG\_SchoolsTV made the analogy of a football field, stating that due to the IT and infrastructure roll out to schools, his production unit knew that “every school has this flat level playing field that we know we can actually kick the goals on”.

**Anon2\_ITV\_Expert:** The respondent stated that ITV has the potential to do “amazing” things in terms of flexible, non-textual, video productions delivering a wide range of information. The proviso was that sufficient money, time and effort would need to be invested in the infrastructure and content of the new technology.

Research carried out by the respondent found that viewers generally prefer to wait until the end of a broadcast program to access advertising content and offers, rather than interrupting their program partway through to interact.

**Section summary:** The interview responses, concerning the delivery of educational materials generally, and of ITV more specifically, focussed on a number of key ideas. These related to delivery options, including matching user characteristics, economic considerations, asynchronous delivery, audience feedback, infrastructure, and timing of delivery.

The importance of matching user characteristics was addressed by AT\_SeniorAcademic, Anon1\_EdExpert, MJ\_Hull, and MG\_SchoolsTV. Anon1\_EdExpert also raised economic considerations in the context of matching user characteristics. MJ\_Hull also raised asynchronous delivery in this context.

AT\_SeniorAcademic claimed that appropriate delivery options, such as matching user characteristics, and method(s) of delivery, comprised a major design characteristic of any interactive program. He said that program delivery could be a barrier to ITV use. He also stated that not only **how** materials could be delivered should be considered, but also **why** such delivery methods were chosen. Anon1\_EdExpert raised the issue of delivery to distance education clients. He/she cited an example of the Internet being chosen for delivery, rather than ITV, for economic reasons. Anon1\_EdExpert asserted that distance education users preferred hard-copy materials. Incidentally, Anon1\_EdExpert also stated that distance education had more money than standard government schools, and that the parents involved comprised a quite powerful lobby group. MJ\_Hull stated that asynchronous delivery on demand catered for students who learn better in the evening. MG\_SchoolsTV emphasised that the delivery design depended on the audience, or the type of client being supported.

Audience feedback was mentioned by MG\_SchoolsTV. He asserted that audience feedback, collected by online forms or email, could directly influence the content being broadcast. However, MG\_SchoolsTV also claimed that audience reaction could often be predicted according to the material presented, which could influence audience decisions and “pretty much guarantee a result that we’re not going to be shocked by”. He said that this was related to the concept of “media truth” and how every person created their own realities.

AT\_SeniorAcademic and Anon2\_ITV\_Expert referred to the timing of delivery. AT\_SeniorAcademic asserted that the timing of delivery was a major design characteristic of

any interactive program. Anon2\_ITV\_Expert's research indicated that interactivity opportunities should be made available at the end of broadcast materials, rather than during.

Additional comments were made by MJ\_Hull, MG\_SchoolsTV, and Anon2\_ITV\_Expert. MJ\_Hull predicted and recommended a greater focus worldwide on IPTV. This would result in delivery via Internet protocols. MG\_SchoolsTV said that interactive elements and live real-time could be utilised in both the web and the satellite environments. He pointed out that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes.

#### **4.3.7. Design**

**Definition:** 'A plan or drawing produced to show the look and function or workings of a building, garment, or other object before it is made' (Stevenson, 2010). ITV-related design is an important concept in the context of the current study, since good design is crucial in provision of worthwhile learning experiences.

**AT\_SeniorAcademic:** AT\_SeniorAcademic stated that the important characteristics for the design of any interactive programs are that the content and the delivery method should be appropriate. He stated that he approached it 'from a couple of different perspectives.' He elaborated that firstly clarity of the purpose of a task or objective was necessary, for example whether it was for knowledge building or entertainment. Secondly, he stated that an understanding was needed of the objective 'in terms of a series of actions or tasks or information exchanges or whatever is involved in achieving that', so that the interaction met its goals. The other 'key determinant' specified by AT\_SeniorAcademic was user characteristics. He stated that it is a 'task-based paradigm and a user-centred paradigm.'

Specific related questions that need to be asked, according to AT\_SeniorAcademic, are:

- Who is the audience?
- What are their particular characteristics?
- What are their needs?
- How do we need to design the way this interaction works so that it does the job for them?

AT\_SeniorAcademic stated that “part of that is about what’s already in their heads.” He described the way in which users interact with materials as being “a function of what they already know and what their expectations are.” He cited the importance of this when considering design aspects such as the detailed layout of interfaces, since users “come to us with expectations and prejudices and preferences.” He gave the example of websites having very familiar layouts, which users expect to see when encountering materials that appear to be website-like.

Furthermore, regarding the user interface, AT\_SeniorAcademic stated that design depended on the project objectives, such as whether the project was designed for an adult user, or for a pre-school child.

AT\_SeniorAcademic described the suitable layout design process as being “task-based and user-centred.” Furthermore, he stated that the “paradigm [he brought] to this work [came] directly from the design of user interfaces and websites” where it is possible to make some design judgements. However, he urged that the designs needed to be prototyped and thoroughly tested with people, using a whole sequence of testing procedures. According to AT\_SeniorAcademic, this approach to prototype development was intended to instil confidence that particular layouts worked in particular contexts.

Specifically, AT\_SeniorAcademic listed educational design questions including:

- Do we present a lot of material then do an assessment of it at the end of the semester?
- Are we getting the students to search material?
- Are we getting them to ask questions and they respond to it?
- Are they doing it individually?
- Are they doing it in collaboration with other students?

He said that there were many associated educational design models or options available.

AT\_SeniorAcademic stated that creativity could be a design constraint.

He expressed a desire for effective design and evaluation of programs in order to foster advantages, entertainment, learning and so on, not just for the most capable users, who could overcome bad design, but for a broad range of users.

According to AT\_SeniorAcademic, there was a need to find the relationships between the elements of pedagogy, hardware, and design, in order to develop a “map” as a first step to producing a descriptive ITV model.

**Anon1\_EdExpert:** Critical pedagogical characteristics of ITV program design and broadcast raised by Anon1\_EdExpert related to scripting and the design issue of the call to interact. The basic issue of a user potentially missing a call to action was raised, and the associated need to enable a user to move on. One suggestion was that the program might make the decision to take the “line of least resistance” through the program, for the user who does not press any buttons.

When asked to offer advice for other practitioners who might be just starting out in designing an ITV program, Anon1\_EdExpert suggested a cautious approach of waiting to see what the big TV networks do. The reason given was that the networks have the money to try and test different things and make mistakes that other people can learn from. Anon1\_EdExpert stated that:

If TV networks are still grappling with how they’re going to do it, educators are going to have even more trouble and it could be quite an expensive lesson to learn.

This caution was also partly attributable to the stated perception of Anon1\_EdExpert that teachers were not fully exploiting the interactivity available on the Internet, at the time of interview.

**MJ\_Hull:** One part of the STREAM system being built at the time of the research interview was designed to allow a lesson to be broadcast straight from a school into homes. This was planned to be of particular benefit for students who are off school with an illness, or who cannot attend school because of a disability, or who need to be somewhere else for the next lesson, but would still like to participate in the broadcast one. Part of the design was intended to allow students to participate interactively in the lesson.

MJ\_Hull stated that while the original STREAM pilot was focused only on secondary school, that is ages 11 to 16, it was based on concepts of lifelong learning. This facilitated the



development of learning resources designed for parents of pre-school children to improve their parenting skills.

When asked to comment on problems or difficulties which may have arisen in the design and development stages, MJ\_Hull cited the issue of how to strike the best balance between providing users with a satisfactory depth and range of information, while only having a “relatively primitive” delivery system.

When the researcher asked MJ\_Hull whether there were any important characteristics of ITV program design which had not been raised yet during the interview, he stated that it could not be thought of as a Web experience or as a formal learning experience, and that consideration should be given to what television, as a medium, provided that other areas could not. MJ\_Hull said that the “worse stuff” he had seen were attempts to transfer directly from paper-based resources to television, resulting in “a lot of text [which] just doesn’t work.”

**CW\_ABCTV:** CW\_ABCTV was the manager of ABC2 Television in Sydney, Australia. Discussing the topic of Optus [major Australian telecommunications provider] and content management, CW\_ABCTV described how Triple J [Australian radio station run by the Australian Broadcasting Commission] material which had been online for 18 months had been updated automatically whenever Triple J’s online producer updated the website. He said that ABC staff had chosen a “small subset of information” which they perceived to be appropriate for the television experience, and had designed a display template with “TV-friendly” fonts and colours. According to CW\_ABCTV, this template looked completely different from the online version, but required no extra work by the ABC staff. While CW\_ABCTV stated that this was a very satisfying outcome, he went on to state that that he did not think that it really interested the viewers, but that the providers were still “some distance from understanding what could be truly engaging about that kind of interactive television”.

CW\_ABCTV gave details of the September 1<sup>st</sup> 1999 presentation by online producer Ingrid Spielman and the then digital content editor Ian Carroll, who became the chief executive of the Australia Channel [previously known as AsiaPac TV]. CW\_ABCTV said that he had worked a bit with Ingrid and Ian on ITV futures, data casting and “other digital stuff, but it was all a bit early”. He described Ingrid as a “very clever designer” who, mainly with Ian, used Macromedia Director to create “a speculative interactive TV experience”, a simulation that could be viewed on a PC, and projected onto a screen for an audience, to emulate an interactive TV experience.

CW\_ABCTV said that Ingrid's model suggested the ability to call up various video streams on demand such as news, a health report, a recipe, or children's content. He described Ingrid as "very prescient", as she was creatively imagining a different type of viewing experience, but one which was not realisable commercially due to the lack of a television platform which could support it. He said that what she did could have been done online but "that wasn't the point". CW\_ABCTV stated that "even" at the time of the interview the ABC interactive television showcase could only have been done in an IPTV environment.

CW\_ABCTV said that there were a number of tools that could be used to create something that resembled a TV experience. At the time of the interview, according to CW\_ABCTV, an application called "After Effects", might have been preferred for this purpose, or an entry level ITV authoring package "explicitly used to emulate the proposed functionality" before too much time is spent on it. CW\_ABCTV continued that the idea, in each case, was to test the application architecture as well as the potential appeal. He stated that navigation using a TV remote was fairly limited, including up/down, left/right, the OK key, four coloured keys, and the number keys, and that it required work. He also stated that a mouse "[did not] make any sense in that environment". CW\_ABCTV said that the TV screen, unlike a web page, was very difficult to sub-divide into distinct active areas, and that it was usually necessary to assume that the screen was all active. He said that there were some ways to work around that, but that it risked being clumsy, and that the general advice was to keep the navigation "very simple and really obvious". Furthermore, CW\_ABCTV declared that if it was necessary to provide big help screens to users of the application, "you've basically failed".

**MG\_SchoolsTV:** While MG\_SchoolsTV had described how most opportunities for interaction came at the end of programs produced by Schools' TV, there were a number of set formulas for delivery, and he emphasised that the delivery design depended on the audience, or the type of client being supported. MG\_SchoolsTV said that any incorporated interaction was considered to be another production standard, in the same way that production standards applied to how their programs were pre-recorded, how their products looked, and how standards were applied to their studio operations. He continued that, therefore, if he was going to make a live interactive program, it meant that he knew that he would need to have phone and web support integrated into the studio environment, and that their panels, hosts and guests needed to be made aware that there was a live component to the studio.

MG\_SchoolsTV stated that "television is designed as a mass communication tool".

MG\_SchoolsTV offered advice on what new ITV program designers needed to know. He said that the main thing was to “first of all establish the playing field”, in terms of knowing what the technology could deliver in such an innovative field. MG\_SchoolsTV elaborated on this point, saying that people often get caught up in the jargon and capabilities of the technology, but that ultimately the key consideration was “what is the end user seeing and what are they experiencing?”

**Anon2\_ITV\_Expert:** Important design characteristics of ITV programs suggested by the respondent were relevance of the interactivity, that the interactivity should make sense, and that it must be important to the viewer.

It's no use if you just stick interactivity in there just because you can as a producer...If it doesn't add anything to the experience people get more annoyed by it than anything else. And it should be intuitive and I think that's got a lot to do with the kind of technology people have previously used.”

**HM\_ResFellow:** HM\_ResFellow described a suite of programs called ‘Black Box Designer’, which he said was very easy to use, and ran on Internet Explorer, and which was sold to advertising agencies so that they could create mock-up ITV advertisements. Another program HM\_ResFellow described was ‘OnQueue’, which he said was used by a company called Ensequence and which was very expensive and much more sophisticated. He said that it could offer “real-time sequencing” so that if a program was running behind schedule, the ITV application could be held back to come in at the right time.

HM\_ResFellow gave his opinion on the important characteristics of the design of ITV programs, speaking hypothetically. He said that consistency was a key one, for many reasons including that young audiences need consistency in the way ITV works, because they need to familiarise themselves week by week with an unfamiliar medium. Consistency was also important for parents, according to HM\_ResFellow, so that every time they press a blue button, for example, parental content may pop up as a screen overlay, suggesting an action such as to go and get an egg carton in readiness for an activity with their child. Consistency was also important, HM\_ResFellow pointed out, for economic reasons. He said that if an interactive template exists which can be re-used, it saves spending money on computer program design and development. HM\_ResFellow suggested that another design hint would be, for very young audiences, to include verbal cues, particularly since they might not be able to read text.

HM\_ResFellow gave an example of where he thought the provision of interactivity was inappropriate. This was in the DVD version of the U.S. TV show '24', where the viewer could choose different endings to the first season. H maintained that there was no point to this interactivity because viewers watched '24' for escapism and realism, with the show running second by second, minute by minute, emulating real-time. He stated that the reason d'être of the show was for the viewer to lose himself/herself and become part of the show, and not be forced to take the action of making a choice.

On the subject of education, HM\_ResFellow said that there were "different answers for different age groups". He said that, at the time of interview, one of the things he had grappled with was whether children also liked to have that level of escapism, whether they also liked not to interact sometimes, or whether there were times when they had the ability to suspend their disbelief at a level where they could interact, and not have their belief in the show disrupted. HM\_ResFellow stated that this was a "big question" and that he had completely different answers for different age groups.

**DV:** DV\_ITRI discussed interactive TV authoring environments. He said that the main available systems, including ones by Emuse and Ensequence, had inbuilt templates, which, while giving the power to author, resulted in boundaries which were problematic for the needs of ITRI. Specifically, DV\_ITRI said that they were problematic because ITRI was mostly trying to look to the future rather than measure existing activities, by developing "entirely new approaches" and pushing boundaries. He stated that ITRI "created a lot of stuff indirectly" and had developed systems that produced good looking video, and software called Head End Light, which was a simulation environment designed to meet ITRI's needs, and provide a "very stable environment" for research testing. DV\_ITRI elaborated that

The test for us is that the look and feel for the viewer is authentic so that we're reproducing what would happen or what is technically possible to happen but we're not spending the time in developing the actual applications to make that happen.

He continued that ITRI could then test many things, determine what things should look like, and then probably pass this information on to industry consortium partners so engineers could build resultant designs. DV\_ITRI emphasised that a few years previously ITRI was "more broadly situated across the interactive TV spectrum" but by the time of interview had become very focussed on the facet of audience research, having gained a global reputation for audience insight projects.

DV\_ITRI then provided several examples of interactive productions that he thought were good. These were an interactive advertisement for Pantene Shampoo, a Robbie Williams music video, and a U.K. comedy show called Banzai. DV\_ITRI described the Pantene ad as his favourite interactive ad, and said that what made it so good was that it was well researched before it was deployed. He described it as being simple, with the viewer clicking to enter a low tech “micro-site” containing nine questions about the viewer’s hair, the purpose of which, according to DV\_ITRI, was to extract information about the person’s lifestyle, and determine which “box” the viewer belonged in, in terms of the parent company Procter and Gamble’s “particular persuasive appeal”. He described how the experience then included diagnosis of the viewer’s hair problem(s), then advice, then details of the appropriate specific Pantene product, thus simulating a real hair salon experience. DV\_ITRI said that this was an example of

really good interactive advertising. The interactivity has a purpose, it’s got a very clear rationale, it’s got a very clear strategy, it’s all been thought through very well, it’s a brilliant campaign.

DV\_ITRI said that he thought this was strategically a very effective advertisement, since it not only gave the viewer “an incredible experience”, but that the viewer actually self-stratified themselves into the market, partly by requesting a product sample. The means of accessing the interactivity in the Pantene ad was by selecting a red button in the corner of the screen. There was no video, so it required low bandwidth. The cost of this interaction, as described by DV\_ITRI, was that the viewer could miss part of the broadcast program after the ad break, since the ad was always the last one in the ad break. He said that this resulted in “clear constraints”, including that a viewer might not be willing to miss part of the show they are watching in order to go into the interactive part of the ad.

DV\_ITRI stated that the best interactive content he had seen was a Robbie Williams music video, ‘You Can’t Manufacture a Miracle’, which portrayed three contestants in a Robbie Williams look-alike contest. He said that the viewer could develop an affinity with the contestants during the three minute story which culminated in a concert, after which the home viewer could vote for their favourite contestant by pressing the red button when the voting icon popped up. What was so great about the Robbie Williams music video, according to DV\_ITRI, was that the three minutes of the music video whetted the viewer’s appetite for the interaction. Despite the fact that not all viewers globally were actually voting, DV\_ITRI said that psychologically they were voting, and this still felt right. He said that this was, to him, a

sign of very good interactive content, in that it was so well done that viewers would even willingly do imaginary participation, so it worked in a “linear world”.

The third positive example of ITV that DV\_ITRI gave was a skit-based U.K. comedy program called Banzai, which included interactivities with the skits. He described one skit, in which there were two elderly women in wheelchairs playing Chicken with each other. The viewer could guess which woman would get out of the way of the other. If they guessed correctly they got a point. DV\_ITRI said that this was:

great, I mean that is just fantastic. It increases the viewer engagement with the content, it's just brilliant.

He continued that, although the program was created interactive, it was distributed globally in a linear format, which meant that invitations to vote still popped up, but viewers just had to do it in their heads. DV\_ITRI said it was “brilliant” how, despite the program intentionally being conceived, designed, created and produced in an interactive format, it had still found a global market as a linear product.

On the other hand, according to DV\_ITRI, so much of interactive TV failed because there was no attempt to whet the appetite for the interaction. To illustrate this point, in contrast to the success of the Robbie Williams video, DV\_ITRI described an “in your face” interactive TV experience which he said was an example of poor interactivity. The TV show DV\_ITRI described was a Discovery Channel documentary about Polynesian migration. He detailed how there was a key scene in the documentary, showing a shark feeding frenzy, at which point an invitation to interact popped up, offering information about sharks. If the viewer accepted, a text screen popped up over the whole screen, superimposed over the streaming video. DV\_ITRI said that was:

a classic example of people not having a clue what this new craft is about because the interactivity actually violates the emotional experience of the viewer. That is not the time to give people a path to getting content on sharks... They're totally missing the point of a person's emotional experience.

In response to the interviewer asking DV\_ITRI his opinion of the important characteristics of ITV program design, he replied “There's a lot”. The first one DV\_ITRI spoke about was the variation of the interactor's experience according to market. He described how research had shown that in the U.K. the number one predictor of whether or not a viewer would interact

was their previous experience with teletext, thus, according to DV\_ITRI, saying a **lot** about how that market had evolved. In the U.S., however, DV\_ITRI stated PVRs would be “the path to interactive TV ... and that means that people will have very different expectations about what it is that interactive TV should do because they’ve evolved through that particular heritage”.

As well as the market factor, DV\_ITRI stated that there were “huge” individual factors, such as age. He said that while the ITV space should be made “energetic and exciting” for younger viewers, it was necessary to consider how to make the space subtle and subdued for older viewers. DV\_ITRI continued to say that there were “very different types” of viewers with very different needs, such as some viewers being “motivated by sensation seeking” and others who “**need** confidence” in feeling that the space will not overwhelm them. He stated that there was “a whole range of demographic factors” which shaped the space.

DV\_ITRI stated that the other area that he thought was really critical in development was the emotional needs of users versus the functional needs of users. He asserted that the functional needs tended to receive a lot of focus, unlike the emotional needs. DV\_ITRI stated that the motivation for people to watch television, however, tended to be emotional rather than functional in character, so it was necessary to ensure that consideration of the viewer’s “emotional journey” was a major part of the development process. He continued that the functional need could be a starting point, but that, even when approaching from an educational perspective, consideration needed to be given to “how to embed that within an emotional experience”. DV\_ITRI said that this was particularly the case regarding TV viewing, as opposed to PC use.

The final comment DV\_ITRI made regarding the important characteristics of ITV program design was that designers were often “driven by a web paradigm into this space and that’s a flaw”. He said it resulted in too much text, noise and cluttering when a PC type of experience was emulated rather than a televisual experience emanating from a “TV centric paradigm”.

One example DV\_ITRI gave of the latter was potentially embedding a maths module for children within a football game broadcast. He said that this could be age-appropriate, so that young children could demonstrate understanding of the score, while Year 12 students could look at player statistics. Another example DV\_ITRI gave related to documentary style television such as the history channel and National Geographic programs. He said that where previously teachers could send away for a program-related activity pack, this could be built into the

actual program broadcast, so that viewers could leave the program to enter numerous “really interesting strands that are designed to maximise the educational opportunity”. The final example DV\_ITRI provided represented the concept of having “alternative narrative streams that are designed around the educational experience of children”. Specifically, he described the possibility of designing a **very** different narrative stream for eight year old viewers of a shark documentary, in order to maximise their learning opportunity.

DV\_ITRI said that these examples were in the context of children using ITV at home, not in the context of in the classroom with teacher guidance. While DV\_ITRI commented that in the formal setting such as distance education it was more immediately obvious that content could be improved by making it interactive, he said that the latter was not where the “real revolution” was. DV\_ITRI asserted that the real revolution was in appropriating the normal television viewing experience and adding an educational opportunity around it, and taking this to children and students in various settings.

**Section summary:** The interview responses concerning the design of ITV focussed on the key ideas of appropriate content and delivery, objectives, evaluation of the design, pedagogical considerations, the call to interact, a cautious approach, and the affordances of ITV. The interviewees also discussed the interface, simulation tools, relevance of interactivity, intuitiveness of use, consistency, user needs, whetting the appetite of users, and the concept of a TV centric paradigm.

AT\_SeniorAcademic stated that the important design characteristics for interactive programs were appropriate content and delivery methods, which firstly required clarity of the objective, user characteristics, and user needs. He recommended effective design and evaluation of programs in order to maximise resultant benefits for a broad range of users.

MJ\_Hull and MG\_SchoolsTV also discussed the inter-relation between design and delivery methods. MJ\_Hull described how one part of the STREAM system was designed to allow a lesson to be broadcast straight from a school into homes, in order to benefit students who could not attend school, and to allow them to participate interactively in the lesson. He cited the design and development difficulty of providing users with a satisfactory depth and range of information, under a restrictive delivery system. While MG\_SchoolsTV had described how most interaction opportunities came at the end of Schools’ TV programs, he said that there were a number of set audience-appropriate formulas for delivery.



Pedagogical considerations were raised by AT\_SeniorAcademic, Anon1\_EdExpert, and MJ\_Hull. According to AT\_SeniorAcademic, there was a need to find the relationships between the elements of pedagogy, hardware, and design, in order to develop a “map” as a first step to producing a descriptive ITV model. Anon1\_EdExpert raised critical pedagogical characteristics of ITV program design and broadcast, related to scripting and the design issue of the call to interact. MJ\_Hull stated that the original STREAM pilot was based on concepts of lifelong learning, which enabled the development of resources for parents.

Anon1\_EdExpert suggested that new designers should take a cautious approach of waiting to see what the big TV networks did. This caution was also partly attributable to the stated perception of Anon1\_EdExpert that teachers were not fully exploiting the interactivity available on the Internet, at the time of interview.

MJ\_Hull, CW\_ABCTV, and MG\_SchoolsTV considered the affordances of ITV in relation to design. MJ\_Hull stated that an ITV program could not be thought of as a Web experience or as a formal learning experience, and that consideration should be given to what the television medium provided that other areas could not. CW\_ABCTV discussed early work by online producer Ingrid Spielman and the then digital content editor Ian Carroll, involving simulation of an interactive TV experience. CW\_ABCTV said that Ingrid’s model suggested the ability to call up various video streams on demand. He said that what she did could have been done online but “that wasn’t the point”. CW\_ABCTV stated that the ABC interactive television showcase could only have been done in an IPTV environment. CW\_ABCTV discussed navigation limitations in terms of hardware, and the TV screen interface. MG\_SchoolsTV said that any incorporated interaction was considered to be another production standard, with related communication support mechanisms in the studio environment. MG\_SchoolsTV advised that new ITV program designers needed to firstly be aware of what the technology could deliver in such an innovative field, with the ultimate consideration of “what is the end user seeing and what are they experiencing?”

AT\_SeniorAcademic and CW\_ABCTV discussed interface design. AT\_SeniorAcademic claimed that user-interface design should be ‘task-based and user-centred’. CW\_ABCTV described how ABC staff had designed an information display template with “TV-friendly” fonts and colours, which completely differed from the online version. However, he stated that he did not think that it really interested the viewers, and that the providers were still “some distance from understanding what could be truly engaging about that kind of interactive television”.

CW\_ABCTV recommended that navigation should be kept “very simple and really obvious”, and that big help screens for users should not be needed.

CW\_ABCTV and HM\_ResFellow referred to how simulation tools could be used to assist in design. CW\_ABCTV alluded to tools that could be used to create something that resembled a TV experience before too much time was spent on it. HM\_ResFellow described a couple of software applications, one useful for simulating ITV commercials, the other useful for appropriate delivery timing of ITV applications. DV\_ITRI stated that the main interactive TV authoring environments available at the time of interview resulted in boundaries that were problematic for ITRI’s needs, so ITRI used a stable simulation environment for research testing. He said ITRI could then pass its findings on to industry consortium partners so engineers could build resultant designs.

Anon2\_ITV\_Expert suggested that interactivity relevance for users was a key design characteristic of ITV programs. He/she also suggested that ITV use should be intuitive, in line with technology people had used previously.

HM\_ResFellow said that consistency was a key characteristic of ITV program design, citing reasons such as enabling user familiarity, and saving money on the cost of design and development. Another design hint HM\_ResFellow suggested was the provision of verbal cues to very young audiences.

Users’ needs in the context of design were discussed by HM\_ResFellow and DV\_ITRI.

HM\_ResFellow gave an example of a commercial TV program where he thought provision of interactivity was inappropriate, due to the audience’s wish to just relax and not be forced to take an action. Regarding education-related programs, he said he also grappled with a “big question” of whether children of various ages preferred escapism or sometimes calls to interaction, concluding that he had completely different answers for different age groups.

DV\_ITRI said that ITRI was known globally for its focus on ITV audience research. DV\_ITRI stated that there were many important characteristics of ITV program design, related to factors such as the particular market, and the associated user experiences and expectations. He also stated that there were key individual factors, such as age and confidence in technology use, and “a whole range of demographic factors” which shaped the space. Consideration of the emotional needs versus the functional needs of users was crucial in ITV program development, according to DV\_ITRI.

DV\_ITRI gave several examples of interactive productions that he thought were good, for various reasons such as being well-researched prior to employment, simplicity of design, and engagement of viewers. He said that whetting the appetite of viewers for the interaction was essential for success.

Finally, DV\_ITRI strongly recommended that ITV program design should be carried out from a “TV centric paradigm” rather than a “web paradigm”. He asserted that appropriating the normal television viewing experience and adding an educational opportunity around it, and taking this to children and students in various settings, was revolutionary.

#### **4.3.8. Future**

**Definition:** ‘A period of time following the moment of speaking or writing; time regarded as still to come’ (Stevenson, 2010). While the future of ITV has been touched upon in the current study, it has been left to other researchers to potentially consider it further.

**AT\_SeniorAcademic:** When discussing potential future impact of ITV technology, AT\_SeniorAcademic said that he foresaw its use mostly in the sphere of education of the general public, such as in training programs for the unemployed, or public awareness of emergencies, or of terrorism. He said “maybe interactive TV has great advantages in that context over more conventional ways of delivering training materials.”

**MJ\_Hull:** MJ\_Hull stated that it was intended that study resource accessibility be extended to mobile phone at some future stage in the STREAM project.

When the researcher asked MJ\_Hull about the potential future impact and possible future affordances of ITV technology, he stated that the critical thing would continue to be building systems capable of working across different platforms.

**MG\_SchoolsTV:** MG\_SchoolsTV stated that future ITV technologies would enable students to get into environments that they could never possibly physically enter, such as the NASA space program. MG\_SchoolsTV maintained that, for example, direct feeds from Mars which had already occurred could not have been delivered any other way, and that new ITV technologies would allow such boundaries to be pushed even further.

MG\_SchoolsTV then spoke about how ITV could be used to build a “dynamic community model” which facilitated a greater understanding about other cultures and ways of doing things. He said that, at the time of interview, his production unit was trying to implement a

model capable of linking students from different cultures on a worldwide interactive platform. This would be intended to compare how Australian students create very different content to, for example, students from Japan or Greenland, so beginning with a shared platform of understanding, then creating what MG\_SchoolsTV referred to as a “cyber group of people”, that is, people separated by physical distance but still interacting quite strongly. MG\_SchoolsTV acknowledged that arguments existed that there were other technologies which could do that as well but that he would argue that the richness was very different, for example, compared to being in a chat room where there is no “visual reference”.

In terms of adapting an ITV system to fulfil individual users’ needs, MG\_SchoolsTV focussed on users with disabilities, stating that it would be possible to push the model a bit further and specifically tailor some of the interactive elements towards persons’ disabilities. He said that he thought it was “more of a case of your biggest issue is breaking the mindset of how television has traditionally been created and working more towards a non-linear fluid model”. Part of this process, said MG\_SchoolsTV, was asking what would happen if something different was done with the technology, but he stated that not many environments were willing to take that risk, largely because most of the Australian TV industry productions were for commercial outcomes. However, MG\_SchoolsTV asserted that “probably education here is quite unique because we **can** take that risk, we can afford to take that risk in terms of saying, let’s see what happens if we do things this way”. He qualified his statement by saying that there was a fair bit of research involved, and it was not just a random process.

**DV\_ITRI:** DV\_ITRI discussed interactive TV authoring environments. He said that the main available systems, including ones by Emuse and Ensequence, had inbuilt templates, which, while giving the power to author, resulted in boundaries which were problematic for the needs of ITRI. Specifically, DV\_ITRI said that they were problematic because ITRI was mostly trying to look to the future rather than measure existing activities, by developing “entirely new approaches” and pushing boundaries.

In regards to ITV technology’s potential impact on education in the future, DV\_ITRI described it as “huge”. He said that, at the time of the interview, education was one of the globally most underdeveloped areas in the ITV space, as a consequence of business modelling, and the focus of the medium on making money. However, he said that “the opportunity for formal education is of course immediately obvious and apparent”. Furthermore, DV\_ITRI stated that what he thought was very interesting and exciting was that educational opportunities could be

extracted from a lot of other non-education-related content. He said that this related to the point he had raised earlier, about making a shift away from being curriculum centred to being child-centred, which suddenly enabled the planting of numerous educational opportunities around the normal television experiences of viewers.

DV's final comment alluded to ITV as a "great medium", and he stated that "I think that this is the start of what will be a very powerful revolution to TV viewing".

**Section summary:** The interview responses concerning the future of ITV focussed on the key concepts of education of the general public, delivery via more devices and platforms, student access to more virtual environments, building of global communities, tailoring for needs of individual users, development of different models, and increased extraction of learning experiences from non-education-related TV programs.

AT\_SeniorAcademic predicted that ITV technology could be advantageous, in the future, for education of the general public.

MJ\_Hull talked about the planned expansion of study resource delivery to mobile phone, and about the importance of the continued building of cross-platform-capable technology.

According to MG\_SchoolsTV, future ITV technologies would enable students to get into environments which were impossible for them to physically enter, and new ITV technologies would allow such boundaries to be pushed even further.

MG\_SchoolsTV talked about using ITV to build global communities, arguing that it was a richer medium to use for this purpose than other technologies. He also stated that an ITV system could be pushed to tailor for the needs of individual users. MG\_SchoolsTV said that the biggest issue was breaking the mindset of how TV was traditionally created, in order to work towards a fluid non-linear model. He said that part of this process was asking what would happen if something different was done with the technology, but that while few environments were willing to take that risk, education could do so.

In his discussion of interactive TV authoring environments, DV\_ITRI said that the main available systems resulted in problematic boundaries for ITRI. He described the potential impact of ITV on education as "huge", but said that for financial reasons ITV use worldwide in education was underdeveloped. DV\_ITRI expressed his excitement that educational

opportunities could be extracted from much non-education-related TV content. DV\_ITRI predicted a major revolution in television viewing.

#### **4.3.9. Interface**

**Definition:** ‘A point where two systems, subjects, organizations, etc. meet and interact’ (Stevenson, 2010). In the context of this study, interface can be defined primarily as the means by which the user interacts with the interactive television application.

**AT\_SeniorAcademic:** AT\_SeniorAcademic described the way in which users interact with materials as being ‘a function of what they already know and what their expectations are.’ He cited the importance of this when considering design aspects such as the detailed layout of interfaces, since users ‘come to us with expectations and prejudices and preferences.’ He gave the example of websites having very familiar layouts, which users expect to see when encountering materials that appear to be website-like.

Regarding the user interface, AT\_SeniorAcademic again stated that design depended on the project objectives. He suggested that the researcher visit the Broadband Bananas website, stating that it had a ‘good selection’ of various graphic TV applications with associated screen overlays. AT\_SeniorAcademic described TV news as ‘one of the strong drivers of interactive television to date’, and described its on-screen layout as being similar to website interfaces, in terms of usually having a lot of text, being ‘quite busy’, having ‘different options that one can choose from the screen layout’, and picture-in-picture video.

In contrast, according to AT\_SeniorAcademic, the screen layout for an interactive version of a preschool program such as Playschool would be ‘totally different.’ He stated that questions which needed to be asked, in order to ‘come to logical conclusions about what’s a good layout or what’s a bad layout’ included:

- What is the method of interaction?
- What do you want users to do?
- What sort of program is it?
- What are your objectives?
- Who are the audience?

AT\_SeniorAcademic described the suitable layout design process as being 'task-based and user-centred.' Furthermore, he stated that the 'paradigm [he brought] to this work [came] directly from the design of user interfaces and websites' where it is possible to make some design judgements. However, he urged that the designs needed to be prototyped and thoroughly tested with people, using a whole sequence of testing procedures. According to AT\_SeniorAcademic, this approach to prototype development was intended to instil confidence that particular layouts worked in particular contexts.

**CW\_ABCTV:** CW\_ABCTV described how, in early 2001, Optus ran a Sydney-based interactive TV trial that took approximately 18 months. He recalled that the trial, which involved approximately two thousand households, began as a technical trial then evolved into a commercial trial. CW\_ABCTV described it as an opportunity for a number of service providers, including the ABC, to participate in a cable-based ITV trial on the Optus platform, which provided an experience in a "walled garden" environment. He stated that the trial was based on work by a cable television provider in London called NTL, and used an HTML-based software package called Liberate to develop the user interface.

**HM\_ResFellow:** Consistency was important for parents, according to H, so that every time they press a blue button, for example, parental content may pop up as a screen overlay, suggesting an action such as to go and get an egg carton in readiness for an activity with their child. Consistency was also important, HM\_ResFellow pointed out, for economic reasons. He said that if an interactive template exists which can be re-used, it saves spending money on computer program design and development. HM\_ResFellow suggested that another design hint would be, for very young audiences, to include verbal cues, particularly since they might not be able to read text.

The content in the next two paragraphs was deemed appropriate by the researcher to include in this sub-theme of 'interface', since it related to user choices, and the initial choices users will make in their interaction are those available via the interface.

HM\_ResFellow said that he had discovered "another little thing" for which he had coined the phrase "ego sufficing behaviour". He said this referred to the concept that if you gave people the option to choose something, they were more likely to have a favourable attitude towards it since they got to make the choice. HM\_ResFellow made the analogy that a person being

complimented on their spectacles could interpret that compliment as congratulating them on their decision to purchase those spectacles, so validating their decision, which was “an ego thing.”

Continuing on the same theme, HM\_ResFellow said that interactive television brought this ego sufficing behaviour out because given a choice of different options, when a person makes that choice they have an emotional stake in the experience. He said that the theory was that they were “more likely to feel favourably towards it simply because their ego is on the line”, in terms of whether they made a good choice.

**Section summary:** The interview responses concerning ITV interfaces focussed on the key ideas of the importance of users’ expectations and users’ age, project objectives, task-based interface design process, prototyping and testing, development technologies, and consideration of ego-sufficing behaviour.

AT\_SeniorAcademic described the method of user interaction with materials as being ‘a function of what they already know and what their expectations are’, citing the importance of this when considering design aspects such as the detailed layout of interfaces. He stated that the design of the user interface depended on the project objectives, with various graphic TV applications having associated screen overlays. AT\_SeniorAcademic listed a number of questions that he said were necessary to logically conclude whether a layout was good or bad. He described the appropriate layout design process as being ‘task-based and user-centred’, urging that the layout designs needed to be prototyped and thoroughly tested.

CW\_ABCTV described a Sydney-based interactive TV trial that provided an experience in a “walled garden” environment. The associated user interface was developed using an HTML-based software package.

According to HM\_ResFellow, consistency of the interface was important for parents, so that they knew what to expect, and was important for economic reasons. HM\_ResFellow indicated that text-based interfaces might be inappropriate for very young audiences. HM\_ResFellow discussed “ego sufficing behaviour”, and its relationship to viewer choices.

#### **4.3.10. Learning**

**Definition:** ‘The acquisition of knowledge or skills through study, experience, or being taught’ (Stevenson, 2010). In the context of the current study, the key method-related word in this



definition is “experience”, since it is ITV-facilitated learning experiences that are being focussed on.

**AT\_SeniorAcademic:** The project AT\_SeniorAcademic was working on at the time of the research interview involved looking at specific programs for pre-school children, and seeking to introduce interactivity in such a way as to ‘enhance the program either in terms of enhancing enjoyment or enhancing the learning objectives of those programs.’

The ‘overview issue’ when adapting programs for ITV, according to AT\_SeniorAcademic, was engagement, either in terms of enjoyment, or in terms of learning, depending on the context.

AT\_SeniorAcademic considered the question of whether there were affordances of ITV that could enhance the learning environment, as compared with video-conferencing. He stated that video-conferencing allowed multiple participants, possibly with interaction between the learner and an instructor, but that there may be other information that you would want the learner to access. This information included particular aspects of a program, or explanation of terms used.

AT\_SeniorAcademic commented that some of the most successful ITV applications had used multiple technologies, so that, for example, it was not that the ITV was directly competing with a website, but that it could be operating in conjunction with a website, with a general objective such as entertainment or learning.

To illustrate his idea that content could be delivered in a variety of ways, AT\_SeniorAcademic said that some intended audience members might have computers at home, so could access learning materials via a website, possibly looking at different videos, and drilling down to content, while other intended users might not have a home computer, and might not be used to using the web, but might be used to watching TV. He said that the latter intended users could receive similar, or even the same material, via interactive television, rather than online. What the learning objective was, and how to achieve that learning objective, needed to be considered, according to AT\_SeniorAcademic.

**Anon1\_EdExpert:** A negative perception raised by Anon1\_EdExpert was the stigma attached to watching television, in terms of a perception that a person watching TV could not be learning because it was a passive activity. However, Anon1\_EdExpert did temper this observation by stating that this negative perception of television-watching as being passive could actually

point to one of the affordances of interactive TV, that it did allow the learner to be more active and a participant in the activity and to make some choices and decisions.

**MJ\_Hull:** According to MJ\_Hull, about 42% of the local adult population were functionally illiterate, and 45% were functionally innumerate, so

it was a massive issue in terms of “how do you get parents involved in their child’s learning?” A lot of these people had no positive experience of learning when they themselves were at school, and so how do you change that?

In 2005 it was decided to extend the KIT ITV service to another 2000 homes and to another 6 schools, as well as to lifelong learning. It became apparent that the KIT platform was not advanced enough. It was little more than video-on-demand, which enabled delivery of certain resources, but not the ability to personalise the learning experience, assess individuals through it, or direct users to other resources. In 2005, Broadband Capital Ltd was created by the Hull City Council to provide an expanded educational ITV service to local schools. At the time of interview, it ran a business channel and a learning channel. MJ\_Hull was the managing director of the company. Broadband Capital Ltd developed its own IP based television service called STREAM.

Originally the STREAM program was implemented at one school. It was subsequently rolled out to six new schools in April 2006. According to MJ\_Hull,

At the core, the interactive television service is kind of the product, the important bit is really the process behind it, and the process is about getting pupils, parents, and teachers engaged in making learning resources that are distributed through interactive television.

Furthermore, he stated that “the whole broadcast element of user-generated content is something which really helps particularly with those disengaged groups who otherwise have no real interest in learning, so the broadcast element is critical”.

MJ\_Hull stated that one affordance of ITV was that video-based learning resources held within schools could be delivered to people within their homes, to be viewed at their convenience. He stated that this was particularly useful for learners with visual learning styles.

According to MJ\_Hull, an affordance of ITV is that ITV is a learning resource that engages people who have difficulty in engaging with other forms of learning resources which require higher levels of literacy and numeracy.

MJ\_Hull stated that ITV requires extensive work to develop a learning package wrapped in interactive features. Furthermore, he said that the use of ITV

encourages the whole process of learning to go on behind the generation of content...pupils who actually go through that process learn more about their subject while learning important communication and development skills as well, at the same time. So again, it's about the process, not just the product, and that's where I think it has a massive advantage over videoconferencing.

Another difference between videoconferencing and ITV, according to M, was that ITV allowed asynchronous learning as well as synchronous learning.

According to MJ\_Hull, because STREAM was on demand it was "radically different to other interactive TV systems." When a learner logged on in STREAM they immediately received access to a series of learning resources relevant to them. The system personalised itself to who they were so they did not gain access to resources relating to subjects they were not studying. Within that context, students could search the entire content management system by date, media type, keyword, or subject.

This enabled self-directed learning or research, as well as enabling teachers to set homework based on the availability of the resources to students outside school.

MJ\_Hull stated that while the original STREAM pilot was focused only on secondary school, that is ages 11 to 16, it was based on concepts of lifelong learning. This facilitated the development of learning resources designed for parents of pre-school children to improve their parenting skills.

MJ\_Hull stated that the only flaw with ITV pedagogically "comes when people see it as the only means of teaching or learning, and we're very keen to actually say to them that this has to be part of a blended learning experience." According to MJ\_Hull, learning through ITV is as much about making the content, and learning about the subject of the content, as about how it is accessed in the home. He said that, as a result, the STREAM model was slightly different. It was not a broadcaster model where learning resources were made and pumped out. MJ\_Hull described STREAM as "a whole change management model which is based on getting people to make content and be involved and that actually results in learning content that people are more prepared to watch – we think, anyway."

The nature of the STREAM model was not to have, for example, half hour programs followed by a few interactive features, but rather to provide "small bite-sized chunks of learning." At

the time of the study, for example, primary school resources about modern foreign languages were being worked on, These were to be two-minute clips which related directly to specific areas of the curriculum, rather than a series of language learning programs where basic interactions are possible afterwards. MJ\_Hull described the STREAM output as “a kind of virtual learning environment delivered through the television.”

The system was planned to work so that people could be fully supported through it. Typically, one lesson could comprise a learning objective, some video content that was stimulus material, then some assessments, or applications “or something to do as a result of watching that particular piece of content.”

MJ\_Hull asserted that the learning experience needed to be limited or structured so that it was not massively complicated, and that this meant that “traditional virtual learning environments [were] no good for television.” Hence, MJ\_Hull said that they had to build their own learning environment, in an attempt to “use television for what television’s best at, which is visual information, visual learning which doesn’t try and get across too much but which basically makes things exciting, shows processes better, gets people engaged.”

According to MJ\_Hull, it was critical to understand what television could provide as a medium as opposed to other information accessing methods. He stated that if people could understand what he called “the uniqueness of television” and what it could do for them, then it was possible to “create some really excellent learning resources”.

Finally, MJ\_Hull stated that IPTV [Internet Protocol Television] presented “a whole different set of additional learning on top of simply how to use interactive TV as it has been broadly adopted to deliver learning.”

**MG\_SchoolsTV:** During the tour of Schools’ TV, MG\_SchoolsTV drew the researcher’s attention to a circa 2001 photograph of Microsoft’s Bill Gates involved in a one-to-one video conference with a student in Horsham. He described how the conference was simultaneously being broadcast to two and a half thousand sites, hence a one-to-many happening at the same time as the one-to-one. Furthermore, he described how students could phone in and become part of the interaction. MG\_SchoolsTV stated that in terms of learning, it was a unique application, with very few services capable of providing it.

MG\_SchoolsTV stated that Schools' TV had three producers with education and media production backgrounds, who collaborated with the Victorian Office of Learning and Teaching in order to establish specific learning outcomes related to educational content being delivered. He said that this meant that any interaction would always be anchored back into the intended educational outcome, as part of the basic process of considering the aim, how it would be delivered, and how it would meet the educational objective.

**HM\_ResFellow:** HM\_ResFellow's research specialty was children's TV, specifically for ages 4 and 5, so relating to Early Childhood education and the potentials of ITV for early childhood learning.

HM\_ResFellow touched on educational theory that there is potential for an effective learning experience in a classroom environment because teachers can observe students and adjust their teaching to suit. He referred to this adjustment as "prescribing the remedy". On the other hand, according to HM\_ResFellow, normal television has always had the problem that it did not know its audience, in terms of developmental levels and whether one person was watching alone or fifteen people together. Furthermore, HM\_ResFellow said that the TV program broadcaster did not know whether the program was "resonating well" with the audience.

HM\_ResFellow stated that interactivity provided a way not only to engage the viewers and give them a good experience, but also a way for the television to be able to structure its offerings "a little bit – maybe to a limited extent but maybe enough". HM\_ResFellow likened interactive television to a tool, which could be used really well or really poorly. When used really well, H said that it could enable a bit of segmentation of the audience, providing a few paths from which people can choose, triggering the ego sufficing behaviour. HM\_ResFellow referred to this as a "lean forward model", in that the viewer could lean forward and click, and could think, being a bit more cognitive about the whole experience. He said that the viewers could follow a path that was a little easier or a little harder, hence qualifying into groups.

He stated that ITV had not yet reached its enormous potential. Specifically regarding ITV in education HM\_ResFellow stated that:

the interactive nature of it is perfectly poised for education. It allows someone to become an active participant, they don't sit back and absorb, they lean forward and participate, they can question, they can surmise, they can go down a path, they can understand the relationship between cause and effect ... by interacting you've caused something to happen and you can see the results of that.

HM\_ResFellow said that the latter concept was a very basic equation but that was “quite profound” for young children, by helping them to develop the ability to see outside themselves, and observe the consequences of their actions.

**DV\_ITRI:** DV\_ITRI stated that a lot of ITRI’s research involved extremely specific issues relating to how preschoolers learned, including whether children could understand narrative or whether they simply followed characters around.

Regarding enabling the planting of numerous educational opportunities around the normal television experiences of viewers, DV\_ITRI gave the example of providing “alternative narrative streams that are designed around the educational experience of children”. Specifically, he described the possibility of designing a **very** different narrative stream for eight year old viewers of a shark documentary, in order to maximise their learning opportunity.

**Section summary:** The interview responses concerning learning focussed on the key ideas of engagement, multiple technologies, non-passivity, the learning process, the broadcast element, STREAM, a blended learning experience, a structured learning experience without information overload, a video conference based application, and early childhood learning.

The umbrella issue when adapting programs for ITV, according to AT\_SeniorAcademic, was engagement, either in terms of enjoyment or learning. AT\_SeniorAcademic stated that ITV could potentially enhance the learning environment, compared to video-conferencing, by providing information not available via video-conferencing.

According to AT\_SeniorAcademic, some of the most successful ITV applications had used multiple technologies, with a general objective such as learning. He said that content could be delivered in a variety of ways, including similar or even the same material via interactive television, rather than online. AT\_SeniorAcademic asserted that consideration needed to be given to what the learning objective was, and how to achieve it.

Anon1\_EdExpert indicated that the stigma of being a passive activity did not apply to interactive TV, since it afforded a more active experience to the learner.

According to MJ\_Hull, ITV was a learning resource that could engage people who were functionally illiterate and innumerate. He said that the IP based TV service STREAM was developed to carry out functions such as personalizing the learning experience. MJ\_Hull stated that the ITV service was the product, the important part being the learning process behind its

generation, and that the broadcast element was critical in engaging groups who otherwise had no interest in learning. He said that this focus on process gave ITV a huge advantage over videoconferencing.

MJ\_Hull stated that STREAM was fundamentally different to other ITV systems, providing immediate access to relevant learning resources to users who logged in, and enabling self-directed learning and research. He also said that STREAM was based on concepts of lifelong learning.

MJ\_Hull stated that ITV should be “part of a blended learning experience.” MJ\_Hull said that STREAM was not a traditional broadcaster model, but “a whole change management model” based on making content, being involved, and being more willing to watch the learning content. MJ\_Hull said that STREAM delivered a type of “virtual learning environment”, including brief stimulus materials, follow-up activities, underpinned by learning objectives.

According to MJ\_Hull the learning experience needed to be structured, without delivering an overload of information. He also said that IPTV presented a new set of learning on top of what could be delivered by ITV.

MG\_SchoolsTV described a unique video conference based learning application which enabled a simultaneous one-to-one and one-to-many broadcast, during which students could participate by phone. He stated that Schools’ TV producers collaborated with the Victorian Office of Learning and Teaching, to create interactions that met educational objectives.

ITV potential for early childhood learning was HM\_ResFellow’s research speciality. He said that normal television had the barrier of not knowing its audience, or how a program was being received. However, H said that interactivity facilitated viewer engagement, likening ITV to a tool that provided a “lean forward” model. He said that ITV had enormous potential in the field of education, including in allowing young children to see the consequences of their actions.

DV\_ITRI also referred to preschoolers’ learning, discussing ITRI’s research into whether they understood narrative, and stating that their learning opportunities could be maximised by provision of various streams of narrative.

#### **4.3.11. Pedagogy**

**Definition:** ‘The method and practice of teaching, especially as an academic subject or

theoretical concept' (Stevenson, 2010). Pedagogy must be, of course, inextricably linked to the effective educational use of technologies such as the current one under investigation, interactive television.

**AT\_SeniorAcademic:** AT\_SeniorAcademic stated that considerations regarding communication, in the context of educational ITV, would interact with the pedagogy model being used. In summary, AT\_SeniorAcademic said "one has to say what is a pedagogical model which fits the ITV circumstance in this case, for these users, for this particular sort of material which we want to present?"

AT\_SeniorAcademic stated that it was desirable to consider "those key aspects of what's a good pedagogical model, and then to say how can ITV enable those things, what sort of paradigm for the delivery of ITV, what sort of technical capabilities, what sort of content design and interaction design enhances those aspects of learning that we're wanting, that we know through other work are effective ways of learning."

**Anon1\_EdExpert:** After commenting on the negative perception of television-watching as being passive, and the potential ITV affordance of allowing the learner to be more active, Anon1\_EdExpert went on to say:

But it comes down to the philosophy of the educator doesn't it? There's a lot of face-to-face classroom situations where kids don't have opportunities to interact or make decisions so it really comes down to the pedagogy I guess.

Critical pedagogical characteristics of ITV program design and broadcast raised by the interviewee related to scripting and the design issue of the call to interact. The basic issue of a user potentially missing a call to action was raised, and the associated need to enable a user to move on. One suggestion was that the program might make the decision to take the "line of least resistance" through the program, for the user who does not press any buttons. The possibility of being disengaged, despite the provision of multiple options, was also raised. This was attributed to the risk that none of the options might appeal to the user, dependant partially on how many streams were available. The respondent also questioned how effective ITV may be in terms of allowing users to construct their own knowledge, since the choices available could be from a limited range of options.



**MJ\_Hull:** MJ\_Hull stated that the only flaw with ITV pedagogically “comes when people see it as the only means of teaching or learning, and we’re very keen to actually say to them that this has to be part of a blended learning experience.”

**MG\_SchoolsTV:** In terms of aspects of ITV which could give support to enable correct pedagogy, such as enabling students to work collaboratively and constructively, MG\_SchoolsTV stated that this drew on the “psychology of the screen, more on the way that television is designed as a mass communication tool and therefore, as a mass communication tool, it means that students accept that they’re part of a broader community”. He said that the effect of this was to cause collaboration and constructivism skills to be brought into force, and embellished, in the interactive community. MG\_SchoolsTV stated that Schools’ TV had three producers with education and media production backgrounds, who collaborated with the Victorian Office of Learning and Teaching in order to establish specific learning outcomes related to educational content being delivered. He said that this meant that any interaction would always be anchored back into the intended educational outcome, as part of the basic process of considering the aim, how it would be delivered, and how it would meet the educational objective.

**HM\_ResFellow:** HM\_ResFellow touched on educational theory that there is potential for an effective learning experience in a classroom environment because teachers can observe students and adjust their teaching to suit. He referred to this adjustment as “prescribing the remedy”. On the other hand, according to HM\_ResFellow, normal television has always had the problem that it did not know its audience, in terms of developmental levels and whether one person was watching alone or fifteen people together. Furthermore, HM\_ResFellow said that the TV program broadcaster did not know whether the program was “resonating well” with the audience.

HM\_ResFellow stated that interactivity provided a way not only to engage the viewers and give them a good experience, but also a way for the television to be able to structure its offerings “a little bit – maybe to a limited extent but maybe enough”. HM\_ResFellow likened interactive television to a tool, which could be used really well or really poorly. When used really well, HM\_ResFellow said that it could enable a bit of segmentation of the audience, providing a few paths from which people can choose, triggering the ego sufficing behaviour. HM\_ResFellow referred to this as a “lean forward model”, in that the viewer could lean forward and click, and could think, being a bit more cognitive about the whole experience. He

said that the viewers could follow a path that was a little easier or a little harder, hence qualifying into groups.

**Section summary:** The interview responses concerning pedagogy focussed on the key ideas of using a context-appropriate pedagogical model, the pedagogical philosophies of individual educators, limitations, collaborative and constructivist learning, and engagement.

For use in ITV, AT\_SeniorAcademic recommended the choice of a pedagogical model that was case-appropriate, as well as careful consideration of how a good pedagogical model could be defined in relation to the ITV context.

Anon1\_EdExpert reflected on the need to acknowledge the pedagogical philosophy of individual educators when making judgements about the affordances of TV and ITV. He/she discussed the critical pedagogical characteristics of ITV program design and broadcast, including what he/she referred to as the limitations regarding construction of knowledge by users.

However, according to MJ\_Hull, the only problem pedagogically with ITV occurred when people failed to see it as part of a blended, multi-faceted learning experience.

In contrast to Anon1\_EdExpert's comments, MG\_SchoolsTV stated that correct pedagogy such as collaborative and constructivist learning could stem from ITV, since students accepted that they were "part of a broader community".

HM\_ResFellow contrasted the classroom experience, television, and interactive television, concluding that ITV could provide an engaging product.

#### **4.3.12. Problems**

**Definition:** A problem is a 'matter or situation regarded as unwelcome or harmful and needing to be dealt with and overcome' (Stevenson, 2010). In the current study, the word 'problem' is often interchangeable with the word 'barrier'.

**AT\_SeniorAcademic:** In response to a question from the researcher about barriers to the use of ITV, AT\_SeniorAcademic replied that there were a number of production factors including copyrighted material and who had the authority to broadcast it, the need to generate content, administration issues such as how to access and pay for externally produced content, technical constraints in terms of program production, program delivery, program reception and

infrastructure generally, and related financial constraints. He continued that there were also conceptual, design and understanding barriers, and that, at the time of interview, there was “very little research so far or practical experience that people [could] draw on ... your [the researcher’s] work is about trying to overcome that barrier.” Finally, AT\_SeniorAcademic stated that creativity could be a design constraint.

After discussing production barriers, AT\_SeniorAcademic then talked about constraints “at the consumer end.” These included whether the consumer, in particular very young children and older people at the other end of the age spectrum, could “conceptually manage the interaction.” In particular, he said that there were older people who would be less capable than younger people to rapidly adapt to technologies. Other user end barriers, as described by AT\_SeniorAcademic, included some physical constraint issues such as the limitations of remote controls, and the special needs of persons with visual, hearing, or motor disabilities, or with colour blindness. He pointed out that the latter could be a problem in terms of the tendency to use colour coding in some ITV applications.

**Anon1\_EdExpert:** Anon1\_EdExpert suggested that the program might make the decision to take the “line of least resistance” through the program, for the user who does not press any buttons. Anon1\_EdExpert also raised the possibility of being disengaged, despite the provision of multiple options. He/she attributed this to the risk that none of the options might appeal to the user, dependent partially on how many streams were available.

Potential problems or difficulties that may arise during the design and development stages of ITV programs were discussed by Anon1\_EdExpert. These included the disruption of narrative when a user interacts, preparing the viewer to interact competently, how to keep interaction seamless, and how to measure whether the interactivity makes any difference to learning. Factors relating to non-linearity of programs which occupy a particular discrete broadcast timeslot included the dissonance created when a particular path is chosen by the user, the possibility of users such as young children feeling dissatisfied because they didn’t see the other content, and the inability to go back and take another path, as can be done on a computer game.

**MJ\_Hull:** MJ\_Hull stated that:

a massive barrier in our model is getting teachers to be media-literate, effectively. That said, we’ve now got a very good training program and change management program that actually has worked with the

other six schools that we're running into. So I think one of the massive issues is around digital literacy, in its broadest sense, for teachers. That's a massive issue in the UK generally, as well as IT skills of teachers, which still remains as a big problem.

When asked to comment on any other problems or difficulties which may have arisen in the design and development stages, MJ\_Hull cited the issue of how to strike the best balance between providing users with a satisfactory depth and range of information, while only having a "relatively primitive" delivery system. So students had access using a television and a remote control, as well as the use of an infrared keyboard so they could type and do homework through the TV, but this was a limited access system. MJ\_Hull stated that it was difficult to get people to engage with a prime experience based around remote control.

**CW\_ABCTV:** According to CW\_ABCTV, one of the major problems, especially for the commercial operators, was what he called the "bottom line", or, as he said: "Where's the money?" He attributed Sky's ill-fated foray into the ITV shopping project to this problem. However, CW\_ABCTV asserted that this problem also caused an interest in mobile phones, as a means of providing a back channel for guessing competitions or betting, due to the opportunity of using premium SMS to "guarantee some payback".

In reference to ITV platforms, CW\_ABCTV stated that he would have liked to be able to say that the entire free-to-air world was working towards MHP, but that, for example, China, Japan and North America had each adopted different standards. Furthermore, he stated that the lack of consistency was a problem for ABC as its television services were available both on free-to-air and via subscription services to an increasing number of households, nearing 25% of all Australian households according to CW\_ABCTV, at the time of interview. He said that

it makes good content management even more important – at the risk of oversimplifying the issue, the authoring environment dictates how the presentation layer and its functionality are built. The content sits behind that. In fact there are several tools around that allow you to author or publish on both platforms simultaneously. But it's not cheap!

**HM\_ResFellow:** According to HM\_ResFellow, providing choices to the viewer also provided a barrier to the use of ITV, due to the need to produce alternative materials that might not be selected by the viewer. He commented: "That's a major limitation - people don't like creating stuff that may not be seen". HM\_ResFellow listed other barriers to the use of interactive television, including costs such as bandwidth, and political issues. He also listed production

problems such as a production department trying to liaise and keep in step with a department responsible for the addition of the interactive application.

**DV\_ITRI:** DV\_ITRI discussed interactive TV authoring environments. He said that the main available systems, including ones by Emuse and Ensequence, had inbuilt templates, which, while giving the power to author, resulted in boundaries which were problematic for the needs of ITRI. Specifically, DV\_ITRI said that they were problematic because ITRI was mostly trying to look to the future rather than measure existing activities, by developing “entirely new approaches” and pushing boundaries. He stated that ITRI “created a lot of stuff indirectly” and had developed systems that produced good looking video, and software called Head End Light, which was a simulation environment designed to meet ITRI’s needs, and provide a “very stable environment” for research testing.

**Section summary:** The interview responses concerning problems and barriers relating to ITV focussed on the key ideas of design and production factors, problems for users, limited IT skills of teachers, delivery problems, user engagement, costs, varying platforms, inconsistency, need for alternative materials, political issues, and authoring environment limitations.

AT\_SeniorAcademic listed a number of barriers to the use of ITV, including design and production factors, as well as the lack of research to draw on. He also discussed problems for consumers, including older users, and users with special needs.

Anon1\_EdExpert also discussed problems for the user, focusing particularly on the risk of disengagement. He/she also raised possible ITV program design and development problems, such as difficulties associated with path choice in non-linear programs in discrete [limited time] broadcast timeslots.

MJ\_Hull stated that a huge barrier in the STREAM model was the need for teachers to be media-literate, digital-literate, and have effective IT skills. He also cited problems relating to delivery, as well as user engagement in a remote control environment.

CWs said that problems included costs, varying ITV platforms, and lack of consistency.

HM\_ResFellow stated that the need to produce alternative materials for viewer choices was a barrier to ITV use, as well as the problems of cost, political issues, and production problems.

DV\_ITRI talked about a problem specifically experienced by ITRI, the limitations of existing ITV authoring environments, but then explained how a solution had been found.

#### **4.3.13. Synchronous/ real-time**

**Definition:** Synchronous means ‘occurring or existing at the same time’ (Stevenson, 2010).

**AT\_SeniorAcademic:** When AT\_SeniorAcademic referred to his own work involving a remote Indigenous community, he related that a back channel was not available so communication could not be carried out synchronously. He said that this raised the question of how things could be structured to allow users to communicate back asynchronously, possibly by a website, telephone call, postcard or other mechanism.

AT\_SeniorAcademic described how, in the Desert Knowledge CRC project, work was done on technologies intended to facilitate a back channel. AT\_SeniorAcademic described how, with the back channel, interactivity could occur with the place of origin of the program. This would present the option of feedback being sent to the training facilitator either in real-time or ‘delayed feedback as part of that feedback loop’.

In terms of considering unique affordances of ITV, AT\_SeniorAcademic raised the concept of ‘potential of immediacy’ in ITV use. He stated that real-time broadcast material could be stored on a PVR (personal video recorder), and considered to be **different** or **current**, in comparison with material previously placed on a storage medium such as a DVD. Furthermore, he stated that if a back channel was available, the interactivity with the broadcast initiator could be in real-time or in almost real-time compared with website or DVD related feedback. He stated that “back channel availability...might change the nature of the interactivity with ITV, as against activity with another medium.”

AT\_SeniorAcademic stated that the possibility of having real-time feedback should be considered when developing resources for users.

**Anon1\_EdExpert:** Synchronous communication was recommended by Anon1\_EdExpert as an important feature of ITV in an educational setting because “that’s the way people communicate in the real world [and] it’s more inventive”.

**MJ\_Hull:** According to MJ\_Hull, one of the differences between videoconferencing and ITV is that ITV allows asynchronous learning as well as synchronous learning. He described synchronous aspects as being very useful, but “only as part of a package”.

MJ\_Hull described how a successful synchronous learning trial was held in May/June 2002, the English exam revision period. This was a BBC project where an SOS teacher, based in a studio, would answer questions relating to topics such as geography, which were texted or emailed in by students. However, according to MJ\_Hull, “it isn’t something that is entirely sustainable. An asynchronous form of learning would probably be just as effective for that.”

MJ\_Hull stated that any STREAM synchronous and live transmission was recorded and archived so that it was subsequently available on demand, to “try and get extra value from that learning resource – that interaction.”

**CW\_ABCTV:** In response to an observation by the interviewer that the ITV features on “Long Way to the Top” were all asynchronous, CW\_ABCTV acknowledged:

It was pre-recorded. That’s one of the issues, I guess, in talking about all this. Unless a program is live (and very little on television apart from news and sport is) you are pretty much limited to interactive services that provide static information – anything that involves feedback from the broadcaster – like the result of a vote for example, is almost impossible – especially with our time zones. If you’re invited to engage “now” with an online forum – which is a way of talking in real-time with someone who was just on Four Corners for example, “now” still means “now on the east coast”.

One exception that CW\_ABCTV said had occurred was when the lead singer from the Australian band Skyhooks, Shirley, died in a helicopter crash the afternoon before the Skyhooks-related episode of “A Long Way to the Top” aired. He said that the online forum that night went “berserk”, and that the moderator eventually closed the forum at one o’clock in the morning. As a result, CW\_ABCTV continued, the forum had been open for about three and a half hours, which was enough time for everyone across Australia to get involved.

**MG\_SchoolsTV:** MG\_SchoolsTV stated that the interesting thing about the Schools’ TV studio was that unlike commercial TV studios, where there was a seven second lag time between what was said and when the viewer would hear it, the Schools’ TV recording studio was live interactive, meaning that there was only a lag of about 0.25 of a second, so was broadcasting in “relative real-time”. The inherent risk from this, as described by MG\_SchoolsTV, was that whatever a caller was saying to the studio guest was broadcast in real-time, resulting in an extremely fine window of response to incoming content. However, he said that the trade-off was that students could have a rich one-to-one interactive experience rather than a staged one. MG\_SchoolsTV described this as the “**main** difference” between a commercial “quasi-live” TV program such as “Rove”, and an absolute live interactive program.

MG\_SchoolsTV described how Schools' TV, in addition to their satellite broadcasting, had a web service, to which real-time captures of the signal were directed, so users could download the information at the same time as the satellite broadcast. He said that interactive elements and live real-time could be utilised in both the web and the satellite environments.

At the time of interview, MG\_SchoolsTV said that the unit was tending to produce a lot more pre-recorded programs with a live component at the end, rather than entirely live programs. This could involve, for example, after a pre-recorded program about depression, a crossover to a guest live in the studio, who viewers could interact with, possibly by phone hook-ups. MG\_SchoolsTV described student interaction about topics such as youth depression as "critical". MG\_SchoolsTV stated:

I classify that as interactive TV rather than just being a phone hook-up because ... the audience has looked at the content and now they're responding to it and that's interaction. The interaction is responding to the stimulus.

MG\_SchoolsTV described the interactivity features for web-based program delivery as not being embedded as part of the ITV broadcast, but as simple HTML-based applications, such as a form or email. The latter could include voting buttons that initiated a yes/no email response, sent directly to a central point, which could be monitored in the Schools' TV studio, and then live feedback could be given. MG\_SchoolsTV said that this was virtually the "worm" used on TV election coverages, providing a real-time feedback loop of audience opinion, and a way of gauging audience reactions to various debatable topics. The audience feedback could then influence the content being broadcast. MG\_SchoolsTV described how, in that sort of environment, Schools' TV produced two programs rather than one, in order to show content which was of greater interest to the majority of the audience, according to how the audience had voted. The decision of which content to broadcast could not be made in pre-production – it happened live as a direct result of audience feedback.

This following of a particular theme by tailoring content to audience reaction was, according to MG\_SchoolsTV, "an interesting type of dynamic too because it's very rare that television is driven by its audience, it's normally the other way round". This approach meant that there would be material produced which might never make it to air. Interestingly, however, MG\_SchoolsTV stated that audience reaction could often be predicted according to the material presented, and extensive pre-production during which close attention was paid to exactly how information was displayed, and where it was displayed, in the program.



MG\_SchoolsTV stated that this placement could influence audience decisions and “pretty much guarantee a result that we’re not going to be shocked by”. He said that this was related to the concept of “media truth” and how every person created their own realities.

MG\_SchoolsTV stated that synchronous or real-time communication was definitely an important feature of ITV in an educational setting, because we were living in a media literate world where instant feedback was expected, and the rise of the digital age meant that students expected a certain response level from any application they interacted with, such as computer, phone, or game-based applications. He said that there was no excuse for television not to provide that response.

**Anon2\_ITV\_Expert:** Synchronous communication was described as being an important feature of ITV in any setting, because “people don’t want to wait nowadays, do they...people can talk or converse or communicate instantaneously with a person on the other side of the country in a face-to-face manner and have a more personal and more fulfilling experience that way.”

**DV\_ITRI:** DV\_ITRI stated that live synchronous content in ITV applications could heighten the viewer’s emotional engagement, and that it could “be very powerful in creating a sense of community”.

**Section summary:** The interview responses concerning real-time learning experiences focussed on the key ideas of a back channel, asynchronous alternatives, the mirroring of how humans communicate, being part of a package, recording and archiving, synchronicity limited by time zones, richer experiences, web and satellite environments, partially live programming, immediacy in educational experiences, emotional engagement, and creation of a sense of community.

AT\_SeniorAcademic said that a back channel was needed to enable synchronous communication, and that if one was not available then the question of how to enable users to communicate back asynchronously was raised. He stated that synchronicity in the ITV context could be viewed differently to that provided by other technologies. Furthermore, AT\_SeniorAcademic said that back channel availability had the potential to change the nature of interactivity, and that this should be considered when developing user resources.

Anon1\_EdExpert recommended synchronous communication as a significant feature of ITV in an educational context, since it mirrored the way people usually communicated.

M stated that synchronous learning was useful when used as part of a package, and that synchronous transmission could be recorded and archived, in order to be accessible on demand. He described a learning trial that used synchronous communication, but he qualified his comments by saying that an asynchronous learning form would probably be just as effective.

CW\_ABCTV observed that when Australian viewers were invited to participate in a “synchronous” online forum, it usually meant that viewers could only talk in real-time when they lived in the east coast time zone.

MG\_SchoolsTV stated that minimal lag time facilitated richer experiences than longer lag time during interactive programs, despite the risks involved. According to MG\_SchoolsTV, interactive elements and live real-time could be utilised in both the web and the satellite environments.

MG\_SchoolsTV classified pre-recorded programming with a live component at the end as interactive, since viewers were able to respond to broadcast content. He described web-based program interactivity features as simple HTML-based applications. Audience choices of which program options to choose could be, according to MG\_SchoolsTV, guided by careful pre-production decisions.

MG\_SchoolsTV stated that synchronous communication was unquestionably an important feature of ITV in an educational setting, since instant feedback was expected in our media-literate world, and that it was inexcusable for television not to provide that response.

Similarly, Anon2\_ITV\_Expert described synchronous communication as being an important feature of ITV in any setting, because people did not want to wait, but wanted to communicate immediately with others, thus having a more rewarding experience.

Also in a positive vein, DV\_ITRI stated that live synchronous content in ITV applications could heighten the viewer’s emotional engagement, and create a sense of community.

#### **4.3.14. Technology**

**Definition:** ‘The application of scientific knowledge for practical purposes, especially in industry’ (Stevenson, 2010). While it seems apparent that the use of technology enjoys clear guidelines in most industries, such as steel industries for example, this is not generally the case

in the industry of education. Indeed, it can be argued that it is a constant struggle for educators to seek optimal ways of using technologies such as ITV.

**AT\_SeniorAcademic:** According to AT\_SeniorAcademic, when adapting programs for ITV delivery, the adaptation should be objective driven rather than technology driven.

Ways of monitoring different types of interactivity needed consideration, according to AT\_SeniorAcademic, including, for example, monitoring interactivity of a multiple audience with a TV broadcast, compared with monitoring interactivity via other technology such as websites. In relation to this, he stated that thought should be given to what other technologies could deliver, and their functionalities.

AT\_SeniorAcademic commented that some of the most successful ITV applications had used multiple technologies, so that, for example, it was not that the ITV was directly competing with a website, but that it could be operating in conjunction with a website, with a general objective such as entertainment or learning. He said that a range of different technologies could be involved, which might feed off each other. He stated that a couple of Australian ITV trials had used “that paradigm”, such as “Fat Cow Motel”, which he described as a “pretty simplistic example of that”. He expressed the opinion that other technologies could possibly provide capabilities in easier ways than ITV, in the provision of targeted programs to specific students such as university or TAFE students.

AT\_SeniorAcademic stated that he would like ITV to develop in a way that is user-friendly, and “have the technology driven by useability rather than driven by fashion or whatever.”

**Anon1\_EdExpert:** Anon1\_EdExpert commented:

I guess I’m a bit cynical about it, using technology, I think it’s meant to be used for good reasons and I guess because I come from that point of view I sort of take the approach that it’s not necessarily better because it’s technology. And I also don’t want to, I mean there’s that phrase about using old pedagogies and just using new technology to teach the things the old way so I guess I’m really aware of that and I’m keen not to be sort of sucked in by the sexiness of using interactive television just because it’s there.

According to Anon1\_EdExpert, teachers were not fully exploiting the interactive resources available on the Internet, so it seemed ‘wasteful’ to develop something additional. Anon1\_EdExpert stated that if the existing technology was not being exploited, he/she did

not know why something more difficult, complicated, and expensive would be developed 'for potentially an audience that may not use it'. The respondent did qualify this statement by acknowledging that ITV might be the medium that people would prefer to use, that they might think that using TV is 'better'.

**MJ\_Hull:** The particular intention in Hull was to target students and parents who were considered to be digitally and socially excluded to a large extent. They had very little access to technology in the home, or to broadband, and typically experienced low educational levels or periods of unemployment. Interactive television was seen as a means of bridging the barriers faced by these people. Very few households had a personal computer, so parents were given a set-top box and a broadband connection free-of-charge.

One reason that STREAM superseded KIT was the limitations of the set-top box technology associated with KIT. KIT effectively involved broadband into a set-top box. Since it was rolled out in 1998, the set-top box technology in homes was 7 or 8 years old. The associated service was little more than video-on-demand, which enabled delivery of certain resources, but not the ability to personalise the learning experience, assess individuals through it, or direct users to other resources. It could be likened to a very old browser that simply streamed video over the web. However, by 2005, much more sophisticated set-top boxes became available, which enabled more advanced applications. Furthermore, the company took the critical step of moving to a new platform, and new video standards, which allowed them to improve the levels of interactivity through the system. MJ\_Hull stated that STREAM was much cheaper to deliver than KIT.

While provision of servers and boxes was integral to the process of implementing STREAM, MJ\_Hull stated that this had to be supported by a "whole change management process" comprising a significant training and development program that could take a full year for schools with virtually no prior use of technology.

MJ\_Hull said that his developers had to build their own learning environment, in an attempt to "use television for what television's best at, which is visual information, visual learning which doesn't try and get across too much but which basically makes things exciting, shows processes better, gets people engaged." MJ\_Hull stated that balance was always difficult, in

terms of how much to give people, while wanting to give them everything, but realising that they could only access a certain amount through the actual technology.

Furthermore, the STREAM system had a wider impact, since it could operate not only on interactive TV set-top boxes, but also on PCs. It was available on PCs at drop-in IT centres. A home with a PC and a broadband connection could access the service without the financial support of the local public services. The STREAM model was being developed for mobile phone use as well. This broadening of the STREAM capabilities, according to MJ\_Hull, “show[ed] potential funders outside of Hull that whatever we do here can have a wider impact than just those [digitally and socially] excluded groups”.

MJ\_Hull’s company also talked to further education colleges, vocational training organizations for 16 to 18 year olds, as well as to universities, regarding the potential uses of STREAM in these contexts. According to MJ\_Hull, while these educational organisations’ requirements were radically different, they were still finding “opportunities in using this kind of technology.” One of the differences between the potential contexts for STREAM was that users at university were less likely to be digitally and socially excluded in the way that the original targeted users were.

When the researcher asked M about the potential future impact and possible future affordances of ITV technology, he stated that the critical thing would continue to be building systems capable of working across different platforms. M also stated that anything web-based or web-enabled will be capable of accessing ITV services “and it *should* be, because...web-based delivery of television is by far the way to go.” According to M, the BBC reported its expectation that by 2015 50% of television in the UK will be watched via the Internet, compared to 95% currently through traditional means of broadcasting such as television. M said that as a result of this expected trend, there needed to be a focus on facilitating this.

**CW\_ABCTV:** CW\_ABCTV talked about specific examples of how the ABC had incorporated ITV as part of its strategies, subsequent to the Optus trial carried out in 2001. The first event, which CW\_ABCTV thought occurred in 2002, was that of licensing the interactive TV version of the BBC’s ‘Walking with Beasts’, the most recent example at the time of the BBC’s “long-standing experimentation”. CW\_ABCTV described this event as ABC’s involvement in “something much closer to what [he] would call an engaging, interactive television

experience”, made possible by digital TV technology, particularly where access existed to the bandwidth available to satellite and cable broadcasters.

CW\_ABCTV likened the BBC ITV version of ‘Walking with Beasts’ to the model provided by the BBC Wimbledon tennis broadcasts, which allowed viewers a choice of match, and to display desired scores and statistics, providing a great improvement on coverage available via traditional analogue broadcasts. He elaborated:

When the BBC made “Walking with Beasts” a logical successor to “Walking with Dinosaurs” , the most successful and financially rewarding documentary ever made, they decided to take the Wimbledon approach and offer behind the scenes footage – the scientific background and the techniques used to create and animate the beasts which the viewers could select to watch on parallel channels. “Walking with Dinosaurs” had taught them that audiences were fascinated to know how the program makers knew that the animals looked the way they did, and how they were brought to life on screen.

CW\_ABCTV stated that the viewer used the remote control to switch between the channels provided, and in an effort to stop viewers feeling that they were missing out on something, the BBC looped the main documentary, as well as its supporting channels, continuously between each episode.

CW\_ABCTV stated that when the ABC reproduced the BBC interactive viewing experience of ‘Walking with Beasts’ in Australia, via Austar, it was received to great acclaim, and a great deal of excitement. He said that later that year the ABC then did something very similar with the concert version of ‘A Long Way to the Top’. In elaborating, he specified that the first channel showed the concert, the second channel provided the split screen version, the third channel showed archival footage which was in sync with what the viewer was watching, separated in some cases by 35 years, and finally on the remaining channel was an interview with the artist currently on the stage. CW\_ABCTV said that four Austar satellite channels being temporarily available for about a year, at an affordable price, enabled the broadcasts. He also commented that, while he had wanted to broadcast “Long Way to the Top” on other digital platforms, it was too expensive.

CW\_ABCTV stated that, at that time, there was no publicly available interactive content on free-to-air TV. He pointed out that the software standard for authoring such content, the Multimedia Home Platform (MHP), had only been agreed upon by the industry the previous year. Furthermore, CW\_ABCTV stated that there were no set top boxes for sale [at the time of interview] capable of decoding and displaying MHP-based products.

He stated that ABC was building an electronic program guide, an application for the 2004 federal elections, and a news and information service based on online ABC content while “making clever use of content management”. CW\_ABCTV elaborated that the ABC was tending to focus on applications that shrank the TV picture, so allowing the viewer to continue engaging the TV broadcast while also browsing the extra content. He also described other work that incorporated an overlay enhancement technique, by which the TV picture did not change size, and when the viewer called up the enhancement it floated over the top. He stated that, while an enhancement could be transparent, in the example he was referring to the enhancement was not transparent, but was small and off to one side.

CW\_ABCTV gave, as another example of this, an interactive version of “Love is in the Air”, produced for Austar by the ABC. He stated that, while it looked good and was interesting to do, he did not think that many people used it because it interfered with the program too much and had slightly too much content. He said that the interactivity “didn’t really work because it simply distracted from the program rather than adding to it.”

**MG\_SchoolsTV:** The initial part of the interview consisted of a running commentary by MG\_SchoolsTV as he led the researcher on a tour around the Schools’ TV facilities. He summarised the unit as consisting of three main aspects: the actual program production, the satellite broadcast, and the training wing. Other features described by MG\_SchoolsTV included the post-production area, which comprised three post-production suites, within a floor of networked facilities, which enabled editing to occur on TV studio recordings as they were captured, and recordings to go straight from the edit suites to satellite. MG\_SchoolsTV described this as the nerve centre where different sources such as studio feeds could be brought in, and export to various sources could occur, incorporating the use of beta-cams, mini-DVs, and DVDs, which were all linked. MG\_SchoolsTV likened the technology to “digital lego blocks”. He stated that, in addition to these facilities, Schools’ TV owned a new portable V-tel video conferencing system which could also be used in its satellite broadcasting.

During the tour, MG\_SchoolsTV drew the researcher’s attention to a circa 2001 photograph of Microsoft’s Bill Gates involved in a one-to-one video conference with a student in Horsham. He described how the conference was simultaneously being broadcast to two and a half thousand sites, hence a one-to-many happening at the same time as the one-to-one. Furthermore, he described how students could phone in and become part of the interaction. MG\_SchoolsTV

stated that in terms of learning, it was a unique application, with very few services capable of providing it.

MG\_SchoolsTV described an interactive program his unit did, which he said was technologically complex. It was a horse studies program for the Equine Industry, involving a triangular link between firstly the program host, who was a teacher at a university campus about 150 km outside Melbourne, secondly a vet located in the Schools' TV studio, and thirdly a Victorian school. A participant at the school asked the host about whether all horses had the same resting heartbeat. The host passed the question on to the vet, and the vet responded, thus forming what MG\_SchoolsTV called a "triangle of information". MG\_SchoolsTV commented that the complex technology was almost invisible to the end user, who could simply dial up and "it all happens". MG\_SchoolsTV stated that, while the complexity in this scenario was inherent from the production management perspective,

from an outcome perspective it's also an interesting model too because those people weren't sitting in a big class. They weren't sitting in a big community but they still felt like they were part of one.

MG\_SchoolsTV made the point that the type of interaction described in the Equine Industries example was still reliant, in many ways, on the classroom teachers being present to facilitate the interaction.

MG\_SchoolsTV said there was a "radical shift in a lot of new technologies" such as DVD, which potentially opened up opportunities for commercial education. A factor in this, according to MG\_SchoolsTV, was the take-up rate of the particular technology by the end user. MG\_SchoolsTV stated "probably your biggest limitation is always going to be your end user", in terms of mapping an existing educational model onto a commercial model. Specifically, MG\_SchoolsTV pondered the availability of the appropriate technological facilities to enable the end user to interact seamlessly, such as a satellite dish, a decoder, a good quality TV with good sound capabilities, and telephone access. He pointed out that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes, including of a commercial model. MG\_SchoolsTV made the analogy of a football field, stating that due to the IT and infrastructure roll out to schools, his production unit knew that "every school has this flat level playing field that we know we can actually kick the goals on".



MG\_SchoolsTV stated that future ITV technologies would enable students to get into environments that they could never possibly physically enter, such as the NASA space program. MG\_SchoolsTV maintained that, for example, direct feeds from Mars which had already occurred could not have been delivered any other way, and that new ITV technologies would allow such boundaries to be pushed even further.

MG\_SchoolsTV spoke about how ITV could be used to build a “dynamic community model” which facilitated a greater understanding about other cultures and ways of doing things. He said that, at the time of interview, his production unit was trying to implement a model capable of linking students from different cultures on a worldwide interactive platform. This would be intended to compare how Australian students create very different content to, for example, students from Japan or Greenland, so beginning with a shared platform of understanding, then creating what MG\_SchoolsTV referred to as a “cyber group of people”, that is, people separated by physical distance but still interacting quite strongly. MG\_SchoolsTV acknowledged that arguments existed that there were other technologies which could do that as well but that he would argue that the richness was very different, for example, compared to being in a chat room where there is no “visual reference”.

In terms of adapting an ITV system to fulfil individual users’ needs, MG\_SchoolsTV focussed on users with disabilities, stating that it would be possible to push the model a bit further and specifically tailor some of the interactive elements towards persons’ disabilities. He said that he thought it was “more of a case of your biggest issue is breaking the mindset of how television has traditionally been created and working more towards a non-linear fluid model”. Part of this process, said MG\_SchoolsTV, was asking what would happen if something different was done with the technology, but he stated that not many environments were willing to take that risk, largely because most of the Australian TV industry productions were for commercial outcomes. However, MG\_SchoolsTV asserted that “probably education here is quite unique because we **can** take that risk, we can afford to take that risk in terms of saying, let’s see what happens if we do things this way”. He qualified his statement by saying that there was a fair bit of research involved, and it was not just a random process.

Finally, MG\_SchoolsTV offered advice on what new ITV program designers needed to know. He said that the main thing was to “first of all establish the playing field”, in terms of knowing what the technology could deliver in such an innovative field. MG\_SchoolsTV elaborated on this point, saying that people often get caught up in the jargon and capabilities of the

technology, but that ultimately the key consideration was “what is the end user seeing and what are they experiencing?” He illustrated this point by saying that if his production unit had the “most whiz-bang piece of technology” but the end user was watching the program on a really small monitor, with a lot of background noise, and a radio in the background, then the experience would be affected by those environmental factors.

MG’s advice continued: “you can’t think outside the square until you know what the square is, what it’s made of, how big it is, where it sits”. He said this involved getting a sense of what interactive means, what you personally like to experience from interaction, and then incorporate these into a product. MG\_SchoolsTV said he always encouraged his staff, including his junior producers, to push the applications to the n<sup>th</sup> degree, because

in this lovely digital age, you cannot make a mistake digitally. You’ve got these lovely two keys called the control and z which means undo and you’re better off making that, taking that leap and seeing what happens than sort of not . . . so that’s more of an inspirational thing, more of a motivational thing.

**Anon2\_ITV\_Expert:** The respondent stated that ITV has the potential to do “amazing” things in terms of flexible, non-textual, video productions delivering a wide range of information. The proviso was that sufficient money, time and effort would need to be invested in the infrastructure and content of the new technology.

Important design characteristics of ITV programs suggested by the respondent were relevance of the interactivity, that the interactivity should make sense, and that it must be important to the viewer.

It’s no use if you just stick interactivity in there just because you can as a producer...If it doesn’t add anything to the experience people get more annoyed by it than anything else. And it should be intuitive and I think that’s got a lot to do with the kind of technology people have previously used.

Previous use of technologies with similar language was listed as an advantage for persons adapting to use of the new technology. The respondent speculated that television users in the UK felt comfortable in using remotes in a goal-oriented way due to their long-term familiarity with teletext.

**HM\_ResFellow:** HM\_ResFellow began by saying that the key thing he could offer was a practical look at interactive television, in particular, children’s television. He summarised: “what I can offer you I suppose is a good look at the state of the technology, how things are

going and how companies are dealing with the card they've been dealt when it comes to interactive TV."

At the time of the interview HM\_ResFellow had been to the UK, and looked at programs the BBC made, and looked at Disney programs, and Sesame Street. He said that he had noticed that interactive television was hampered by the current state of the technology. He qualified this by saying "however, that is a rapidly evolving thing in itself in that things we can't do this year we can probably do next year and you need to keep a really open mind about that."

Technological restrictions relating to ITV were discussed by HM\_ResFellow. He said that there were many, including that there was no really specific way of putting applications together. He said that there were a multitude of ways, as well as different companies and software, and that it had been found in the UK that producing an interactive show disrupts the production timeline. The latter could be 12 weeks for a show to be put together, but five months to make the interactive application. As a result, according to HM\_ResFellow, children's interactive television was restricted to several shows per year, at the time of interview.

HM\_ResFellow began his closing comments by observing that "we are in the formative age of interactive television and probably will be for many years". To illustrate this, H said that in the previous year he had his research "sorted out", but then "Disney went ahead and discovered new ways of doing interactive television" which made work H had done "irrelevant". H continued that interactive television was at a certain level of technology, cost, and ability, and that this would change and evolve, so that costs would come down, time lines would reduce, and people would become more capable of using it. He stated that ITV had not yet reached its enormous potential.

Finally, HM\_ResFellow re-iterated that "[ITV is] merely a tool, a tool that is developing in its sophistication but the most important thing is the quality of the product that you use this tool to create".

**DV\_ITRI:** DV\_ITRI stated that ITRI had staff responsible for developing the "traditional", not interactive, audiovisual functionalities in use at ITRI, computer programmers, and a person who worked on engineering projects such as building recording boxes for a particular study.

The latter study was being organised at the time of interview. DV\_ITRI said that about 75 of the recording boxes, which had multiple functions, were to be supplied to the U.S. market, in

conjunction with the large study, which involved recording people watching TV in their home environment. He gave further details of this, describing how as the recording box videotaped the people it also kept track of their remote control use by “automatically planting meta-tags throughout the experience”. DV\_ITRI said that a linkage was planned with a couple of American ratings companies, to enable the actual program data to be automatically encoded. In relation to this, he said that ITRI had a very large archiving system at Murdoch University with which the data encoding would be compatible, so that file transfer would be all that was required, rather than re-encoding the data.

At this point in the interview DV\_ITRI showed the interviewer several rooms used at ITRI for various functions, such as conference, participant surveys, and TV viewing by research participants. He said that the latter room was being re-designed so that it felt more like a domestic lounge room, and less institutional. DV\_ITRI stated that everything was highly controlled within the viewing room, with multiple cameras so that the researchers could watch the viewing behaviour of the participants. An innovation developed at ITRI, according to DV\_ITRI, was to have a coffee table which could move up and down, and which contained an eye-gaze camera. He said that this was designed to be fairly unobtrusive, while enabling researchers to track the eye movements of viewers.

DV\_ITRI described how the post-viewing survey was in the process of being automated. He said that at the end of the viewing process a code would appear which indicated whether, for example, the participant had chosen to interact with an interactive advertisement. This, and any other interactive viewing choices, would determine which version of the post-viewing survey would be automatically uploaded onto a computer for the individual participant to fill in.

DV\_ITRI and the interviewer then moved to another room, which DV\_ITRI said was being converted to a combination sound booth for production of audio recording, and debrief room. They then moved to the observation room, which DV\_ITRI said would normally have its lights down when in use, and which provided the researchers with different camera feeds from the viewing room, which could typically be displayed as a quad split on an aggregated screen with, for example, the superimposed eye gaze. DV\_ITRI said that the researchers had a number of different ways of coding the behaviour, including a Noldus observer, which he described as “a classic kind of human factors logging system”, used commonly by research communities. However, DV\_ITRI described the latter system as being “very inflexible”, and said that ITRI was

in the process of adapting a system developed by Sportstech, an Australian company which had been “very helpful” in assisting ITRI to mould the sports-designed system into a new product version to meet ITRI’s needs for a more flexible research coding system. Furthermore, he stated that it was possible, with a more flexible studio code system, to carry out “very rich” procedures such as finding individual incidents from within ITRI’s entire archive and putting them together.

DV\_ITRI showed the interviewer the rack room, which contained various computerised systems including the play out system, the automatic behaviour logging system, the eye-gaze system, and a dedicated MHP carousel. He stated that, because of work being done with American companies, ITRI had a lot of the same infrastructure in NTSC format to support their NTSC equipment, and enable conversions to take place. DV\_ITRI then pointed out other features of the technology in the rack room, including facilities which provided a laboratory version of a cable TV system, and allowed their signal to be modulated across satellite, terrestrial, and cable, and included a full Open TV carousel system, replicating a lot of the technology that was on the Foxtel platform.

DV\_ITRI discussed interactive TV authoring environments. He said that the main available systems, including ones by Emuse and Ensequence, had inbuilt templates, which, while giving the power to author, resulted in boundaries which were problematic for the needs of ITRI. Specifically, DV\_ITRI said that they were problematic because ITRI was mostly trying to look to the future rather than measure existing activities, by developing “entirely new approaches” and pushing boundaries. He stated that ITRI “created a lot of stuff indirectly” and had developed systems that produced good looking video, and software called Head End Light, which was a simulation environment designed to meet ITRI’s needs, and provide a “very stable environment” for research testing. DV\_ITRI elaborated that

The test for us is that the look and feel for the viewer is authentic so that we’re reproducing what would happen or what is technically possible to happen but we’re not spending the time in developing the actual applications to make that happen.

He continued that ITRI could then test many things, determine what things should look like, and then probably pass this information on to industry consortium partners so engineers could build resultant designs. DV\_ITRI emphasised that a few years previously ITRI was “more broadly situated across the interactive TV spectrum” but by the time of interview had become

very focussed on the facet of audience research, having gained a global reputation for audience insight projects.

DV\_ITRI described a Pantene ad as his favourite interactive ad, and said that what made it so good was that it was well researched before it was deployed. He described it as being simple, with the viewer clicking to enter a low tech “micro-site” containing nine questions about the viewer’s hair, the purpose of which, according to DV\_ITRI, was to extract information about the person’s lifestyle, and determine which “box” the viewer belonged in, in terms of the parent company Proctor and Gamble’s “particular persuasive appeal”.

DV\_ITRI commented that educational television was “still caught in the old paradigm of education” and was “still curriculum centred”. He qualified this by saying that this largely had to be attributed to the nature of technology. However, DV\_ITRI continued that, as technology entered a domain where interactivity became feasible, this suddenly allowed television to “make that shift from being curriculum centred to being child centred and that’s a very exciting shift”.

DV\_ITRI touched on the difference between the levels of complexity of interactions which older viewers were capable of compared to younger viewers, as indicated by another ITRI study. He said that, while older viewers struggled with distractions when using technology, teenagers could multitask to the extent that technology was a “normal extension to their body”, and they seemed to be “genetically different” to older viewers. DV\_ITRI stated that the key was that if the technology could be intuitive, so that users did not need to think about what they were doing, then it could be considered viable.

In regards to ITV technology’s impact on education in the future, DV\_ITRI described it as “huge”.

**Section summary:** The interview responses concerning technology focussed on the key ideas of monitoring methods, functionalities, multiple technologies, useability-driven development, cynicism regarding use, use in bridging social barriers, associated training and development, practicalities, and workability across different platforms. The responses also related to limitations imposed by the delay in widespread adoption of MHP, “digital lego blocks”, the take-up rate of technology, availability of the appropriate technological facilities including significant infrastructures, future technology use, the richness of the ITV experience, disabled users, research, the ability to undo digital actions, money, time and effort, familiarity of users

with similar technological language, the potential of ITV technology, and the need for technology usage to be intuitive.

AT\_SeniorAcademic stated that program adaptation for ITV delivery should be objective driven, rather than technology driven, and that he would like the development of ITV to be useability-driven rather than fashion-driven. He said that different interactivity monitoring methods needed to be considered, with particular attention being given to the differing technologies' functionalities. AT\_SeniorAcademic also said that some of the most successful ITV applications used multiple technologies.

Anon1\_EdExpert expressed cynicism about technology being used simply because it existed, and concern that existing technologies were not even being used to their full advantage. However, Anon1\_EdExpert qualified these assertions by acknowledging that people might prefer to use the TV-related ITV medium.

MJ\_Hull described how digitally and socially excluded students and parents in Hull were the target audience of his company's ITV technologies, seen as a way of bridging barriers that the families faced. He described how the technologies had become more advanced over time. He pointed to the need for a significant and lengthy training and development program for schools with virtually no prior use of technology.

MJ\_Hull said that his developers needed to build their own learning environment which optimized the use of television for engaging visual learning, but which required a difficult balance between what they would like to provide versus the practicalities. He also discussed how the STREAM model was being broadened to facilitate other end-uses.

The critical factor for the future, according to MJ\_Hull, would continue to be building ITV systems capable of working across different platforms, including web-based ones.

CW\_ABCTV discussed BBC's and ABC's forays into the use of ITV technology. He also discussed the limitations imposed, at the time, by the waiting period for widespread acceptance and implementation of the software-authoring standard, MHP. CW\_ABCTV described interface technologies, and the level of effectiveness of interactivity in a number of cases.

MG\_SchoolsTV gave the researcher a tour of the Schools' TV facilities, likening the technology to "digital lego blocks". He described a number of different projects his unit was involved in,

including one that made participants feel like they were part of a big community, even though they were not actually sitting in one.

MG\_SchoolsTV said there was a “radical shift in a lot of new technologies” which potentially opened up opportunities for commercial education. He pondered the related take-up rate of the particular technology by the end user, and the availability of the appropriate technological facilities to enable the end user to interact seamlessly. MG\_SchoolsTV stated that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes.

Future ITV technologies, according to MG\_SchoolsTV, would enable students to get into environments that they could never possibly physically enter, such as the NASA space program.

MG\_SchoolsTV also spoke about how ITV could be used to build a “dynamic community model” which facilitated a greater understanding about other cultures and ways of doing things. He acknowledged the existence of arguments that there were other technologies that could also do this, but that he would argue that the richness of the ITV experience was very different.

In terms of adapting an ITV system to fulfil individual users’ needs, MG\_SchoolsTV focussed on disabled users, stating that education was probably unique because it could afford to take the risks involved. He qualified his statement by saying that there was a fair bit of research involved, and it was not just a random process.

MG\_SchoolsTV offered advice on what new ITV program designers needed to know. He also said that he encouraged his staff to push the applications to the n<sup>th</sup> degree, because it was not possible to make a mistake digitally, due to the ability to undo digital actions.

Anon2\_ITV\_Expert stated that ITV technology had the potential to do remarkable things, provided that sufficient money, time and effort were invested in the infrastructure and content. He/she listed important design characteristics of ITV programs. Previous use of technologies with similar language was listed as an advantage for persons adapting to use of the new technology.

HM\_ResFellow discussed the programs he had observed in his overseas travels, stating that he had noticed that interactive television was hampered by the current state of the technology.



He qualified this by saying that consideration should be given to potential future rapid technology improvements, which could lead to cost reduction, time line reduction, and user-capability increases. He stated that ITV had not yet reached its enormous potential, but emphasised that ITV was simply a tool.

DV\_ITRI described the roles of ITRI technology staff. He also described the technologies employed at ITRI, whilst giving the researcher a tour of the ITRI facilities.

DV\_ITRI discussed interactive TV authoring environments, including ITRI's own.

He described his favourite interactive ad, and listed the features which made it so successful.

In regards to educational television, DV\_ITRI stated that, as technology entered a domain where interactivity became feasible, this suddenly allowed television to "make that shift from being curriculum centred to being child centred and that's a very exciting shift".

DV\_ITRI stated that the viability key for users of different ages and capabilities was that the technology be intuitive, so that users did not need to think about what they were doing. He described ITV technology's potential impact on education in the future as enormous.

#### 4.4. Summary of locations of sub-themes in interviews

The following Table 4.2 details the location of the sub-themes in the interviews. It provides an overview of where the sub-themes have emerged during the interview process.

Table 4.2: Locations of sub-themes in the interviews

Sub-theme	Respondents
Affordances	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, MG_SchoolsTV, Anon2_ITV_Expert, HM_ResFellow, DV_ITRI
Assessments	AT_SeniorAcademic, MJ_Hull
Collaboration	AT_SeniorAcademic, MJ_Hull, MG_SchoolsTV
Communication	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, MG_SchoolsTV, Anon2_ITV_Expert, HM_ResFellow
Constructivism	Anon1_EdExpert, MG_SchoolsTV,
Delivery	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, MG_SchoolsTV, Anon2_ITV_Expert
Design	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, CW_ABCTV, MG_SchoolsTV,

	Anon2_ITV_Expert, HM_ResFellow, DV_ITRI
Future	AT_SeniorAcademic, MJ_Hull, MG_SchoolsTV, DV_ITRI
Interface	AT_SeniorAcademic, CW_ABCTV, HM_ResFellow
Learning	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, MG_SchoolsTV, HM_ResFellow, DV_ITRI
Pedagogy	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, MG_SchoolsTV, HM_ResFellow
Problems	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, CW_ABCTV, HM_ResFellow, DV_ITRI
Synchronous/ real-time	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, CW_ABCTV, MG_SchoolsTV, Anon2_ITV_Expert, DV_ITRI
Technology	AT_SeniorAcademic, Anon1_EdExpert, MJ_Hull, CW_ABCTV, MG_SchoolsTV, Anon2_ITV_Expert, HM_ResFellow, DV_ITRI

## **Chapter 5**

### **Discussion and Conclusions**

This final chapter has a number of functions. Firstly, the research problem has been re-stated via the research questions. Secondly, responses to the research questions have been discussed in the context of the collected data. These responses have been argued substantively from the thematically-organised data in Chapter 4. The data gathered and previously presented have been applied to address the research questions. Literature review findings documented in Chapter 2 have also been drawn into the discussion of the problem and answers, in an attempt to critically engage with the literature. A list of ITV design guidelines, emanating from the data, has then been provided. Finally, conclusions have been drawn from the discussions, and presented at the end of the chapter. These conclusions address the research problem. The conclusions also include recommendations for further research.

#### **5.1. Re-statement of research problem**

Interactive television, in its most advanced forms, comprises a fusion of various multi-media technologies. It affords a number of potential uses, including commercial, non-commercial, and/or educational ones.

The current study is an investigation of potential educational uses of ITV. From a pedagogical point of view, a number of associated research questions arise, including the two formulated for the purposes of the current study:

1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?
2. What are the critical pedagogical characteristics of ITV program design and broadcast?

#### **5.2. Responses to research questions**

Responses to the two research questions have been sought through interviews with key contributors to the field and have been reported through the thematic data analyses documented in Chapter 4, as well as from the literature. Section 5.2 is presented in three parts: the responses specific to research question 1, the responses specific to research question 2, and the responses which are common to both research questions 1 and 2.

### **5.2.1. Responses to research question 1**

Q1. What are the affordances of interactive television (ITV) that facilitate the design and delivery of socio-constructivist learning environments?

The findings relating to question 1 show that the respondents focussed on the themes of affordances, collaboration, communication, delivery, design, interface, problems, synchronous/real-time experiences, and technology. These themes were the same as those determined a priori from the literature, and all except three are now discussed in more detail. The three themes of collaboration, communication, and design are common to both research question 1 responses and research question 2 responses, so are discussed in more detail in sub-section 5.2.3., which relates to both research questions.

#### **5.2.1.1. Affordances**

The interview responses concerning the affordances of ITV focussed on the key ideas of assessment or monitoring of user actions, engagement of users through a sense of ownership or control, and making the end user the focus rather than the content or delivery. One respondent also discussed potential advantages of ITV.

It was stated by AT\_SeniorAcademic and HM\_ResFellow that assessment and monitoring of user actions could be carried out by logging viewer actions, and the use of eye-gaze technology. According to the ITRI research fellow HM\_ResFellow, the ITV affordance of being “trackable”, led to “an interesting paradox” of audience choice versus producer control. These findings reflect the current study’s theoretical underpinning of technological determinism.

MJ\_Hull, MG\_SchoolsTV, Anon2\_ITV\_Expert and HM\_ResFellow discussed engagement of users. Indeed, the key affordance MJ\_Hull attributed to ITV was engagement of users. MG\_SchoolsTV described affordances that supported MJ\_Hull’s view, such as the creation of a sense of ownership for the audience, the user being able to see what they want when they want, and the creation of a sense of community. Another affordance mentioned by MG\_SchoolsTV, which did not apply to users, but to ITV producers, was that of a feeling during production, of “foot-to-board”. He claimed that this was inter-related to the need to facilitate the affordances of ownership and instancy to users. The ability to engage users with special needs was also touched upon, by Anon2\_ITV\_Expert.

Affordances that facilitated the engagement of children were noted by the respondents. HM\_ResFellow discussed visual engagement, animation, the “quite profound” opportunity for children to see outside themselves, and the consequences of their actions. DV\_ITRI raised the potential to shift the central focus from curriculum to the user – the child. DV\_ITRI also stated that ITV’s key advantage was its closeness to the original content.

Other ITV affordances raised by HM\_ResFellow included security, stability, consumer perceptions, and the communication return path. He claimed that ITV had not yet reached its full potential, including in the educational field, while emphasising that ITV was merely a tool to be used to provide what was really important: a good quality product.

One respondent, Anon1\_EdExpert, provided an alternative viewpoint about ITV affordances, reflecting on the need to adopt a cautious approach to utilising unproven technologies such as ITV in attempts to enhance learning. Since Anon1\_EdExpert made this comment, there has been some more work done on investigating the affordances of various technologies for educational use.

In the literature, for example, Luxton-Reilly, Denny, Plimmer and Sheehan (2012) investigated how student-generated questions assisted learning. Their study included a focus on the affordances of related purpose-built applications. Their findings included responses from student users regarding the affordances of the applications. Student responses included their satisfaction with technology affordances such as the ability of the applications to filter and sort questions.

Furthermore, Bower (2008) described how e-learning experiences could be designed by matching the task requirements with technology affordances. Further studies, similar to those of Luxton-Reilly and colleagues (2012) and Bower (2008), may have the potential to address the important issues that Anon1\_EdExpert raised in relation to caution about ITV affordances for education.

#### **5.2.1.2. Delivery**

The interview responses, concerning the delivery of educational materials generally, and of ITV more specifically, focussed on a number of key ideas. These related to delivery options,

including matching user characteristics, economic considerations, asynchronous delivery, audience feedback, infrastructure, and timing of delivery.

AT\_SeniorAcademic claimed that not only **how** materials could be delivered should be considered, but also **why** such delivery methods were chosen. Distance education was an example raised by Anon1\_EdExpert, that illustrated AT\_SeniorAcademic's claim, in terms of use of the Internet, provision of hard copy materials, and the lobbying power of parents involved. Asynchronous delivery on demand was cited, by MJ\_Hull, as a method that catered for students who learn better in the evening. This supported the idea that the delivery design depended on the audience, or the type of client being supported.

MG\_SchoolsTV stated that audience feedback could directly influence the content being broadcast, although, paradoxically, he also claimed that audience reaction could often be predicted according to the material presented.

Research by Anon2\_ITV\_Expert indicated that opportunities for interactivity should be made available at the end of broadcast materials, rather than during. The implication for educational ITV appears to be that short "packages" of video, interspersed with interactivity opportunities, may be a preferred mode for viewers, as opposed to interactivity causing interruption to streamed lengthy videos.

A greater focus worldwide on delivery via Internet protocols [known as IPTV] was predicted and recommended by MJ\_Hull. His prediction has been borne out in the literature, through studies such as Yuzer and Kurubacak's 2011 investigation of the integration of IPTV with distance learning for multicultural communities. They found that IPTV could be used to help build online constructivist communities.

Examination of the literature revealed that distance education originally consisted of the delivery by 'traditional' mail of instructional materials to learners. Currently, reference to distance education connotes delivery via some form of electronic means, involving various levels of interactivity. Interactive television (ITV) was at the cutting edge of the new-generation of distance delivery technologies, according to descriptive articles concerning the capabilities of ITV published at the time of this study. Indeed, it can be argued that ITV, in the form of IPTV, has continued to be at the cutting edge of distance delivery technologies, as described by Yuzer and Kurubacak (2011).

During a Scottish study by Nicol and colleagues (2003), experiences of students and tutors during delivery of an online module were evaluated. Asynchronous online discussions were held and analyzed. Nicol and colleagues (2003) found confirmation that the social context of face-to-face learning differs qualitatively from online learning,

In a study by Chang (2003) relating to a Taiwanese distributed web-based learning community [DisWBLC], students indicated that many learning resources could be more effectively delivered via audio and video media which the DisWBLC did not adequately provide. ITV, on the other hand, does have the capability to deliver resources such as video-on-demand and hypervideo.

In a study emanating from Iowa State University (Johnson, 1988, cited in Thompson, Simonson & Hargrave, 1996), high school students were surveyed about their attitudes towards satellite-delivered instructional television. Findings were that students mostly held positive attitudes, but did tend to prefer traditional instructional methods. However, since then, television technologies have advanced greatly.

In 2011, Simonson, Schlosser and Orellana carried out a review of distance education research literature. They concluded that ‘the research clearly shows that distance education is an effective method for teaching and learning’ (p. 139). In terms of distance education being afforded by ITV, Yuzer and Kurubacak (2011) went so far as to describe ITV as ‘one of the most effective distance education tools’ (p.259). These studies have implications for potential educational uses of interactive television.

#### **5.2.1.3. Interface**

The interview responses concerning ITV interfaces focussed on the key ideas of the importance of users’ expectations and users’ age, project objectives, task-based interface design process, prototyping and testing, and development technologies.

Specifically, AT\_SeniorAcademic claimed that the design of the user interface depended on the project objectives, with various graphic TV applications having associated screen overlays.

CW\_ABCTV provided an interface example relating to a Sydney-based interactive TV trial that provided an experience in a “walled garden” environment. The associated user interface was developed using an HTML-based software package.

According to HM\_ResFellow, consistency of the interface was important for parents, so that they knew what to expect, and was important for economic reasons. He also indicated that text-based interfaces might be inappropriate for very young audiences. In addition to the responses outlined above, HM\_ResFellow discussed what he coined “ego sufficing behaviour”, and its relationship to viewer choices. He defined “ego sufficing behaviour” as the concept that if you gave people the option to choose something, they were more likely to have a favourable attitude towards it since they got to make the choice.

It was found during compilation of the literature review that many studies have investigated student-computer interface design, even as far back as the late 1980s (Criswell, 1989, cited in Thompson, Simonson & Hargrave, 1996). Furthermore, Thompson, Simonson and Hargrave (1996), cited the division of the computer screen into functional areas as a means of avoiding clutter on the screen. This ties in with descriptions of ITV user interfaces provided within the interview data.

However, according to Chorianopoulos (2008), “contemporary research has identified the differences in the UI requirements between the PC and ITV, but there are still no design principles to address the idiosyncracies of ITV users and applications” (p. 557).

#### **5.2.1.4. Problems**

The interview responses concerning problems and barriers relating to ITV focussed on the key ideas of design and production factors, problems for users, limited IT skills of teachers, delivery problems, user disengagement, costs, varying platforms, inconsistency, need for alternative materials, political issues, and authoring environment limitations.

The lack of research to draw on was also raised, by AT\_SeniorAcademic. Other problems raised by AT\_SeniorAcademic included problems for older users and users with special needs.

Anon1\_EdExpert and MJ\_Hull discussed the risk of disengagement, with MJ\_Hull pointing to potential engagement difficulties in a remote control environment. Anon1\_EdExpert raised possible ITV program design and development problems, such as difficulties associated with path choice in non-linear programs in discrete [limited time] broadcast timeslots.

The problem of technology useability, and user related problems, echoed those found in the literature review. Becker (1990, cited in Thompson, Simonson & Hargrave, 1996) cited attitude



of teachers, and lack of teacher education, as major barriers to appropriate and effective computer use. He also suggested that inadequate hardware seriously limited software uptake. In 1999, Evans, Stacey and Tregenza carried out a multiple-case study in Australia to investigate the 'extent, nature and problematics of educational dialogue through interactive television (ITV) in primary and secondary schools' (p.215). They claimed that the problem of the predicted decline in teacher numbers pointed to the increasing importance of the role of technologies such as ITV in the context of learning. One finding of a study by Fallahkhair, Masthoff and Pemberton (2004) was that usability of the technology was a problem, specifically mentioning usability of the remote control; this problem could conceivably be overcome by user training, if the user was willing.

Furthermore, another potential barrier is the level of adoption of new technologies. Drawing on Greek mythology, Straub (2009) stated that:

Technology adoption has become a Sisyphean task. As Sisyphus was condemned to eternity of pushing a boulder up a mountain, only to have to roll it back down again, the average individual is doomed to a cycle of continual technology implementation. About the time an individual adopts a technology, a new one is developed and marketed, requiring a new adoption cycle. (p.643)

#### **5.2.1.5. Synchronous/real-time**

The interview responses concerning real-time learning experiences focussed on the key ideas of a back channel, asynchronous alternatives, the mirroring of how humans communicate, being part of a package, recording and archiving, synchronicity limited by time zones, richer experiences, web and satellite environments, partially live programming, immediacy in educational experiences, emotional engagement, and creation of a sense of community.

AT\_SeniorAcademic stated that synchronicity in the ITV context could be viewed differently to that provided by other technologies. In regards to back channel availability, he said that it had the potential to change the nature of interactivity, and that this should be considered when developing user resources.

While MJ\_Hull described a learning trial that used synchronous communication, he qualified his comments by saying that an asynchronous learning form would probably be just as effective.

CW\_ABCTV observed that when Australian viewers were invited to participate in a “synchronous” online forum, it usually meant that viewers could only talk in real-time when they lived in the east coast time zone.

MG\_SchoolsTV stated that minimal lag time facilitated richer experiences than longer lag time during interactive programs, despite the risks involved. He also stated that interactive elements and live real-time could be utilised in both the web and the satellite environments. Furthermore, he stated that synchronous communication was unquestionably an important feature of ITV in an educational setting, since instant feedback was expected in our media-literate world, and that it was inexcusable for television not to provide that response.

Similarly, Anon2\_ITV\_Expert described synchronous communication as being an important feature of ITV in any setting, because people did not want to wait, but wanted to communicate immediately with others, thus having a more rewarding experience.

Also in a positive vein, DV\_ITRI stated that live synchronous content in ITV applications could heighten the viewer’s emotional engagement, and create a sense of community.

Numerous references to synchronous learning occur in the literature. Chang (2003) evaluated a distributed web-based learning community (DisWBLC) at the National Taipei University of Technology in Taiwan. Two of the under-utilized functions were the expert consultation and the synchronous conference room. These functions can be mirrored in ITV, raising the question, of course, of whether they would be under-utilized in this context also.

#### **5.2.1.6. Technology**

The interview responses concerning technology focussed on the key ideas of monitoring methods, functionalities, multiple technologies, useability-driven development, cynicism regarding use, use in bridging social barriers, associated training and development, practicalities, and workability across different platforms. The responses also related to limitations imposed by the delay in widespread adoption of MHP (Multimedia Home Platform, an open middleware system standard, which enables the receipt and execution of interactive applications on a TV set), “digital lego blocks”, the take-up rate of technology, availability of the appropriate technological facilities including significant infrastructures, future technology use, the richness of the ITV experience, disabled users, research, the ability to undo digital

actions, money, time and effort, familiarity of users with similar technological language, the potential of ITV technology, and the need for technology usage to be intuitive.

AT\_SeniorAcademic stated that program adaptation for ITV delivery should be objective driven, rather than technology driven. He also said that some of the most successful ITV applications used multiple technologies.

Anon1\_EdExpert expressed reservations about technology being used simply because it existed, and concern that existing technologies were not even being used to their full advantage. However, the academic qualified these assertions by acknowledging that people might prefer to use the TV-related ITV medium.

The UK respondent, MJ\_Hull, said that his developers needed to build their own learning environment which optimized the use of television for engaging visual learning, but which required a difficult balance between what they would like to provide versus the practicalities. He also discussed how the STREAM model was being broadened to facilitate other end-uses.

The technology at Schools' TV facilities in Victoria was likened by its manager MG\_SchoolsTV to "digital lego blocks". He also stated that his unit was involved in a number of different projects, including one that made participants feel like they were part of a big community, even though they were not actually sitting in one. MG\_SchoolsTV also said there was a "radical shift in a lot of new technologies" which potentially opened up opportunities for commercial education. He pondered the related take-up rate of the particular technology by the end user, and the availability of the appropriate technological facilities to enable the end user to interact seamlessly. Furthermore, he stated that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes.

In addition, MG\_SchoolsTV spoke about how ITV could be used to build a "dynamic community model" which facilitated a greater understanding about other cultures and ways of doing things. He acknowledged the existence of arguments that there were other technologies that could also do this, but that he would argue that the richness of the ITV experience was very different. His viewpoint is reflected by Yuzer and Kurubacak (2011).

MG\_SchoolsTV also said that he encouraged his staff to push the applications to the n<sup>th</sup> degree, because it was not possible to make a mistake digitally, due to the ability to undo digital actions.

The ITRI research fellow, HM\_ResFellow, discussed the programs he had observed in his overseas travels, stating that he had noticed that interactive television was hampered by the current state of the technology. He qualified this by saying that consideration should be given to potential future rapid technology improvements, which could lead to cost reduction, time line reduction, and user-capability increases. He stated that ITV had not yet reached its enormous potential, but emphasised that ITV was simply a tool.

The manager of ITRI, DV\_ITRI, stated that, as technology entered a domain where interactivity became feasible, this suddenly allowed television to make the change from being curriculum centred to child centred. He also stated that the viability key for users of different ages and capabilities was that the technology be intuitive, so that users did not need to think about what they were doing.

There were a number of technology issues raised in the literature, some of which were not raised in the interviews. They comprised examination of some of the theories involved, and of technology use in various educational contexts. These are now summarised below, and the related literature is cited.

Technology-related theories were canvassed in the literature. One theoretical approach that underpins the current study was labelled as technological determinism (Hiltz, 1994), according to which the features of a hardware-software system decide user behaviour and a computer application's level of success.

Conversely, Gallant (2000, cited in Finley & Hartman, 2004) asserted that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics. While this is, of course, a pedagogically sound approach, in actual practice, teaching and learning issues are often not the sole drivers in selection of technologies for educational use.

Furthermore, Hiltz (1994) suggested that it may be reasonable to predict significant correlations between level of benefits and use of a system with the level of satisfaction with

the system, and that a technology should have the same impact, irrespective of the differences between classes it is used in.

McClelland (1987, cited in Thompson, Simonson & Hargrave, 1996) stated that University of Minnesota researchers investigated whether instructional television facilitated or constrained learning and teaching. Their findings included that teachers need training and practice to enable effective instructional television technology use, and a remote class may become invisible from the viewpoint of participation. While ITV technologies have advanced considerably since this study, so arguably diminishing the probability of remote classes being invisible, the importance of the need for teacher training has not lessened, irrespective of the technology at hand.

Evans, Stacey and Tregenza (1999) claimed that the expected reduction in teacher numbers pointed to the increasing importance of the role of technologies such as ITV in the context of learning. They suggested that the requirement for schools to implement a wide-ranging curriculum, and the expected reduction in the number of teachers, pointed to technologies such as ITV having elevated profiles. It can be argued that this suggestion is still as valid today as it was in 1999, particularly in light of the widespread ageing of the teacher workforce in Australia and other western countries, and teacher attrition rates alluded to, for example, by Pucella (2011). Pucella (2011) stated that while the school-age population continued to grow in the U.S., teacher attrition and retention problems meant that the teacher workforce did not. She quoted statistics from the 2003 U.S. National Council on Teacher Quality, indicating that, of the 50% of teacher graduates that actually made it to the classroom, 46% left within the first five years.

Fallahkhair, Masthoff and Pemberton (2004) studied the approaches and attitudes, to language learning and its supporting technologies, of independent adult learners at a UK university. The researchers stated that TV offered learners the opportunity to be engrossed in authentic learning materials relating to language and culture. Furthermore, a number of interesting findings emerged from the study. One finding was that usability of the technology was a problem, specifically mentioning usability of the remote control; this problem could conceivably be overcome by user training, if the user was willing.

#### ***5.2.1.7. Summary of responses to research question 1: The affordances of ITV that facilitate the design and delivery of socio-constructivist learning environments***

The responses detailed above in section 5.2.1. are summarised in the following paragraphs. Findings related to affordances, delivery, interface, problems, synchronous/real-time experiences, and technology are outlined.

ITV affords assessment or monitoring of user actions, engagement of users through a sense of ownership or control, and making the end user the focus rather than the content or delivery. It also has the potential to shift the central focus from curriculum to the user. The advantages of ITV include its closeness to the original content, security, stability, consumer perceptions, and the communication return path.

ITV also affords unique delivery options such as IPTV, the ability to match user characteristics, audience feedback capabilities, and flexible timing of delivery. Furthermore, audience feedback can directly influence the content being broadcast.

Interfaces for ITV have the flexibility to cater for various user expectations, age, and abilities, as well as being task-based and project-oriented. It is possible to avoid clutter on the TV screen by dividing it into functional areas.

In terms of synchronous and asynchronous access, ITV affords real-time learning experiences, interactivity via a back channel, asynchronous alternatives, the mirroring of how humans communicate, asynchronous resources being part of a package, recording and archiving, richer experiences, web and satellite environments, partially live programming, immediacy in educational experiences, emotional engagement, and creation of a sense of community. The synchronicity affordances may be limited by time zones.

There are two key ITV affordances with particular pertinence in terms of successfully delivering a socio-constructivist learning environment. These are that ITV can be used to bridge social barriers, and that ITV's strong ties to traditional television promote greater user familiarity with similar technological language. ITV also has the potential to deliver rich learning experiences, via intuitive interfaces.

Problems which may impact negatively on ITV-delivered learning environments include design and production factors, problems for users, limited IT skills of teachers, delivery problems, user disengagement, costs, varying platforms, inconsistency, need for alternative materials, political

issues, and authoring environment limitations. However, it should be noted that these problems are not unique to ITV, but are common to other ICTs.

### **5.2.2. Responses to research question 2**

Q2. What are the critical pedagogical characteristics of ITV program design and broadcast?

The findings relating to question 2 show that the respondents focussed on the themes of assessments, collaboration, communication, constructivism, design, learning, and pedagogy. This was similar to the literature, except that the themes of assessments and pedagogy in relation to ITV use were not explicitly raised in the literature review. The findings related to all except three of these themes are now discussed in more detail. The three themes of collaboration, communication, and design are common to both research question 1 responses and research question 2 responses, so are discussed in more detail in sub-section 5.2.3., which relates to both research questions.

#### **5.2.2.1. Assessments**

The interview responses concerning the sub-theme of assessments related to explicit and implicit assessment, and the placement of assessment tasks. AT\_SeniorAcademic stated that interactivity enabled explicit or implicit assessment, such as by logging user behaviour.

Furthermore, AT\_SeniorAcademic raised the educational design question of whether assessments of students should be carried out immediately after associated materials were presented. An example provided by MJ\_Hull of just such an approach was that of a STREAM-delivered lesson, for which the lesson's follow-up activity might be an assessment.

In the literature, online assessment methods have become increasingly focussed upon as time has progressed. Henke and Wuttke (2007) discussed reusable learning objects, with specific focus on assessment. They found that it was possible to successfully provide simple assessment tasks for European engineering students studying remotely, in the form of multiple choice tests and cloze passages. However, they also stated that it was very difficult to assess high-level knowledge in a web-based learning environment, and that it was not supported in usual learning management systems.

While IPTV, in particular, functions in a web-based environment, it can be argued that it is not, at this stage, a "usual" learning management system. Hence, there is room for further

investigation of the possible use of IPTV, and ITV generally, in effective assessment of high-level skills.

#### **5.2.2.2. Constructivism**

The two interviewees who raised the sub-theme of constructivism, Anon1\_EdExpert and MG\_SchoolsTV, expressed opposing views. Anon1\_EdExpert questioned the effectiveness of ITV in allowing users to construct their own knowledge, since it might provide limited choices. On the other hand, MG\_SchoolsTV stated that constructivism skills were brought into force in the interactive community, due to students accepting that they were part of a wider ITV community.

A number of findings relating to constructivism arose from the literature review. These included the viewpoint referred to regularly by respondents: that constructivism is important in the learning process (Duffy & Cunningham, 1996; Jonassen, Davidson, Collins, Campbell & Bannan Haag, 1995; Nicol, Minty, & Sinclair, 2003). In a review of literature relating to constructivism and communication in distance education, the concept of constructivist instruction being an oxymoron was coined (Jonassen & colleagues, 1995). The researchers asserted that learning should occur with the use of constructivist tools, in environments that foster socially negotiated meaning, rather than sequential instruction.

Other researchers, Nicol, Minty, and Sinclair (2003), claimed that social constructivism allows learners joint construction of knowledge and distribution across learning communities. The current study adopted those researchers' assumptions that knowledge is constructed by learners through engaging actively with texts, and through interacting and communicating with others. In other words, the researcher assumed that learners within the ITV learning environment construct their knowledge through engagement with the broadcasts and products available, and through talking to and interacting with other learners.

In 2008, Engstrom, Santo and Yost investigated an American student cohort in an online master's program in instructional technology, seeking to understand how the participants constructed knowledge about instructional theories and practices. They found that collaboration, particularly between students, was the best means of knowledge construction. This included collaboration via an ITV system during the first semester. The findings of Engstrom and colleagues (2008) support the researcher's assumptions, and also the views of



MG\_SchoolsTV that constructivism skills are brought into force in the interactive community. This indicates that ITV has the capacity to provide a constructivist learning environment.

#### **5.2.2.3. Learning**

The interview responses concerning learning focussed on the key ideas of engagement, multiple technologies, non-passivity, the learning process, the broadcast element, STREAM, a blended learning experience, a structured learning experience without information overload, a video conference based application, and early childhood learning.

The umbrella issue when adapting programs for ITV, according to AT\_SeniorAcademic, was engagement, either in terms of enjoyment or learning. He stated that ITV could potentially enhance the learning environment, compared to video-conferencing, by providing information not available via video-conferencing. AT\_SeniorAcademic also claimed that some of the most successful ITV applications had used multiple technologies, with a general objective such as learning.

Anon1\_EdExpert indicated that, in their opinion, the stigma of being a passive activity did not apply to interactive TV, since it afforded a more active experience to the learner.

According to the manager of the UK ITV service STREAM, MJ\_Hull, ITV was a learning resource that could engage people who were functionally illiterate and innumerate. He said that the IP based TV service STREAM was developed to carry out functions such as personalizing the learning experience. He also stated that the ITV service was the product, the important part being the learning process behind its generation, and that the broadcast element was critical in engaging groups who otherwise had no interest in learning. MJ\_Hull said that this focus on process gave ITV a huge advantage over videoconferencing.

Furthermore, MJ\_Hull stated that STREAM was fundamentally different to other ITV systems, providing immediate access to relevant learning resources to users who logged in, and enabling self-directed learning and research. He also said that STREAM was based on concepts of lifelong learning.

MJ\_Hull also stated that ITV should be “part of a blended learning experience”. He said that STREAM was not a traditional broadcaster model, but “a whole change management model” based on making content, being involved, and being more willing to watch the learning

content. He also said that STREAM delivered a type of “virtual learning environment”, including brief stimulus materials and follow-up activities, underpinned by learning objectives.

According to MJ\_Hull, the learning experience needed to be structured, without delivering an overload of information. He also said that IPTV presented a new set of learning on top of what could be delivered by ITV.

The Schools’ TV manager, MG\_SchoolsTV described a unique video conference based learning application which enabled a simultaneous one-to-one and one-to-many broadcast, during which students could participate by phone. He stated that Schools’ TV producers collaborated with the Victorian Office of Learning and Teaching, to create interactions that met educational objectives.

ITV potential for early childhood learning was HM\_ResFellow’s research speciality. He said that normal television had the barrier of not knowing its audience, or how a program was being received. However, he said that interactivity facilitated viewer engagement, likening ITV to a tool that provided a “lean forward” model. He said that ITV had enormous potential in the field of education, including in allowing young children to see the consequences of their actions.

The manager of ITRI, DV\_ITRI, also referred to preschoolers’ learning, discussing ITRI’s research into whether they understood narrative, and stating that their learning opportunities could be maximised by provision of various streams of narrative.

References to the underlying learning theories for the current study were sought in the literature. It was found that in a study such as the current one where the main focus is on interactive learning environments, it is clear that what is likely to underpin it is a Vygotskian social constructivist theory of learning. For example, Almala (2006) states that:

The principles of constructivism meet the theoretical demands of a quality e-learning environment...students use their prior knowledge and the knowledge of their peers and instructor to enrich the class discourse and negotiation process and, therefore, find the appropriate solutions to the problem on hand. This learning process is founded, acknowledged, and supported by the principles of [Vygotskian] social constructivism. (p.35)

A special type of learning community, the virtual community, exists in the realm of distance learning, which is one of the topics explored in the current study. There are theories which

relate to distance learning which fall under the umbrella of social constructivism, such as Holmberg's theory of distance teaching which alludes to the need for learners to be engaged in discussions and decisions, in order to facilitate effective learning (Cavanaugh, 2001).

This relates to the current study since ITV involves distance teaching and often involves synchronous and asynchronous communication to and from learners.

Other learning issues were raised in the literature. For example, Cavanaugh (2001) carried out a quantitative meta-analysis of various studies, published between 1990 and 1998, of interactive distance education utilizing videoconferencing and online telecommunications. Cavanaugh's argument that, as interactive distance education usage increases and there is a development of expertise, an increase in academic gains can be expected, indicates the need to maximize such gains, including those potentially enabled by ITV. Possible academic gains may be facilitated by one of the benefits of distance learning, that close physical proximity is not needed to form effective learning communities (Cavanaugh, 2001).

Within distance learning, learning communities are often virtual, meeting across cyberspace. According to Nicol, Minty and Sinclair (2003), social theorists such as Lave, Wenger, Resnick and Mayes generally agree that knowledge is constructed jointly and is spread across learning communities. Research into learning online suggests that online environments differ from face-to-face environments on a range of counts/characteristics, including the creation of virtual communities consisting of students, teachers and experts. For example, Pincas (2000) asserted that the social features of learning within online environments differ inevitably from those in face-to-face environments.

Nicol, Minty and Sinclair (2003) conducted research into the social features of learning online, in the context of the University of the Highlands and Islands Millennium Institute (UHIMI), a partnership of 11 further education colleges and two research institutions in Scotland. Experiences of students and tutors during delivery of an online module were evaluated. Asynchronous online discussions were held and analyzed. Nicol and colleagues (2003) found confirmation that the social context of face-to-face learning differs qualitatively from online learning, and concluded that this has considerable implications for the design of online learning. Similar research needs to be carried out on the virtual communities of ITV learning environments, particularly since much of the interaction within these communities is synchronous, rather than asynchronous. Whereas the participants in the Scottish study could

not see or hear each other, it is likely that research on virtual communities in ITV environments might indicate that the social context of face-to-face learning will not differ qualitatively to the same extent, since participants will be able to see and hear each other in real-time.

Computer supported learning environments were studied by Newhouse and Rennie (2001), who completed a longitudinal study of school classroom environments. They found that learning opportunities were not generally enhanced by the use of the computers.

However, it has also emerged from the literature that research has shown that multimedia use can radically improve student learning (Facciola, 1997, cited in Evans & Sabry, 2003; Wallace & Mutooni, 1997, cited in Evans & Sabry, 2003).

Abrams and Streit (1986, cited in Thompson, Simonson & Hargrave, 1996) compared the effectiveness of interactive video to linear video, for teaching basic photography to students majoring in education. The study found that interactive video use had a larger impact on attitude than on achievement. Significantly greater achievement gains by the interactive video group were indicated, with researcher speculation that this was due partly to attentiveness level required of the learner, with “tuning out” more likely in the case of linear video. The lack of opportunities for practice and review were cited, by the linear video group, as shortcomings of the linear video. Anandam and Kelly (1981, cited in Thompson, Simonson & Hargrave, 1996) asserted that interactive video transforms the student from being a passive observer to being an active participant. Findings such as these have implications for ITV, due to some its features being comparable to those of multimedia.

Thompson, Simonson and Hargrave (1996) state that ‘[d]etermining effective ways to teach students how to learn in hypermedia [or multimedia] environments will be an important research agenda for the future” (p.53). This resonates with the aims of the current study.

Four case studies carried out by the department of vocational and technical education at the University of Minnesota investigated how learners and teachers interacted in classes held in a two-way instructional television context (McClelland, 1987, cited in Thompson, Simonson & Hargrave, 1996). The researchers also investigated whether instructional television facilitated or constrained learning and teaching. Their findings included that the lesson flow did not appear to be significantly affected, teachers need training and practice to enable effective

instructional television technology use, and a remote class may become invisible from the viewpoint of participation.

Fallahkhair, Masthoff and Pemberton (2004) studied the approaches and attitudes, to language learning and its supporting technologies, of independent adult learners at a UK university. A number of interesting findings emerged from Fallahkhair, Masthoff and Pemberton's (2004) study. Participant suggestions included the greater exploitation of the potential of subtitles, labels being attached to screen objects, the development of interactive language learning games, and the use of built-in communication facilities to enable 'post-programme conversations in the target language with other learners or native speakers' (p.4342). Conclusions reached by the researchers included that interactivity enhancements should be added to existing programs rather than developing TV programs specifically for language students, various levels of multimedia support could be provided according to the viewer's choices, fixed program timeslots help motivate users to learn, and learner contact with other people increased motivation.

#### **5.2.2.4. Pedagogy**

The interview responses concerning pedagogy focussed on the key ideas of using a context-appropriate pedagogical model, the pedagogical philosophies of individual educators, limitations, collaborative and constructivist learning, and engagement.

For use in ITV, AT\_SeniorAcademic recommended the choice of a pedagogical model that was case-appropriate, as well as careful consideration of how a good pedagogical model could be defined in relation to the ITV context.

Anon1\_EdExpert reflected on the need to acknowledge the pedagogical philosophy of individual educators when making judgements about the affordances of TV and ITV. He/she discussed the critical pedagogical characteristics of ITV program design and broadcast, including what he/she referred to as the limitations regarding construction of knowledge by users.

In contrast to this, the Victorian Schools' TV manager MG\_SchoolsTV stated that correct pedagogy such as collaborative and constructivist learning could be supported by ITV, since students accepted that they were part of a wider community.

However, according to the UK STREAM manager MJ\_Hull, the only problem pedagogically with ITV occurred when people failed to see it as part of a blended, multi-faceted learning experience.

HM\_ResFellow contrasted the classroom experience, television, and interactive television, concluding that ITV could provide an engaging product.

The theme of pedagogy was raised in the literature review. Gallant (2000, cited in Finley & Hartman, 2004) asserted that any adoption of technological innovations should be driven by teaching and learning issues rather than by technological determinism or economics. While this is, of course, a pedagogically sound approach, in actual practice, teaching and learning issues are often not the sole drivers in selection of technologies for educational use.

#### ***5.2.2.5. Summary of responses to research question 2: The critical pedagogical characteristics of ITV program design and broadcast***

The responses detailed above in section 5.2.2. are summarised in the following paragraphs. Findings related to assessments, constructivism, learning, and pedagogy are outlined.

Explicit or implicit assessment, such as by logging user behaviour, can be carried out during ITV program use. Assessments of students can be carried out immediately after associated materials have been presented.

Learning should occur with the use of constructivist tools, in environments that foster socially negotiated meaning, rather than sequential instruction. Constructivist skills can be brought into force in the interactive community, due to students accepting that they are part of a wider ITV community. It is possible for learners within the ITV learning environment to construct their knowledge through engagement with the broadcasts and products available, and through talking to and interacting with other learners. Such interaction with other learners can increase motivation to learn.

An ITV program/broadcast should provide a blended learning experience. It should be a structured learning experience without information overload. A key issue when adapting programs for ITV is engagement, either in terms of enjoyment or learning. Some of the most successful ITV applications use multiple technologies, with a general objective such as learning. They should provide a more active experience for the learner.

ITV is a learning resource that can engage people who are functionally illiterate and innumerate. The broadcast element is critical in engaging groups who otherwise have no interest in learning. The ITV learning experience can be personalized. ITV can provide immediate access to relevant learning resources to users, and may enable self-directed learning and research. It can enable lifelong learning.

Learning opportunities for young children should be maximized by provision of various streams of narrative. They should have opportunities for interaction that allow them to see the consequences of their actions. The amount of text should be limited.

ITV programs can be enhanced by the use of subtitles where appropriate, labels being attached to screen objects, the development of interactive learning games, and the use of built-in communication facilities. One cost-effective approach is for Interactivity enhancements to be added to existing programs. Various levels of multimedia support can be provided according to the viewer's choices.

An ITV program should be based on a good, context-appropriate pedagogical model, while acknowledging the pedagogical philosophies of individual educators. It should aim to enable collaborative and constructivist learning across wider communities, where possible. Pedagogically, ITV needs to be seen as part of a blended, multi-faceted learning experience.

### **5.2.3. Themes relating to both research questions 1 and 2**

The themes that related to both research questions 1 and 2 were collaboration, communication, and design. The findings relating to these three themes are now discussed in more detail.

#### **5.2.3.1. Collaboration**

The interview responses concerning the sub-theme of collaboration focussed on the key ideas of collaboration between academics and broadcasters, student, parent and teacher collaboration, community-based collaboration, and professional collaboration.

AT\_SeniorAcademic described how collaboration occurred to bring ITV to a remote community, and to produce learning resources for ITV broadcasts. Collaboration between professionals, which facilitated interactions being anchored into planned educational outcomes, was also described, by MG\_SchoolsTV.

In the literature review, researchers claimed that ITV could facilitate collaborative learning (Roberts & Herrington, 2005).

#### **5.2.3.2. Communication**

The interview responses concerning communication focussed on the key ideas of outward and inward bound communications, the technology involved, the pedagogy, and synchronous communication.

More specifically, AT\_SeniorAcademic gave responses regarding communication that referred to transmission of emergency public messages, back-channels for use by Indigenous users and students generally. A comparison of video-conferencing and communicating via ITV was made by MJ\_Hull. AT\_SeniorAcademic discussed technicalities of communication, while Anon1\_EdExpert focussed on communication of learners' critical reflections on their interactive experience. MG\_SchoolsTV and Anon2\_ITV\_Expert raised the importance of synchronous communications that was tied into contemporary expectations of immediacy in communication. Their comments were supported by Engstrom and colleagues (2008). While most of the communication in the online master's program studied by Engstrom and colleagues (2008) was asynchronous, some took place synchronously via ITV, and some took place in face-to-face informal study groups.

There were a number of communication issues raised in the literature, some of which were not raised in the interviews.

Nicol and colleagues (2003) found:

Again a tension can be noted between 'normative' and emerging interaction patterns. When modes of communication are new then it is natural for both students and tutors to seek ways of anchoring new interaction patterns in the familiar (p.275).

Evans, Stacey and Tregenza (1999) suggested that

[while] usage [of ITV] in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers – particularly in specialist areas such as languages other than English – points to ITV, and other communications and computer technologies, adopting a higher profile. (p.214)

Themes that emerged from the first year of the 1999 Evans, Stacey and Tregenza study included the increasing integration of electronic communication with ITV media.



Gawlinski (2003, cited in Fallahkhair, Masthoff & Pemberton, 2004) claimed that the TV experience can be further enhanced by interactivity, which facilitates communication and new ways of retrieving information.

Suggestions from participants in Fallahkhair, Masthoff and Pemberton's 2004 study included the greater exploitation of the potential of subtitles, labels being attached to screen objects, the development of interactive language learning games, and the use of built-in communication facilities to enable 'post-programme conversations in the target language with other learners or native speakers' (p.4342).

#### **5.2.3.3. Design**

The interview responses concerning the design of ITV focussed on the key ideas of appropriate content and delivery, objectives, evaluation of the design, pedagogical considerations, the call to interact, a cautious approach, and the affordances of ITV. The interviewees also discussed the interface, simulation tools, relevance of interactivity, intuitiveness of use, consistency, user needs, whetting the appetite of users, design simplicity, and the concept of a TV centric paradigm.

The inter-relation between design and delivery methods was discussed by MJ\_Hull and MG\_SchoolsTV. An example given of this, by MJ\_Hull, was that the STREAM system was designed to allow a lesson to be broadcast straight from a school into homes, in order to benefit students who could not attend school, and to allow them to participate interactively in the lesson. In this context, the inability of students to attend school was not based on the premise of living in geographically remote locations. However, in countries such as Australia and Canada, the geographical remoteness of rural students, for example, would be a key indicator of the potential applicability of this type of technology.

The design and development difficulty of providing users with a satisfactory depth and range of information, under a restrictive delivery system, was raised by MJ\_Hull. The timing of interaction opportunities was discussed. For example, the fact that most interaction opportunities came at the end of Schools' TV programs was tempered by the acknowledgement by MG\_SchoolsTV that there were a number of set audience-appropriate formulas for delivery.

AT\_SeniorAcademic stated that there was a need to find the relationships between the elements of pedagogy, hardware, and design, in order to develop a “map” as a first step to producing a descriptive ITV model.

Anon1\_EdExpert recommended that new designers should take a cautious approach of waiting to see what the big TV networks did. This caution was also partly attributable to the stated perception that teachers were not fully exploiting the interactivity available on the Internet, at the time of interview.

MJ\_Hull, CW\_ABCTV and MG\_SchoolsTV considered the affordances of ITV in relation to design. MJ\_Hull claimed that an ITV program could not be thought of as a Web experience or as a formal learning experience, and that consideration should be given to what the television medium provided that other areas could not. For example, while acknowledging that calling up various video streams on demand could simply be done online, according to CW\_ABCTV the ABC interactive television showcase could only have been done in an IPTV environment. MG\_SchoolsTV advised that new ITV program designers needed to firstly be aware of what the technology could deliver in such an innovative field, with the ultimate consideration of “what is the end user seeing and what are they experiencing?”

Interface design was raised by AT\_SeniorAcademic and CW\_ABCTV. AT\_SeniorAcademic claimed that user-interface design should be ‘task-based and user-centred’. While CW\_ABCTV stated that ABC staff had designed an information display template with “TV-friendly” fonts and colours, which completely differed from the online version he stated that he did not think that it really interested the viewers, and that the providers were still “some distance from understanding what could be truly engaging about that kind of interactive television”. CW\_ABCTV also recommended that navigation design should be kept “very simple and really obvious”, and that big help screens for users should not be needed.

Simulation tools were pointed to by CW\_ABCTV and HM\_ResFellow as being useful in assisting in design. DV\_ITRI stated that ITRI was using a stable simulation environment for research testing then passing on its findings to industry consortium engineers so engineers could build resultant designs.

As well as Anon2\_ITV\_Expert suggesting that interactivity relevance for users was a key design characteristic of ITV programs, he/she also suggested that ITV use should be intuitive, in line with technology people had used previously.

Consistency was given by HM\_ResFellow as a key characteristic of ITV program design, with reasons cited such as enabling user familiarity, and saving money on the cost of design and development. Another design hint that he suggested was the provision of verbal cues to very young audiences.

Users' needs were discussed by HM\_ResFellow and DV\_ITRI. HM\_ResFellow recommended consideration of whether users simply wished to relax, and not be forced to take action, and whether they preferred escapism or sometimes calls to interaction. DV\_ITRI raised design factors such as the particular market with associated user experiences and expectations, individual factors such as age and confidence in technology use, and demographic factors that shaped the space. Consideration of the emotional needs versus the functional needs of users was also crucial in ITV program development, according to DV\_ITRI.

DV\_ITRI strongly recommended that ITV program design should be carried out from a "TV centric paradigm" rather than a "web paradigm". He also asserted that appropriating the normal television viewing experience and adding an educational opportunity around it, and then taking this to children and students in various settings, was revolutionary.

There were design issues raised in the literature, some of which were raised in the interviews, and some were not. Nicole et al (2003) claimed that the social context of face-to-face learning differs qualitatively from online learning, and concluded that this has considerable implications for the design of online learning. This would also have implications for ITV, due to its similarities to online learning in terms of social context.

Thompson, Simonson and Hargrave (1996) found that many researchers have focussed on finding effective ways of designing computer-based learning experiences. According to Criswell (1989, cited in Thompson, Simonson & Hargrave, 1996), issues studied include student-computer interface design, lesson sequencing, interactions, evaluation, and revision.

Fallahkhair, Masthoff and Pemberton (2004) asserted that an essential component of learning software design should be familiarity with learner behaviours, attitudes and beliefs. This is similar to findings from the interviews.

#### ***5.2.3.4. Summary of responses relating to both research questions 1 and 2***

The responses detailed above in section 5.2.3. are summarised in the following paragraphs. Findings related to the common themes of collaboration, communication and design are outlined.

The interview responses concerning the sub-theme of collaboration focussed on the key ideas of collaboration between academics and broadcasters, student, parent and teacher collaboration, community-based collaboration, and professional collaboration. Such collaborations are afforded by ITV, and indeed are necessary for the pedagogical success of ITV broadcasts.

The interview responses concerning communication focussed on the key ideas of outward and inward bound communications, the technology involved, the pedagogy, and synchronous communication. The provision of a back-channel is an important affordance of ITV, in order to facilitate and deliver a socio-constructivist learning environment. Synchronous communication is an important affordance of ITV, particularly in light of contemporary expectations of immediacy in communication. This is supported by the literature, in studies such as Engstrom and colleagues (2008).

There were a number of communication issues raised in the literature, some of which were not raised in the interviews. For example, it was stated that, when using new methods of communication, users will try to call on their experiences of using familiar communications methods (Nicol et al, 2003). ITV affords such behaviour by its proximity to the widely familiar pre-existing communication technology of television. This familiarity should be taken advantage of when designing and delivering ITV programs and broadcasts.

It was stated in the literature that the requirements for schools to deliver a diverse curriculum, and the anticipated drop in teacher numbers, pointed to ICTs having greater importance (Evans, Stacey & Tregenza, 1999; Pucella, 2011). ITV affords the potential to design and deliver rich learning experiences to students, and a different, engaging means of delivering curricula to students. Before it can do that though, numerous barriers need to be overcome.

The interview responses concerning the design of ITV focussed on the key ideas of appropriate content and delivery, objectives, evaluation of the design, pedagogical considerations, the call to interact, a cautious approach, and the affordances of ITV. The interviewees also discussed the interface, simulation tools, relevance of interactivity, intuitiveness of use, consistency, user

needs, whetting the appetite of users, design simplicity, and the concept of a TV centric paradigm. An attempt to translate these design-related responses into guidelines for the design and development of educational ITV applications and programs has been made in Section 5.3 of the current report.

ITV allows a lesson to be broadcast straight from a school into homes, in order to benefit students who cannot attend school, and to allow them to participate interactively in the lesson. Furthermore, in countries such as Australia the geographical remoteness of rural students, for example, would be a key indicator of the potential applicability of this type of technology.

The timing of interaction opportunities needs to be appropriate according to the overall format of the program/broadcast. If a broadcast is broken up into small packages, then it may be acceptable/desirable for interaction opportunities to take place throughout the broadcast. However, users may not want to have a viewing experience interrupted by an interaction opportunity, particularly if the broadcast is streaming in such a way that they will miss part of the program if they choose to pursue the opportunity for interaction.

It is necessary to find the relationships between the elements of pedagogy, hardware, and design, in order to develop a plan as a first step to producing a descriptive ITV model. Interactive programs produced by the major TV networks, such as BBC-TV's 'Walking with Dinosaurs' can be looked at by designers as potential proven models for further design of ITV programs. The over-riding consideration is the end-user's experience.

The user interface for an ITV program should be designed to be task focussed and user-centric. Navigation design should be simple and intuitive. Simulation tools can be useful in assisting in design. Such simulation tools also provide a potential way of avoiding costly mistakes.

Interactivity relevance for users is a key design characteristic of ITV programs, and ITV use should be intuitive, in line with technology people have used previously. Consistency is a key characteristic of ITV program design, in order to enable user familiarity, and save money on the cost of design and development. Verbal cues could be useful for very young audiences.

User needs are paramount. Other design factors to be considered include the particular market with associated user experiences and expectations, individual factors such as age and confidence in technology use, and demographic factors which shape the space. Consideration

of the emotional needs versus the functional needs of users is also crucial in ITV program development.

It is advisable for ITV program design to be based on a TV prototype rather than a web prototype. A normal television viewing experience can have an educational opportunity added around it.

A key finding from the literature was that an essential component of learning software design should be familiarity with learner behaviours, attitudes and beliefs (Fallahkhair, Masthoff and Pemberton, 2004). This may then facilitate the design and development of ITV applications and programs that users will have an immediate affinity with. This is similar to findings from the interviews.

### **5.3. Guidelines for ITV Design**

A number of guidelines for the design of educational ITV applications and programs have emanated from the data generated by the current study. These guidelines have been listed in point form below. While the guidelines are numbered for ease of reference, they are not in any particular order, and the numbering does not infer level of importance.

1. Navigation should be simple and the method of use obvious.
2. Big help screens for users should not be needed.
3. In order to avoid expensive and time-consuming mistakes, simulation tools should be used to assist in design.
4. Interactivity should be relevant for users. This becomes more difficult when there is more than one target audience, for example, young students and their parents.
5. ITV use should be intuitive, in line with technology people have used previously.
6. User experiences and expectations should be taken into account. Key individual factors to consider include confidence in technology use, and demographic factors such as age and socio-economic context. In other words: know your audience.
7. The program should be well-researched prior to deployment.

8. Design generally should be simple.
9. Engagement of viewers is paramount. This includes whetting the appetite of viewers for the interaction.
10. Consistency is a key characteristic, in order to enable user familiarity, and save money on the cost of design and development.
11. Verbal cues should be provided to very young audiences.
12. Systems capable of working across different platforms are critical.
13. Design should be carried out from a television paradigm rather than a web paradigm.
14. Relationships need to be found between the elements of pedagogy, hardware, and design.
15. Appropriate content and delivery methods require clarity of the objective, user characteristics, and user needs.
16. Effective evaluation of programs is necessary. This may enable iterative improvements to designs.
17. Avoid placing calls to interaction at inappropriate points in a broadcast, for example where the tension in a documentary program is building to a specific climax. May often be best to hold the call to interaction until the end of the program.
18. Consider what the end user is seeing and what they are experiencing.
19. Numerous applications are possible, including that of broadcasting lessons straight into homes.
20. Consider users' existing knowledge and expectations of other technologies, in particular non-interactive television.
21. Use IPTV technology, not less sophisticated forms of ITV technology.
22. Avoid emulating a PC type of experience, with too much text, noise and screen cluttering.
23. Use "TV-friendly" fonts and colours.

24. Extract educational opportunities from existing non-education-related content.
25. Provide a fluid non-linear model.
26. Prepare the viewer to interact competently.
27. Provide opportunities for synchronous and asynchronous communication by users.
28. Provide users with a satisfactory depth and range of information.
29. Integrate online assessment methods.
30. Develop reusable learning objects.
31. Consider the method of interaction, such as remote control.
32. Consider what you want users to do.
33. Consider the type of program.
34. Consider the objectives of the program.
35. Attempt to trigger a “lean-forward” response by users.
36. Prototype the design and test thoroughly with people, using a whole sequence of testing procedures.
37. Visit websites such as Broadband Bananas to see what is already being done in the ITV arena. While ITV examples from websites such as this do not generally have an educational focus, the information gleaned from such websites has the potential to be adapted for use in the field of education.

#### **5.4. Conclusions**

The current study is an attempt to provide educators with some idea of what interactive television, in various guises, is capable of, and to provide insight from a range of respondents with expertise in the area. These concluding paragraphs provide a brief précis of findings, and an overview of predictions for the future of ITV. The latter have provided a basis for recommended future research.



To some extent, the context of this study has changed, as technology has advanced over the past five years. This is particularly the case with the Schools' TV operation in Australia that became defunct partway through the current study, apparently mainly due to financial reasons. However, the STREAM case study in Hull, U.K., was and still is cutting-edge. STREAM has since expanded beyond local schools ITV service provision to projects such as providing an IPTV service to the elderly, as documented in the literature review. The contributions of ITRI, the focus of the third case study, are still as valid today as when the current study was instigated.

The foremost current incarnation of ITV is IPTV (Internet Protocol Television), which by definition is a convergence of the Internet and interactive television, hence providing a blended environment. But can ITV successfully provide a blended **learning** environment? The current study has found that it may be possible to provide a successful blended learning environment, particularly as demonstrated by the STREAM program in Hull.

In order to assist teachers in using ITV in a pedagogically sound manner, further incremental research needs to be carried out, and guidelines provided for successful implementation of ITV as an effective learning tool. Comprehensive training for educators, such as teachers, is recommended by the researcher as a fundamental requirement for success in the educational applications of ITV.

The experts participating in the current study made a number of predictions regarding the future of ITV. These expert comments are as relevant today as they were when originally made. They also provide useful pointers for future research topics. A summary of these responses follows, and fittingly provides important concluding comments for this final chapter of the current study.

The interview responses concerning the future of ITV focussed on the key concepts of education of the general public, delivery via more devices and platforms, student access to more virtual environments, building of global communities, tailoring for needs of individual users, development of different models, and increased extraction of learning experiences from non-education-related TV programs.

AT\_SeniorAcademic predicted that ITV technology could be advantageous, in the future, for education of the general public. He stated that he would like the development of ITV to be useability-driven rather than fashion-driven.

MJ\_Hull talked about the planned expansion of study resource delivery to mobile phone, and about the importance of the continued building of cross-platform-capable technology.

According to MG\_SchoolsTV, future ITV technologies would enable students to get into environments that were impossible for them to physically enter, and new ITV technologies would allow such boundaries to be pushed even further.

MG\_SchoolsTV talked about using ITV to build global communities, arguing that it was a richer medium to use for this purpose than other technologies. He also stated that an ITV system could be pushed to tailor for the needs of individual users. MG\_SchoolsTV said that the biggest issue was breaking the mindset of how TV was traditionally created, in order to work towards a fluid non-linear model. He said that part of this process was asking what would happen if something different was done with the technology, but that while few environments were willing to take that risk, education could do so.

In his discussion of interactive TV authoring environments, DV\_ITRI said that the main available systems resulted in problematic boundaries for ITRI. He described the potential impact of ITV on education as “huge”, but said that for financial reasons ITV use worldwide in education was underdeveloped. DV\_ITRI expressed his excitement that educational opportunities could be extracted from much non-education-related TV content. DV\_ITRI predicted a major revolution in television viewing.

Anon2\_ITV\_Expert stated that, with sufficient investment of money, time and effort, ITV has the potential to do “amazing” things.

Based on the predictions of the respondents listed above, interactive television is looking like becoming ubiquitous in the future. The relevance of my study to these predicted future changes is its provision of an overview of the status of ITV in the field of education, both from the points of view of the respondents, and from the literature.

The current study promulgates the idea that interactive television (ITV) is at the cutting edge of the new-generation of distance delivery technologies. It is acknowledged, however, that the bulk of the primary data was gathered in 2005. In an attempt to offset this shortcoming, more recent literature has been reviewed during the later stages of the research process.

Generally speaking, there has been an exponential increase in the amount of ITV-related literature available now, compared to the very limited amount published when the current

study began. This was immediately evident to the researcher by carrying out library catalogue database searches, and online searches. For example, when the researcher carried out a search last year using the key term “interactive television” via the online University of Wollongong Library Summon application, it returned 39 805 results. When the researcher refined this search to the key terms “interactive television and education”, it returned 3,790 results. When the researcher limited this search to articles from scholarly publications, including peer-reviewed, it still returned 905 results. However, more detailed searching and reading through a sample of this literature revealed that it is still difficult to find empirical research on educational use of current ITV technology.

This indicates that ITRI’s concern in 2003 that the rapid development of the innovative technology of current-generation ITV, and its subsequent use in learning environments, had not been informed by empirical research into its uses in the field of education, is still as relevant today. Therefore, while some researchers are beginning to address this shortcoming, much more needs to be done.

The researcher recommends particularly that further research should be carried out on Internet Protocol television [IPTV]. The state-of-the-art STREAM projects in Hull, England, would provide ideal opportunities for empirical studies. The current study comprised the obligatory literature review, as well as observations and interviews. Future studies could incorporate surveys of IPTV users, either online or paper based, in order to seek feedback such as recommendations for improvement.

The focus of the current study was efficiency. In order to achieve this aim, the interviews were semi-structured, which resulted in limitations to some extent. Future studies could involve less structured interview schedules.

The current study has found that participants will often attempt to interact in ways in which they are used to, regardless of the more ‘high-tech’ means available to them in new technologies. However, it has also found evidence of the ability of users to adapt, based on the ongoing success of STREAM in the U.K. The phenomenal rise of social networking media, such as Facebook (Inc), also indicates the ability of users to adapt to new technologies. This needs to be investigated further.

While the current study is qualitative, quantitative studies have the potential to be of use to educators. For example, user action logging software, such as that used by ITRI, could be used

to count the number of times certain actions are carried out. This could then be used as the basis for incremental and iterative improvements to existing programs and interfaces.

The current study focuses largely on the use of ITV for children of various ages. Future studies could investigate the role of IPTV in educating tertiary students, vocational students, the general public, employees, and/or the elderly.

In response to DV\_ITRI's statement that the motivation for people to watch television tended to be emotional rather than functional in character, and that consideration needed to be given to "how to embed [the functional aspects] within an emotional experience" even when approaching from an educational perspective, future studies around the emotional experiences of ITV users need to be carried out.

In conclusion, as mentioned previously, there are limitations on the amount of available research in the field of ITV and education. The current study seeks to make a contribution to the existing research literature in this field, but more studies are needed.

The final word goes to one of the respondents in the current study, HM\_ResFellow. In 2005, when discussing the current state of ITV technology, he stated "that is a rapidly evolving thing in itself in that things we can't do this year we can probably do next year and you need to keep a really open mind about that."

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## Appendices

### APPENDIX 1: Glossary of terms

Term	Definition
A priori	Before
ACARA	The Australian Curriculum, Assessment and Reporting Authority (ACARA) is the independent authority that is responsible for the development of the Australian national curriculum.
Affordance	Affordances are the elementary properties that establish how something can be used
Asynchronous	Two or more events which are not happening at the same time
BAFTA	British Academy of Film and Television Arts
Cyberspace	The imaginary environment in which communication takes place via computer networks
Desert Knowledge CRC	Desert Knowledge Cooperative Research Centre
Digital immigrant	Person born prior to digital natives. Often described as having to try to catch up with digital natives in the understanding of technologies.
Digital native	Generation of people who are described as having been immersed in technology all their lives, so being familiar and reliant on information and communication technologies. Years of birth vary from source to source: approximately 1970s to 1980s.
Distance learning	A learning environment where the instructor is typically in a different geographical location to the learner(s)

DisWBLC	Distributed web-based learning community
Ego-sufficing behaviour	Term coined by HM_ResFellow, related to the idea that people would look more favourably on a choice which they were able to select themselves, and in which they could have an emotional stake.
Epistemology	The theory of knowledge
Heterogeneous	Dissimilar in nature
Hypervideo	Video with embedded links
ICT	Information and communication technology
IMPARJA	'Imparja is a private, fully commercial television company registered in the Northern Territory, Australia. It is totally owned and controlled by Northern Territory and South Australian Aboriginal shareholders. Imparja (pronounced IM-PAR-JA) is the anglicised spelling and pronunciation of the word Impatye, meaning tracks or footprints in the Arrernte language. Arrernte (pronounced AH-RUNTA) is the traditional tribe and language of the Alice Springs region.' (IMPARJA, 2011)
Indigenous user	Native user. In the context of this study, however, specifically refers to Australian Indigenous (Koori) user.
IP	Internet protocol
IPTV	Internet protocol television: current generation ITV
ITRI	Interactive Television Research Institute, located at Murdoch University in Western Australia
ITV	Interactive television
KIT	Kingston Interactive Television (the predecessor to STREAM in Hull, U.K.)
Meta-analysis	The statistical analysis of the combined

	results of a number of research studies
MHP	Multimedia Home Platform, an open middleware system standard, which enables the receipt and execution of interactive applications on a TV set
Middleware	Software that enables clients and servers to communicate
PC	Personal computer
Pedagogy	Pedagogy comprises the principles and methods of teaching
PVR	Personal video recorder
Social constructivism	Theory of learning within which learners engage with available texts, and work together to construct their own knowledge.
STREAM	IP based television service, centred in Hull, U.K.
Synchronous	Two or more events that are happening at the same time. Also known as real-time.
TAMALLE	Television and mobile phone assisted language learning environment
Technological determinism	The theoretical approach in which the features of a hardware-software system influence user behaviour and the level of success of a computer application
TiVo	Digital video recorder that enables access to digital television. [Pronounced 'Tee-voh']
UI	User interface
Value proposition	A marketing term. A statement that summarises why a consumer should use a service. The proposed value to be delivered to the customer or user.
Videoconferencing	Synchronous conference between two or more parties across geographical distances, via technology incorporating video and audio

	capabilities
Virtual community	A community that is not physically/geographically gathered in the one place. Instead it meets across distances by technologies such as the Internet and video-conferencing
Walled garden	Closed information services provided to users, with restricted access to content and applications. Particularly useful for providing suitable content for children.
WebCT	A course management system used for online learning.
ZPD	Zone of proximal development, as defined by Vygotsky. The difference between a learner's existing independent ability, and potential ability when assisted by more highly skilled others.



## **APPENDIX 2: Information sheet provided to participants**

### **An investigation of the educational applications of interactive television**

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Master of Education Research Proposal Summary Sheet

**Postgraduate Student:** Jann Roberts

**Supervisors:** Professor Barry Harper, Associate Professor Jan Herrington

#### **Abstract**

The proposed research entails an investigation into the educational applications of interactive television (ITV). It will comprise a multiple case study, consisting of 3-4 cases of ITV production units, as well as interviews with experts in interactive television. The methodology will be predominantly qualitative. Data collection methods will include reading appropriate literature, observing ITV production units, observing ITV broadcasts, and interviewing practitioners. Unique characteristics and affordances<sup>2</sup> of ITV will be explored, and guidelines for effective educational use of interactive television will be developed for use by educators.

#### **Selection of cases**

Three ITV sites, specifically school, university, and commercial, will be selected by a purposive sampling method, to allow 'planned comparisons along certain potentially important dimensions' (Schofield, 1990, p.213). Specifically, critical cases will be selected from the literature so that 'logical generalization and maximum application of information to other cases' can be permitted (Miles & Huberman, 1994, p.28). Optimal, fully-operational, state-of-the-art examples of each case will be selected, in Australia if possible. The availability of sites to be sampled is very limited due to the lack of existing ITV facilities.

#### **Processes subsequent to initial contact**

1. The persons nominated by the contact person as suitable interview candidates will be contacted by email to ascertain whether they are willing to be interviewed. Interview times suitable for both the researcher and the interviewees will be set. The allotted time will be approximately one hour for each interview. Semi-structured interviews will be carried out with 2-3 expert practitioners from each site, such as managers, instructional designers, or producers. The interviews will preferably be carried out on site, but, if this is not possible or is not convenient for the interviewees, by telephone. Each informant will be asked to nominate 3 ITV programs which they consider to be the most innovative.

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<sup>2</sup> *Affordances*: The term refers to 'the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. A chair affords ("is for") support and, therefore, affords sitting' (Norman, 1998, p.9). 'The computer system, with its keyboard, display screen, pointing device (e.g., mouse) and selection buttons (e.g., mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the display screen' (Norman, 2010, p.1)

2. The ITV programs nominated by the interviewees will be examined to ascertain their affordances. These ITV programs may be real-time broadcasts, although some will probably be archived videotapes.
3. Non-participant observations will be carried out, of the ITV production units and any concurrent broadcasts. Copious observational notes will be made at each of the three sites, about the affordances of the technology, and about any observed broadcasts.
4. Documents will be accessed. Documents to be accessed include available in-house documents from the ITV production units, as well as policy documents from educational authorities, such as the DET ICT Strategic Plan 2002-2006.
5. The collected data will be analyzed, with themes being explored and documented, including the affordances of ITV.
6. Refined guidelines for the production and use of ITV in educational settings will be developed, based on findings from the data collection and analysis.

Potential participants are free to refuse to participate or, having consented, are free to withdraw their consent at any time. If participants request anonymity, meticulous steps will be taken to maintain anonymity, by measures such as attaching numbers rather than names to interview transcripts. All files will be stored in a location accessible only to the researcher.

If you have any further questions about the research, please do not hesitate to contact Jann Roberts on telephone number (02)4284 7995 or email [jroberts@uow.edu.au](mailto:jroberts@uow.edu.au). You are also welcome to direct any enquiries to Jann's research supervisor Jan Herrington, at [janh@uow.edu.au](mailto:janh@uow.edu.au).

### **APPENDIX 3: Consent form provided to interviewees**

#### **UNIVERSITY OF WOLLONGONG**

#### **CONSENT FORM<sup>3</sup>**

##### **An investigation of the educational applications of interactive television**

##### **Jann Roberts**

I have been given information about *An investigation of the educational applications of interactive television* and discussed the research project with Jann Roberts, who is conducting this research as part of a Master of Education, supervised by Barry Harper and Jan Herrington in the Faculty of Education at the University of Wollongong.

I have also been given information about the need for Jann Roberts to carry out face-to-face interviews as part of the data collection.

I have been advised of the potential risks and burdens associated with this interview, which include inconvenience and expenditure of time, and have had an opportunity to ask Jann Roberts any questions I may have about the research and my participation.

I understand that my participation in this interview is voluntary, I am free to refuse to participate and I am free to withdraw from the interview at any time. My refusal to participate or withdrawal of consent will not affect my treatment in any way.

If I have any enquiries about the research, I can contact Jann Roberts (Ph.0413031788), and Jan Herrington (Ph. 42214277) or if I have any concerns or complaints regarding the way the interview is or has been conducted, I can contact Jan Wright (Ph. 42213664).

By signing below I am indicating my consent to participate in a face-to-face interview conducted by Jann Roberts, the purpose of which has been described to me in writing by Jann Roberts. I give my permission for the interview to be recorded on an audio recorder. I understand that the data collected from my participation will be used in Jann Roberts' thesis, and I consent for it to be used in this manner.

Signed

Date

.....

...../...../.....

Name (please print)

.....

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<sup>3</sup> Modified from Sample Consent Form (HREC, 2003, p.18)

## APPENDIX 4: Timing of Interviews and Perspectives of Respondents

The following table serves the purpose of detailing part of the audit trail. It lists the interviewees, the perspective from which their data emanated, and when the interviews happened.

<b>Interviewee Pseudonym</b>	<b>Expertise</b>	<b>Perspective</b>	<b>When interview took place</b>
MG_SchoolsTV	ITV producer/manager	Manager of Schools' TV Victoria, Australia	March 2005
CW_ABCTV	Television manager	Manager of ABC2 in Sydney, Australia	June 2005
DV_ITRI	ITV research centre manager	Manager of Interactive Television Research Institute [ITRI] at Murdoch University, Western Australia	July 2005
AT_SeniorAcademic	ITV and education	Academic at Murdoch University, Western Australia	July 2005
HM_ResFellow	ITV use in education of children	Post Graduate Fellow at Murdoch University, Western Australia	July 2005
Anon1_EdExpert	Education and ITV	Academia, educational research	July 2005
Anon2_ITV_Expert	ITV and tourism, advertising	Academia, post-doctoral research into ITV	July 2005
MJ_Hull	ITV manager	Manager of STREAM in Hull, United Kingdom	2006

## APPENDIX 5: Interview schedule

The following interview schedule was used during the interviews carried out in the data collection phase of the current study.

Interview Schedule
<p><i>Thank you for being willing to take part in this interview. Firstly, I wish to assure you that, if you have requested anonymity, your participation is anonymous and your name will not be attached to any interview records. Please consider the following questions in your professional capacity of (manager/producer/instructional designer, etc.), in the context of learning environments within your organisation.</i></p> <p>Explain right to withdraw and ask permission to audio-record the interview.</p>
<p><i>What sort of ITV work have you been involved in?</i></p>
<p><i>What are the affordances of interactive television that you have found useful for education (will need to tell participant what is meant by affordances<sup>4</sup>)? Why is it better than simply video conferencing?</i></p>
<p><i>Do you think that synchronous (real-time) communication is an important feature of ITV in an educational setting? Why?</i></p>
<p><i>Are any methods employed to provide resources in an asynchronous (outside broadcast time) manner?</i></p>
<p><i>Which of the affordances you have mentioned do you consider unique to ITV? [Interviewer will also have a list of unique affordances gleaned from the literature, and raise any previously unmentioned]</i></p>
<p><i>Do you think these affordances are transferable to a tertiary/school/commercial broadcasting educational setting?</i></p>
<p><i>What are the barriers to the use of ITV? Is there anything else that you can think of that would be a barrier? [Prompts: Are there any technological problems, administrative difficulties, or pedagogical problems?]</i></p>
<p><i>What impact on education can you see ITV technology having in the future? What do you think the affordances of new ITV technologies will be? In other words, what do you think they will make possible which would not otherwise be possible?</i></p>
<p><i>What would you like to do with ITV if you could?</i></p>
<p><i>In its ICT Strategic Vision, DET states that '[s]tudents will use technology to communicate with peers, regardless of location, and work collaboratively on learning</i></p>

<sup>4</sup> Affordances are the fundamental properties that determine how something can be used. A chair is for support and, therefore, affords sitting (Norman, 1998, p.9). 'The computer system, with its keyboard, display screen, pointing device ([such as] mouse) and selection buttons ([such as] mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the display screen' (Norman, 2010, p.1)

<b>Interview Schedule</b>
<i>programs' (2002, p.15). What is your opinion of this statement?</i>
<i>Can you please name 3 ITV programs, connected with your ITV unit, which you consider to be the most innovative?</i>
<i>Can you describe each program generally, and how viewers interact during the broadcast?</i>
<i>What do you consider to be the strengths of each program? What do you consider to be the weaknesses of each program?</i>
<i>How many times has each program run? Are figures available for number of viewers/participants?</i>
<i>Why was each program developed? Was it an existing program which was adapted for ITV delivery or was it created specifically for ITV? If the program existed as a face-to-face or distance unit, what factors influenced the way it was adapted for ITV delivery?</i>
<i>Were there any problems or difficulties that arose during the design and development stages?</i>
<i>How effective do you think each program is? What have been the outcomes of the program, generally for the students?</i>
<i>Can you compare each program's impact to an earlier version of the program that may have been in a different mode?</i>
<i>In your opinion, what are the important characteristics of the design of ITV programs?</i>
<i>How willing would you be to be involved in the design of another ITV program using similar principles and strategies?</i>
<i>What advice would you offer other practitioners who might be just starting out to design an ITV program using similar principles?</i>
<i>Do you have any further comments which you would like to make?</i>
<i>Thank you very much for helping me and giving up your time.</i>

## **APPENDIX 6: Individual summaries from themes chapter**

As part of the data analysis process, data was extracted from the interviews, and categorised into the various sub-themes of the study. This formed the basis of Chapter 4, the Themes chapter. Within each sub-theme, the individual interviewee data was then summarised into individual summaries. The overall data within each sub-theme was then summarised into section summaries.

As a result of this process, one unplanned outcome was a considerable amount of repetition between the individual summaries and the section summaries. A decision was therefore made to cut the individual summaries from the themes chapter, consolidate these summaries into the current chapter, and place this chapter in the Appendix of the thesis.

### **Affordances**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic's comments seemed to indicate that the affordances of ITV could be partially defined by the affordances of another technology: PVRs, by using this technology in conjunction with ITV. Separately, his comments about "drilling down" to further details, using either ITV or DVD, appear to allude to an affordance which is common to both technologies – hence not being a unique affordance of ITV. While explicit assessment, such as a question 'popping up' on the screen, is not a unique affordance of ITV, it can be argued that implicit assessment, where a user's actions are logged, is a unique form of assessment, or at the very least, a unique way of monitoring viewer choices. Unique affordances pointed to by AT\_SeniorAcademic were those of the psychological and sociological aspects of the communal television viewing experience, which were, virtually by default, applicable to the interactive television viewing experience. Another unique affordance he referred to, in terms of comparison of interactive media, was the "potential of immediacy" of ITV broadcasts.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert expressed a level of scepticism that there were any overriding affordances of ITV in terms of its educational impact. He/she warned of the danger of using new technologies to simply deliver old pedagogies. Economics was another factor mentioned by Anon1\_EdExpert. One positive affordance Anon1\_EdExpert referred to was that of ITV encouraging learners to be more active, as compared to the passive process of watching traditional television.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull described three affordances of ITV, in the context of the school-based ITV Program he was managing in Hull, UK. These were the ability to transmit video-based learning resources to homes, engagement of users because they liked to see themselves on the screen in user-generated content, and engagement of users who have low levels of literacy and numeracy. In terms of future affordances, MJ\_Hull said that it would be critical for ITV to work across different platforms.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV described a number of affordances, such as the creation of a sense of ownership for the audience, the user being able to see what they want when they want, and the creation of a sense of community. He also mentioned the affordance of a feeling, during production, of "foot-to-board", which he said was inter-related to the need to facilitate the affordances of ownership and instancy to users. MG\_SchoolsTV stated that a live program happened dynamically due to the interaction of viewers, by phoned-in responses, for example. He touched on the potential of transferring affordances to a commercial broadcasting education setting, highlighting the importance of what the intended outcome or aim would be of any program. Building on the idea of the affordance of building a sense of community, MG\_SchoolsTV discussed his production unit's plans, at the time of interview, of building a "dynamic community model" on a worldwide interactive platform, to facilitate a shared platform of understanding between students from different cultures.

**Summary interpretation regarding Anon2\_ITV\_Expert's comments:** Anon2\_ITV\_Expert specifically focussed on the ITV affordance of enhanced interactive experiences for users with special needs.

**Summary interpretation regarding HM\_ResFellow's comments:** HM\_ResFellow stated that, in his experience, important attributes for children's TV or ITV were that it provided a visually engaging experience, few words, animation, and a tree branch style of making viewer choices. Regarding affordances of ITV, HM\_ResFellow described ITV as being "trackable", which he said led to "an interesting paradox" of audience choice versus producer control. HM\_ResFellow also discussed advantages of ITV as opposed to Internet use, including the security of being in a walled garden, stability in terms of not crashing, and TV being perceived as "trustworthy" by consumers. He said that the ITV communication return path was useful for students to be able to participate, and not just be passive recipients of communications. HM\_ResFellow stated that ITV had not yet reached its full potential, including in the educational field, for which he



said ITV was “perfectly poised” to provide an engaging participant experience. Regarding ITV use by children, HM\_ResFellow stated that it gave the children a “quite profound” opportunity to see outside themselves, and observe the consequences of their actions. Finally, HM\_ResFellow emphasised that ITV was merely a tool to be used to provide what was really important: a good quality product.

**Summary interpretation regarding DV\_ITRI’s comments:** In regards to children’s TV educational content, DV\_ITRI stated that, as technology entered a domain where interactivity became feasible, this enabled the affordance of television to “make that shift from being curriculum centred to being child centred and that’s a very exciting shift”. DV\_ITRI stated that it was the “proximity to the original content that’s [ITV’s] key advantage”.

### **Assessments**

**Summary interpretation regarding AT\_SeniorAcademic’s comments:** AT\_SeniorAcademic stated that interactivity facilitated the switch from information intake mode to assessment mode, the latter being either explicit or implicit. An example he gave of implementation of implicit assessment was via logging user behaviour. AT\_SeniorAcademic raised the educational design question of whether end-of-semester assessments of students should be carried out, after presentation of a lot of associated materials.

**Summary interpretation regarding MJ\_Hull’s comments:** MJ\_Hull described a lesson delivered in the STREAM model as comprising a learning objective, stimulus video material and a follow-up activity which might be an assessment.

### **Collaboration**

**Summary interpretation regarding AT\_SeniorAcademic’s comments:** AT\_SeniorAcademic described how he, University of Wollongong academics, and an Indigenous broadcasting group collaborated in investigating technical issues such as the delivery of ITV to a remote community. Regarding student collaboration, he raised the question of whether ITV users were collaborating with other students.

**Summary interpretation regarding MJ\_Hull’s comments:** MJ\_Hull said the fact that broadcasts would be seen by other people encouraged pupils, parents and teachers to collaborate in making learning resources to be broadcast for those people.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV stated that the effect of students accepting that they were part of a broader community of TV viewers was to cause collaboration and constructivism skills to be brought into force in the interactive community. MG\_SchoolsTV stated that Schools' TV had three producers who collaborated with the Victorian Office of Learning and Teaching, with the result that any interaction would always be anchored back into the intended educational outcome.

## **Communication**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic touched on communication modes relating to two different projects. The first focussed on investigating ways of transmitting emergency messages to the public. The second project, involving a remote Indigenous community, raised the issue of how to enable users to communicate back asynchronously, when a back channel was not available.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert recommended that the learner should be encouraged to critically reflect on, and communicate about, what they see, and the choices they make.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull compared communicating via video-conferencing with communicating via ITV. He said that video-conferencing required less preparation than ITV, and that pupils who generated ITV content went through an associated learning process. MJ\_Hull stated that "[ITV] has a massive advantage over videoconferencing".

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV stated that TV should provide a response-level commensurate with living in a media literate world where synchronous feedback was expected. In terms of supporting collaborative and constructivist learning, MG\_SchoolsTV stated that students accepted that they belonged to a "broader community", due to television being a "mass communication tool".

**Summary interpretation regarding Anon2\_ITV\_Expert's comments:** Anon2\_ITV\_Expert stated that synchronous communication was an important feature of ITV because of contemporary expectations of immediacy in communication.

**Summary interpretation regarding HM\_ResFellow's comments:** HM\_ResFellow drew attention to the usefulness of the ITV return path for student participation.

## **Constructivism**

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert questioned the effectiveness of ITV in allowing users to construct their own knowledge, since ITV might provide limited choices. He/she recommended that learners be encouraged to critically reflect on the choices that they make. Anon1\_EdExpert also stated that users might be disengaged due to limited options available.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV stated that the effect of students accepting that they were part of a "broader [ITV] community" was to bring into force collaboration and constructivism skills in the interactive community.

## **Delivery**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic stated that appropriate delivery options comprised a major design characteristic of any interactive program. His related comments included that the delivery option should match user characteristics, such as provision of less text for Indigenous users, and audio in the local Indigenous language. AT\_SeniorAcademic stated that the timing of delivery needed to be considered, to support a task-based and user-centric interactive materials development methodology. In remote communities he suggested that an onsite person could facilitate delivery of job-related training materials, or the process could be managed by the trainees themselves.

According to AT\_SeniorAcademic, program delivery could be a barrier to the use of ITV.

He stated that consideration should be given to how parts of a suite of materials might be delivered, and why various delivery methods might be chosen.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert described how a Western Australia instructional design unit used the Internet instead of ITV, due to economic reasons. Anon1\_EdExpert asserted that distance education users preferred hard-copy materials. He/she also stated that distance education had more money than standard government schools, and that the parents involved comprised a quite powerful lobby group.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull described how STREAM was an improvement on its predecessor KIT, including in terms of delivery of materials. He said that

asynchronous delivery on demand catered for students who learn better in the evening. MJ\_Hull predicted that in the future anything web-enabled would be capable of accessing ITV services, and that there needed to be a focus on facilitating more TV broadcasting via the Internet. He cited the difficulty of providing users with a satisfactory depth and range of information, using a limited delivery system. MJ\_Hull emphasised that the ITV platforms used in Hull were more sophisticated than other ITV platforms, due to being on-demand IPTV. However, he acknowledged that in the U.S. IPTV was being massively invested in.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV said that interactive elements and live real-time could be utilised in both the web and the satellite environments. He said that there was really no difference other than being different delivery methods, and pushing the products via a streaming codec or a satellite codec. MG\_SchoolsTV described the interactivity features for web-based program delivery as not being embedded as part of the ITV broadcast, but as simple HTML-based applications, such as a form or email. The audience feedback could then influence the content being broadcast. The decision of which content to broadcast could not be made in pre-production – it happened live as a direct result of audience feedback.

This following of a particular theme by tailoring content to audience reaction was, according to MG\_SchoolsTV, “an interesting type of dynamic too because it’s very rare that television is driven by its audience, it’s normally the other way round”. However, MG\_SchoolsTV stated that audience reaction could often be predicted according to the material presented, which could influence audience decisions and “pretty much guarantee a result that we’re not going to be shocked by”. He said that this was related to the concept of “media truth” and how every person created their own realities.

MG\_SchoolsTV emphasised that the delivery design depended on the audience, or the type of client being supported. He said that any incorporated interaction was considered to be another production standard. MG\_SchoolsTV pointed out that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes. MG\_SchoolsTV made the analogy of a football field, stating that due to the IT and infrastructure roll out to schools, his production unit knew that “every school has this flat level playing field that we know we can actually kick the goals on”.

**Summary interpretation regarding Anon2\_ITV\_Expert's comments:** Anon2\_ITV\_Expert stated that ITV has the potential to do “amazing” things in terms of flexible, non-textual, video productions delivering a wide range of information, if sufficient money, time and effort were invested. The respondent's research indicated that interactivity opportunities should be made available at the end of broadcast materials, rather than during.

## **Design**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic stated that the important design characteristics for interactive programs were appropriate content and delivery methods. He said that firstly clarity of the objective, user characteristics, and user needs was required. An example AT\_SeniorAcademic gave of this was the need to consider user expectations and preferences when designing user interfaces. He described the layout design process as being ‘task-based and user-centred’, involving prototyping and testing, which was intended to instil confidence that particular layouts worked in particular contexts.

AT\_SeniorAcademic listed a number of educational design questions, including ones relating to how the students would be expected to interact with the material. He stated that creativity could be a design constraint. AT\_SeniorAcademic recommended effective design and evaluation of programs in order to maximise resultant benefits, not just for the most capable users, who he said could overcome bad design, but for a broad range of users.

According to AT\_SeniorAcademic, there was a need to find the relationships between the elements of pedagogy, hardware, and design, in order to develop a “map” as a first step to producing a descriptive ITV model.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Critical pedagogical characteristics of ITV program design and broadcast raised by Anon1\_EdExpert related to scripting and the design issue of the call to interact. This included reference to the need to cater for users who missed calls to action, or did not choose any.

When asked to offer advice for other practitioners who might be just starting out in designing an ITV program, Anon1\_EdExpert suggested a cautious approach of waiting to see what the big TV networks do, since the latter had the funds to experiment. This caution was also partly

attributable to the stated perception of Anon1\_EdExpert that teachers were not fully exploiting the interactivity available on the Internet, at the time of interview.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull described how one part of the STREAM system, being built at the time of the research interview, was designed to allow a lesson to be broadcast straight from a school into homes. This was particularly intended to benefit students who could not attend school, for example, due to illness or disability. Part of the design was intended to allow students to participate interactively in the lesson.

MJ\_Hull stated that the original STREAM pilot was based on concepts of lifelong learning. This enabled the development of parenting skills learning resources for parents of pre-school children.

MJ\_Hull cited a difficulty that arose during the design and development stages, the issue of how to strike the best balance between providing users with a satisfactory depth and range of information, while only having a "relatively primitive" delivery system.

MJ\_Hull stated that an ITV program could not be thought of as a Web experience or as a formal learning experience, and that consideration should be given to what television, as a medium, provided that other areas could not. MJ\_Hull said that the "worse stuff" he had seen were attempts to transfer directly from paper-based resources to television, resulting in "a lot of text [which] just doesn't work."

**Summary interpretation regarding CW\_ABCTV's comments:** CW\_ABCTV said that ABC staff had chosen a "small subset of information" which they perceived to be appropriate for the television experience, and had designed a display template with "TV-friendly" fonts and colours. According to CW\_ABCTV, this template looked completely different from the online version, but required no extra work by the ABC staff. However, he went on to state that he did not think that it really interested the viewers, but that the providers were still "some distance from understanding what could be truly engaging about that kind of interactive television".

CW\_ABCTV discussed early work by online producer Ingrid Spielman and the then digital content editor Ian Carroll. He described Ingrid as a "very clever designer" who, mainly with Ian, used Macromedia Director to create "a speculative interactive TV experience", a simulation that emulated an interactive TV experience. CW\_ABCTV said that Ingrid's model suggested the ability to call up various video streams on demand such as news, a health report, a recipe, or

children's content. He said that Ingrid imagined a different type of viewing experience, but one that was not realisable commercially due to the lack of a television platform that could support it. He said that what she did could have been done online but "that wasn't the point".

CW\_ABCTV stated that "even" at the time of the interview the ABC interactive television showcase could only have been done in an IPTV environment.

CW\_ABCTV said that there were a number of tools which could be used to create something that resembled a TV experience, in order "to emulate the proposed functionality" in terms of architecture and appeal, before too much time was spent on it.

He stated that navigation using a TV remote was fairly limited, and that it required work. He also stated that a mouse "[did not] make any sense in that environment". CW\_ABCTV said that the TV screen, unlike a web page, was very difficult to sub-divide into distinct active areas. He said that there were some ways to work around that, but that it risked being clumsy, and that the general advice was to keep the navigation "very simple and really obvious". Furthermore, CW\_ABCTV declared that if it was necessary to provide big help screens to users, "you've basically failed".

**Summary interpretation regarding MG\_SchoolsTV's comments:** While MG\_SchoolsTV had described how most interaction opportunities came at the end of Schools' TV programs, he said that there were a number of set formulas for delivery, dependent on the audience, or the type of client being supported. MG\_SchoolsTV said that any incorporated interaction was considered to be another production standard, in the same way that production standards applied to pre-recording of programs, how products looked, and studio operations standards. He continued that, therefore, if he was going to make a live interactive program, it meant that he knew that he would need to have phone and web support integrated into the studio environment.

MG\_SchoolsTV advised that new ITV program designers needed to "first of all establish the playing field", in terms of knowing what the technology could deliver in such an innovative field. MG\_SchoolsTV elaborated, by saying that people often get caught up in the jargon and capabilities of the technology, but that ultimately the key consideration was "what is the end user seeing and what are they experiencing?"

**Summary interpretation regarding Anon2\_ITV\_Expert's comments:** Anon2\_ITV\_Expert suggested that key design characteristics of ITV programs were relevance of the interactivity,

that the latter should make sense, and that it must be important to the viewer. He/she also suggested that it should be intuitive, in line with technology people had used previously.

**Summary interpretation regarding HM\_ResFellow's comments:** HM\_ResFellow described a suite of programs called Black Box Designer, which was sold to advertising agencies so that they could create mock-up ITV advertisements. Another program HM\_ResFellow described was OnQueue, which he said could offer "real-time sequencing" so that if a program was running behind schedule, the ITV application could be held back to come in at the right time.

HM\_ResFellow said that consistency was a key characteristic of ITV program design. He said that this was for a number of reasons, including young audiences' need for consistency so they can familiarise themselves with the way ITV works, and for parents so they know what to expect, such as a call for action when a particular button is pressed. Furthermore, HM\_ResFellow stated that consistency was important for economic reasons, in that re-usable interactive templates would save money on computer program design and development. HM\_ResFellow suggested that another design hint would be to include verbal cues for very young audiences, particularly since they might be unable to read text.

HM\_ResFellow stated that the DVD version of the U.S. TV show '24' was an example of where he thought the provision of interactivity was inappropriate. The viewer could choose different endings to the first season. HM\_ResFellow maintained that there was no point to this interactivity because the reason d'être of the show was for the viewer to lose himself/herself and become part of the show, and not be forced to take the action of making a choice.

On the subject of education, HM\_ResFellow said that, at the time of interview, one of the things he had grappled with was whether children also liked to have that level of escapism, or whether there were times when they had the ability to suspend their disbelief at a level where they could interact. HM\_ResFellow stated that this was a "big question" and that he had completely different answers for different age groups.

**Summary interpretation regarding DV\_ITRI's comments:** DV\_ITRI discussed interactive TV authoring environments, saying that while the main available systems gave the power to author, they resulted in boundaries which were problematic for ITRI's needs. Specifically, DV\_ITRI said that they were problematic because ITRI was mostly trying to look to the future rather than measure existing activities, by developing "entirely new approaches" and pushing boundaries. He stated that ITRI used a stable simulation environment for research testing,



which made it possible to reproduce what could technically happen, without developing the actual applications.

DV\_ITRI continued that ITRI could pass its findings on to industry consortium partners so engineers could build resultant designs. DV\_ITRI emphasised that a few years previously ITRI was “more broadly situated across the interactive TV spectrum” but by the time of interview had become very focussed on the facet of audience research, for which it was known globally.

DV\_ITRI then provided several examples of interactive productions that he thought were good, comprising an interactive Pantene shampoo advertisement, a Robbie Williams music video, and a U.K. comedy show called Banzai. DV\_ITRI described the Pantene ad as his favourite interactive ad, and said that what made it so good was that it was well researched prior to deployment. He described it as being simple, with the viewer answering questions, receiving diagnosis of the corresponding hair problem(s), then advice including product recommendation, thus simulating a real hair salon experience. DV\_ITRI said that this was an example of

really good interactive advertising. The interactivity has a purpose, it’s got a very clear rationale, it’s got a very clear strategy, it’s all been thought through very well, it’s a brilliant campaign.

DV\_ITRI said that he thought this was strategically a very effective ad, since it not only gave the viewer “an incredible experience”, but that the viewer actually self-stratified themselves into the market, partly by requesting a product sample. Also, the interaction required low bandwidth. However, DV\_ITRI described the cost of this interaction as being that the viewer could miss part of the broadcast program since the ad was always the last one in the ad break.

DV\_ITRI stated that the best interactive content he had seen was a Robbie Williams music video, ‘You Can’t Manufacture a Miracle’, which portrayed three contestants in a Robbie Williams look-alike contest. He said that what was so great about the Robbie Williams music video was that the three minutes of the music video whetted the viewer’s appetite for the interactive act of voting for their favourite contestant. DV\_ITRI stated that despite the fact that not all viewers globally were actually voting, psychologically they were voting, and this still felt right, so the interactive content even worked in a “linear world”.

Similarly, DV\_ITRI stated that a skit-based U.K. comedy program called Banzai, which included interactivities with the skits, was distributed globally in a linear format, which meant that

invitations to vote still popped up, but viewers just had to do it in their heads. DV\_ITRI said it was “brilliant” how, despite the program intentionally being conceived, designed, created and produced in an interactive format, it had still found a global market as a linear product.

On the other hand, according to DV\_ITRI, so much of interactive TV failed because there was no attempt to whet the appetite for the interaction. He gave an example of a documentary where choosing to interact resulted in a text screen being superimposed over the fascinating streaming video. DV\_ITRI said that this violated the viewer’s emotional experience.

DV\_ITRI stated that there were many important characteristics of ITV program design. He said that the interactor’s experience would vary according to the market they were in, and they would have differing expectations about what interactive TV should do based on their previous experiences. Specifically, he discussed teletext use in the U.K. market and PVR use in the U.S. market providing different paths to ITV, through which people’s expectations would have evolved.

DV\_ITRI stated that there were also “huge” individual factors, such as age. He contrasted the needs of young viewers compared with older viewers, and sensation-seeking viewers with those who needed confidence that they would not be overwhelmed by the space. He stated that there were “a whole range of demographic factors” which shaped the space.

Another area which DV\_ITRI said was critical in ITV program development was that of the emotional needs versus the functional needs of users. He asserted that the latter received a lot more focus than the emotional needs, despite the motivation for people to watch television tending to be emotional rather than functional in character. DV\_ITRI stated that while the functional need could be a starting point, consideration needed to be given to “how to embed that within an emotional experience”. DV\_ITRI said that this was particularly the case regarding TV viewing, as opposed to PC use.

The final comment DV\_ITRI made regarding the important characteristics of ITV program design was that designers were often “driven by a web paradigm into this space and that’s a flaw”. He said that the users should be provided with a televisual experience emanating from a “TV centric paradigm”. He gave several examples of this, in the context of children using ITV at home rather than in the classroom with teacher guidance. These examples included the potential for embedding an age-appropriate maths module in a sports broadcast, the possibility of building numerous engaging educational activities into a documentary-style

program, and providing children with different program-related narrative streams, in order to maximise their learning opportunities.

DV\_ITRI asserted that appropriating the normal television viewing experience and adding an educational opportunity around it, and taking this to children and students in various settings, was revolutionary.

## **Future**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** Regarding the potential future impact of ITV technology, AT\_SeniorAcademic predicted its use mainly in educating the general public, by way of training programs for unemployed persons, or making the public aware of emergencies.

**Summary interpretation regarding MJ\_Hull's comments:** At some future stage in the STREAM project, MJ\_Hull said that it was planned for study resources to be accessible via mobile phone. When asked about potential future impact and affordances of ITV technology, MJ\_Hull stated that it was crucial that systems capable of working across different platforms continued to be built.

**Summary interpretation regarding MG\_SchoolsTV's comments:** Future ITV technologies, according to MG\_SchoolsTV, would enable students to get into environments such as the NASA space program, which they could not possibly enter physically. He said that new ITV technologies would allow such boundaries to be pushed even further.

MG\_SchoolsTV promulgated the use of ITV to build a "dynamic community model" which facilitated a greater understanding about other cultures and ways of doing things. Specifically, he said that his production unit was attempting to implement an interactivity model that could link students internationally via a shared platform of understanding, resulting in strong interactions despite the physical distances.

MG\_SchoolsTV acknowledged the argument that other technologies could be used to build the cyber community, but he argued that the richness was very different, giving the comparison of being in a chat room with no "visual reference".

Regarding the adaptation of an ITV system in order to fulfil individual users' needs, MG\_SchoolsTV stated that the model could be pushed a bit further and, for example, some

interactive elements could be specifically tailored towards the needs of persons with disabilities. He said that the biggest issue was breaking the mindset of how TV was traditionally created, in order to work towards a fluid non-linear model. MG\_SchoolsTV said that part of this process was asking what would happen if something different was done with the technology, but he stated that few environments were willing to take that risk, largely for commercial reasons. However, he asserted that education was probably uniquely placed to take that risk, provided that associated research was carried out.

**Summary interpretation regarding DV\_ITRI's comments:** In DV\_ITRI's discussion of interactive TV authoring environments, he said that the main available systems resulted in problematic boundaries for ITRI, particularly as ITRI was trying to look to the future and develop "entirely new approaches".

DV\_ITRI described ITV technology's future potential impact on education as "huge", alluding to ITV as a "great medium". He said that education was one of the globally most underdeveloped areas in the ITV space, due to business modelling, and the medium's focus on making money, but that "the opportunity for formal education is of course immediately obvious and apparent". DV\_ITRI stated that it was very interesting and exciting that educational opportunities could be extracted from a lot of other non-education-related content. He said that this related to making a shift away from being curriculum centred to being child-centred, which facilitated the planting of numerous educational opportunities around normal television experiences. DV\_ITRI stated that he thought that it was the beginning of what would be a "very powerful revolution to TV viewing".

## **Interface**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic described the method of user interaction with materials as being 'a function of what they already know and what their expectations are', citing the importance of this when considering design aspects such as the detailed layout of interfaces. He gave the example of the familiar layouts of websites.

AT\_SeniorAcademic stated that the design of the user interface depended on the project objectives, with various graphic TV applications having associated screen overlays. He described TV news as 'one of the strong drivers of interactive television to date', depicting its on-screen layout as being similar to website interfaces. In contrast to this, according to

AT\_SeniorAcademic, the screen layout for an interactive version of a preschool program would be completely different. AT\_SeniorAcademic listed a number of questions that he said were necessary to logically conclude whether a layout was good or bad. The questions related to the method of interaction, the intended actions of the users, the type of program, the objectives, and the nature of the audience.

He described the appropriate layout design process as being ‘task-based and user-centred.’ AT\_SeniorAcademic stated that the model he brought to the design process stemmed from the design of user interfaces and websites, although he urged that the layout designs needed to be prototyped and thoroughly tested with people. He said that this prototype development approach was planned to instil confidence in specific layouts working in precise contexts.

**Summary interpretation regarding CW\_ABCTV’s comments:** CW\_ABCTV described a Sydney-based interactive TV trial run by Optus, which involved approximately two thousand households. He said that the trial began as a technical trial then evolved into a commercial trial. CW\_ABCTV said that the trial, based on work by a London cable television provider, was an opportunity for a number of service providers to participate in a cable-based ITV trial that provided an experience in a “walled garden” environment. The associated user interface was developed using an HTML-based software package.

**Summary interpretation regarding HM\_ResFellow’s comments:** According to HM\_ResFellow, consistency of the interface was important for parents, so that they knew what to expect when they took a particular action. He said that consistency was also important for economic reasons, such as the ability to save money on design and development by re-using an interactive template.

HM\_ResFellow indicated that text-based interfaces might be inappropriate for very young audiences, who might benefit from the inclusion of verbal cues.

HM\_ResFellow discussed the phrase he had coined, “ego sufficing behaviour”, which related to the idea that people would look more favourably on a choice which they were able to select themselves, and in which they could have an emotional stake.

## **Learning**

**Summary interpretation regarding AT\_SeniorAcademic’s comments:** The project AT\_SeniorAcademic was working on at the time of the research interview sought to introduce

interactivity in such a way as to ‘enhance the program either in terms of enhancing enjoyment or enhancing the learning objectives of those programs.’

The ‘overview issue’ when adapting programs for ITV, according to AT\_SeniorAcademic, was engagement, either in terms of enjoyment or learning.

AT\_SeniorAcademic considered the question of whether there were affordances of ITV that could enhance the learning environment, as compared with video-conferencing, concluding that there may be other information that you would want the learner to access that was unavailable via video-conferencing.

According to AT\_SeniorAcademic, some of the most successful ITV applications had used multiple technologies, so that, for example, it was not that the ITV was directly competing with a website, but that it could be operating in conjunction with a website, with a general objective such as learning. He illustrated his idea that content could be delivered in a variety of ways by saying that some users could receive similar, or even the same material, via interactive television, rather than online. AT\_SeniorAcademic asserted that what the learning objective was, and how to achieve that learning objective, needed to be considered.

**Summary interpretation regarding Anon1\_EdExpert’s comments:** Anon1\_EdExpert raised the negative perception that a person watching TV could not be learning because it was a passive activity. However, he/she indicated that this stigma did not apply to interactive TV, since it afforded the learner a more active experience.

**Summary interpretation regarding MJ\_Hull’s comments:** MJ\_Hull stated that a large proportion of the local adult population in Hull were functionally illiterate and functionally innumerate, and had not had positive learning experiences at school themselves, so it was difficult to see how they could get involved in their children’s learning. According to MJ\_Hull, ITV was a learning resource that could engage such people.

In 2005 it was decided to extend the reach of the KIT ITV service. However, it became apparent that the technology underpinning KIT was not advanced enough to do this, or to carry out functions such as personalizing the learning experience for users. As a result of this, a company called Broadband Capital Ltd took over the work which KIT had been doing, by developing its own IP based television service called STREAM.

MJ\_Hull stated that the ITV service was the product, the important part being the process behind it, of engaging students, teachers, and parents in producing learning resources to be distributed via the ITV service. He said that the broadcast element was critical in engaging groups who otherwise had no interest in learning.

MJ\_Hull said that school-held, video-based learning resources could be delivered to people's homes via ITV for convenience, and could particularly benefit those with visual learning styles.

MJ\_Hull stated that extensive work was needed to develop a learning package wrapped in interactive features. He said that ITV use encouraged a whole learning process to occur behind content generation, resulting in students learning more about their subject and also simultaneously learning significant communication and development skills. According to MJ\_Hull, because of this focus on process, and not just the product, he thought ITV had a huge advantage over videoconferencing. Another difference between videoconferencing and ITV, according to MJ\_Hull, was that ITV allowed asynchronous learning as well as synchronous learning.

MJ\_Hull stated that STREAM was fundamentally different to other ITV systems. Users who logged into STREAM received immediate access to relevant learning resources, and were able to search the content management system. MJ\_Hull said that this enabled self-directed learning or research, and enabled teachers to set homework based on the outside-school availability of the resources.

MJ\_Hull said that while the original STREAM pilot was focused only on secondary school, it was based on concepts of lifelong learning, which facilitated the development of learning resources designed for parents of pre-school children to improve their parenting skills.

MJ\_Hull stated that the only flaw with ITV pedagogically came when it was seen as the only way of teaching or learning, when it should be "part of a blended learning experience." According to MJ\_Hull, since learning through ITV was as much about making the content, and learning about the subject of the content, as about how it was accessed in the home, the STREAM model was different. He said that it was not a traditional broadcaster model, but "a whole change management model" based on making content, being involved, and being more willing to watch the learning content.

The nature of the STREAM model, as described by MJ\_Hull, was to provide “small bite-sized chunks of learning”, such as two-minute foreign language clips. He described the STREAM output as “a kind of virtual learning environment delivered through the television.” MJ\_Hull stated that the STREAM system was planned to be fully supportive of its users, with a typical lesson comprising a learning objective, stimulus material, and then some sort of follow-up activity.

According to MJ\_Hull the learning experience needed to be structured to avoid massive complication. He said that this meant the virtual learning environment needed to be built in order to use television to its best effect, by providing engaging visual learning that did not try to get too much information across. MJ\_Hull stated that it was crucial to understand what television could uniquely provide, so that excellent learning resources could be created. Finally, he said that IPTV [Internet Protocol Television] presented a new set of additional learning on top of what could be delivered by ITV.

**Summary interpretation regarding MG\_SchoolsTV’s comments:** MG\_SchoolsTV described a circa 2001 one-to-one video conference between Microsoft’s Bill Gates and a student, which was simultaneously broadcast to 2,500 sites, so also being one-to-many. He also described how students could become part of the interaction by phoning in. MG\_SchoolsTV stated that it was a unique application in terms of learning.

MG\_SchoolsTV stated that Schools’ TV producers with education and media production expertise collaborated with the Victorian Office of Learning and Teaching, to create learning outcomes related to the delivered content, so that any interaction would be anchored back into the intended educational outcome, in order to meet the educational objective.

**Summary interpretation regarding HM\_ResFellow’s comments:** HM\_ResFellow’s research specialty related to the potentials of ITV for early childhood learning. According to HM\_ResFellow, while educational theory pointed to the potential for an effective learning experience in a classroom environment, where teachers know their students, conversely normal television has always had the problem of not knowing its audience. Also, HM\_ResFellow stated that the TV program broadcaster did not know how the program was being received.

HM\_ResFellow said that interactivity facilitated viewer engagement, and a good viewing experience, and also a means of TV structuring its offerings. HM\_ResFellow likened ITV to a



tool, which could be used well by providing alternative paths which could segment the audience, triggering the ego sufficing behaviour, and providing a “lean forward model”.

He stated that ITV had not yet reached its enormous potential, and in education its interactive nature was “perfectly poised for education”, allowing a user to participate actively, and to see the results of their interaction. He said that the latter was “quite profound” for young children, since it helped enable them to see outside themselves, and see their actions’ consequences.

**Summary interpretation regarding DV\_ITRI’s comments:** DV\_ITRI said that much of ITRI’s research involved very explicit issues concerning how preschoolers learned, such as whether they could understand narrative. He said that “alternative narrative streams” could be provided to children in order to maximise their learning opportunity.

### **Pedagogy**

**Summary interpretation regarding AT\_SeniorAcademic’s comments:** AT\_SeniorAcademic discussed the importance of considering particular case-appropriate circumstances when selecting a pedagogical model for use in ITV. He also recommended the consideration of what defines a good pedagogical model, in regards to deciding on appropriate ITV delivery methods, technical specifications, content and interaction design, in order to enhance effective learning methods.

**Summary interpretation regarding Anon1\_EdExpert’s comments:** Anon1\_EdExpert commented on the perceived passivity of TV watching, and the alternative potentially active learning role afforded by ITV, qualifying these comments by acknowledging the role of the educator’s pedagogical philosophy in such consideration.

In relation to the critical pedagogical characteristics of ITV program design and broadcast, Anon1\_EdExpert discussed scripting, calls to interact, the appeal or otherwise of provided options/streams, and the limitations of the same in regards to users’ construction of knowledge.

**Summary interpretation regarding MJ\_Hull’s comments:** According to MJ\_Hull, the only problem pedagogically with ITV occurred when people failed to see it as part of a blended learning experience, and not a stand-alone method.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV stated that the “psychology of the [ITV] screen” enabled correct pedagogy such as collaborative and constructivist learning, due to corresponding acceptance by students that they were “part of a broader community”.

MG\_SchoolsTV described how Schools’ TV producers collaborated with the Victorian Office of Learning and Teaching to establish specific learning outcomes, meaning that any interaction would be anchored back into the intended educational outcome.

**Summary interpretation regarding HM\_ResFellow's comments:** HM\_ResFellow contrasted the classroom experience, where teachers can observe their students and respond according, with that of traditional television where broadcasters did not know their audience, and could not observe how a program was being received.

However, HM\_ResFellow said that interactivity in TV provided a way of engaging the viewers, and structuring televised offerings. Furthermore, he likened ITV to a tool, which when used well could enable some segmentation of the audience via their choices, and provide a “lean forward model” and a triggering of what HM\_ResFellow coined as “ego sufficing behaviour”.

## **Problems**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic listed a number of barriers to the use of ITV, such as production factors including generation of content, administration issues, technical constraints and financial constraints. He also listed conceptual, design, and understanding barriers, and the lack of research to draw on.

AT\_SeniorAcademic also discussed constraints for consumers, such as whether consumers could cope with the interaction, particularly older users. Other end user barriers he described included physical constraint issues such as limitations of remote controls, and the requirements of special needs users. One of these was colour blindness, which AT\_SeniorAcademic pointed out could be a problem considering colour-coding often used in ITV applications.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert pointed to the potential problems relating to the user not making any choices, being disengaged, and the available options being potentially unappealing. He/she also discussed potential ITV program design and development problems, such as the disruption of narrative due to user interaction,

how to keep the interaction seamless, and measure whether the interactivity makes any difference to learning. Furthermore, Anon1\_EdExpert raised problems associated with path choice in non-linear programs in discrete broadcast timeslots.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull stated that a huge barrier in the STREAM model was the need for teachers to be media-literate, digital-literate, and have effective IT skills.

Other problems MJ\_Hull cited included the problem of providing satisfactory information levels, while restricted by a limited delivery system. He also stated that it was difficult to engage people with a remote control based experience.

**Summary interpretation regarding CW\_ABCTV's comments:** CW\_ABCTV said that a major problem, particularly for commercial operators, was costs. Regarding ITV platforms, CW\_ABCTV said that there were problems due to different standards being adopted in different countries. He said that the lack of consistency was a problem for ABC-TV.

**Summary interpretation regarding HM\_ResFellow's comments:** HM\_ResFellow stated that providing choices to the viewer also provided a barrier to ITV use, due to the drawback of needing to produce alternative materials. Other barriers HM\_ResFellow listed included costs, political issues, and production problems.

**Summary interpretation regarding DV\_ITRI's comments:** DV\_ITRI talked about the inbuilt templates in ITV authoring environments resulting in boundaries that were problematic for ITRI, since ITRI was mostly trying to look to the future and push boundaries. However, he said that ITRI had addressed this problem by the use of a simulation environment that provided a stable environment for research testing.

### **Synchronous/Real-time**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** Referring to his own work involving a remote Indigenous community, AT\_SeniorAcademic said that communication could not be carried out synchronously, due to the lack of a back channel, hence raising the question of how users could be enabled to communicate back asynchronously. He said that where a back channel was available, user feedback could be sent either in real-time or asynchronously via the feedback loop.

AT\_SeniorAcademic stated that synchronicity in the ITV context could be viewed differently to that provided by other technologies such as DVD. He said that back channel availability had the potential to change the nature of interactivity. AT\_SeniorAcademic also stated that the possibility of synchronous feedback should be taken into account when developing resources for users.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert recommended synchronous communication as a significant feature of ITV in an educational context, since it mirrored the way people communicated generally in the real world. Anon1\_EdExpert also suggested encouraging learners to be critical, to reflect, and to communicate their reflections.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull described how ITV allowed asynchronous learning and synchronous learning, with synchronicity being very useful when used as part of a package.

MJ\_Hull described a successful synchronous BBC learning trial, involving a studio-based teacher answering student questions sent by text or email. However, he cautioned that this was not completely sustainable, and that an asynchronous learning form could probably suffice as effectively.

MJ\_Hull said that STREAM synchronous transmissions were recorded and archived to obtain extra value from subsequently being made available on demand.

**Summary interpretation regarding CW\_ABCTV's comments:** CW\_ABCTV observed that, at the time of interview, when Australian viewers were invited to participate in a "synchronous" online forum, it generally meant that viewers could only talk in real-time when they lived in the east coast time zone. He described one exception that occurred after the death of Australian band Skyhooks' lead singer.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV drew attention to the unusually brief broadcast time lag of 0.25 of a second for Schools' TV broadcasts. He said that the risk from this was a very restricted opportunity to vet callers' responses for inappropriateness. However, MG\_SchoolsTV stated that this enabled students to have a rich one-to-one experience, rather than a staged one. MG\_SchoolsTV described this as

the key difference between a commercial “quasi-live” TV program and an absolute live interactive program.

According to MG\_SchoolsTV, interactive elements and live real-time could be utilised in both the web and the satellite environments.

MG\_SchoolsTV stated that, at the time of interview, Schools’ TV was tending to produce a lot more pre-recorded programs with a live component at the end, rather than being entirely live. He classified such programming as interactive, because viewers were responding to broadcast content, and consequently interacting, possibly via phone hook-ups.

MG\_SchoolsTV described the interactivity features for web-based program delivery as not being embedded as part of the ITV broadcast, but as simple HTML-based applications, such as a form or email. The responses could be monitored in the Schools’ TV studio, and then live feedback given. He said that the audience responses could also be used to determine which one of two associated programs would then be broadcast. MG\_SchoolsTV stated that such audience-driven broadcasting choices were rare, and that it meant that some material produced might never make it to air. However, he said that such audience choice could be influenced, and often predicted, by careful pre-production decisions about how and where to display information within a program.

MG\_SchoolsTV stated that synchronous communication was unquestionably an important feature of ITV in an educational setting, because we were living in a media literate world where instant feedback was expected. Furthermore, he said that it was inexcusable for television not to provide that response.

**Summary interpretation regarding Anon2\_ITV\_Expert’s comments:** Anon2\_ITV\_Expert described synchronous communication as being an important feature of ITV in any setting, because people did not want to wait, but wanted to communicate immediately with other people in different locations in a face-to-face mode, hence having a more rewarding experience.

**Summary interpretation regarding DV\_ITRI’s comments:** According to DV\_ITRI, live synchronous content in ITV applications could heighten the viewer’s emotional engagement, and create a sense of community.

## **Technology**

**Summary interpretation regarding AT\_SeniorAcademic's comments:** AT\_SeniorAcademic stated that program adaptation for ITV delivery should be objective driven, not technology driven.

At stated that methods of monitoring different types of interactivity needed to be considered, with particular attention being given to the functionalities of the differing technologies. Furthermore, he said that some of the most successful ITV applications used multiple technologies that could feed off each other.

Regarding ITV technology's potential future impact, AT\_SeniorAcademic foresaw its use mainly in the sphere of public education. He surmised that ITV possibly had great advantages in this context compared to conventional training delivery methods. However, AT\_SeniorAcademic opined that other technologies might more easily be capable of producing targeted programs to specific students such as tertiary students.

AT\_SeniorAcademic stated that he would like the development of ITV to be useability-driven rather than fashion-driven.

**Summary interpretation regarding Anon1\_EdExpert's comments:** Anon1\_EdExpert expressed cynicism about technology, including ITV, being used simply because it existed, rather than for sound pedagogical reasons. Furthermore, he/she stated that existing technology such as interactive Internet-based resources were not being fully exploited by teachers, so could not see the benefit in developing a more complicated and expensive ITV technology for an audience which might not use it. However, Anon1\_EdExpert qualified this assertion by acknowledging that people might prefer to use the TV-related ITV medium.

**Summary interpretation regarding MJ\_Hull's comments:** MJ\_Hull stated that digitally and socially excluded students and parents in Hull were the target audience of KIT and STREAM ITV technologies, seen as a way of bridging barriers that the families faced. Parents were provided with a set-top box and broadband connection at no charge.

STREAM superseded KIT partly because of the limitations of the set-top box technology associated with KIT. By 2005, much more sophisticated set-top boxes became available, which enabled more advanced applications, and the company took the critical step of moving to a new platform, and new video standards, which allowed them to improve the levels of interactivity through the system. Furthermore, MJ\_Hull stated that STREAM was much

cheaper to deliver than KIT, as well as having a wider impact due to its ability to also operate on PCs.

MJ\_Hull stated that the implementation of STREAM needed the support of a significant training and development program that could take a full year for schools with virtually no prior use of technology.

MJ\_Hull said that his developers had to build their own learning environment that optimized the use of television for engaging visual learning. He stated that balance was always difficult, in terms of how much to give people, while wanting to give them everything, but realising that they could only access a certain amount through the actual technology.

At the time of interview, the STREAM model was being developed for mobile phone use as well. This broadening of the STREAM capabilities, according to MJ\_Hull, demonstrated to possible funders outside Hull that STREAM's impact could be wider than just for digitally and socially excluded users. MJ\_Hull's company also talked to a variety of other educational organisations in regards to their potential use of STREAM technology.

MJ\_Hull stated that the critical factor in possible future affordances of ITV technology would continue to be building systems capable of working across different platforms. MJ\_Hull also stated that anything web-based would be capable of accessing ITV services, and that as a result of this expected trend, there needed to be a focus on facilitating this.

**Summary interpretation regarding CW\_ABCTV's comments:** CW\_ABCTV discussed BBC's forays into the use of ITV technology, including the world-renowned 'Walking with Beasts'. CW\_ABCTV stated that the viewer used the remote control to switch between the channels provided, and in an effort to stop viewers feeling that they were missing out on something the BBC looped the main documentary, as well as its supporting channels, continuously between each episode.

CW\_ABCTV described the various channels made available by the ABC when it provided an ITV-style production of a music concert. He said that this was made possible by the provision of four satellite channels. CW\_ABCTV said that it was too expensive to also broadcast the program on other digital platforms.

CW\_ABCTV stated that, at that time, there was no publicly available interactive content on free-to-air TV. He pointed out that the software standard for authoring such content, MHP,

had only been agreed upon by the industry the previous year, and that there were no set top boxes for sale [at the time of interview] capable of decoding and displaying MHP-based products.

CW\_ABCTV described how the ABC had been working on a number of projects which focussed on shrinking the TV picture so allowing the viewer to continue engaging the TV broadcast while also browsing the extra content. He also described other work which incorporated an overlay enhancement technique, which was small and off to one side. In one example CW\_ABCTV described, he said that the interactivity did not work because it distracted from the program instead of adding to it.

**Summary interpretation regarding MG\_SchoolsTV's comments:** MG\_SchoolsTV gave the researcher a tour of the Schools' TV facilities. He likened the technology to "digital lego blocks".

MG\_SchoolsTV described a number of different projects his unit was involved in, including a one-to-one and one-to-many video conference, and a program involving a triangular link between participants. He commented that the complex technology in the latter was almost invisible to the end user, and that while the complexity in this scenario was inherent from the production management perspective, it was also an interesting model because participants felt like they were part of a big community, even though they were not actually sitting in one.

MG\_SchoolsTV said there was a "radical shift in a lot of new technologies" such as DVD, which potentially opened up opportunities for commercial education. A factor in this, according to MG\_SchoolsTV, was the take-up rate of the particular technology by the end user. Specifically, MG\_SchoolsTV pondered the availability of the appropriate technological facilities to enable the end user to interact seamlessly. He pointed out that a significant infrastructure was needed to facilitate TV level interaction, which needed to be standardised for delivery purposes. MG\_SchoolsTV made the analogy of a football field, stating that due to the IT and infrastructure roll out to schools, his production unit knew that "every school has this flat level playing field that we know we can actually kick the goals on".

Future ITV technologies, according to MG\_SchoolsTV, would enable students to get into environments that they could never possibly physically enter, such as the NASA space program.



MG\_SchoolsTV spoke about how ITV could be used to build a “dynamic community model” which facilitated a greater understanding about other cultures and ways of doing things. MG\_SchoolsTV acknowledged that arguments existed that there were other technologies which could do that as well but that he would argue that the richness was very different, for example, compared to being in a chat room where there is no “visual reference”.

In terms of adapting an ITV system to fulfil individual users’ needs, MG\_SchoolsTV focussed on users with disabilities, stating that it would be possible to push the model a bit further and specifically tailor some of the interactive elements towards persons’ disabilities. He stated that not many environments were willing to take that risk, largely because most of the Australian TV industry productions were for commercial outcomes. However, MG\_SchoolsTV asserted that education was probably unique because it could afford to take that risk, qualifying his statement by saying that there was a fair bit of research involved, and it was not just a random process.

MG\_SchoolsTV offered advice on what new ITV program designers needed to know, including knowing what the technology could deliver, considering what the end user was seeing and experiencing in the context of their own environment, getting a sense of what interactive means and what they would like to experience from interaction themselves, and then incorporating these into a product. He also said that he encouraged his staff to push the applications to the n<sup>th</sup> degree, because it was not possible to make a mistake digitally, due to the ability to undo digital actions.

**Summary interpretation regarding Anon2\_ITV\_Expert’s comments:** Anon2\_ITV\_Expert stated that ITV had the potential to do remarkable things in terms of flexible, non-textual, video productions delivering a wide range of information, provided that sufficient money, time and effort were invested in the infrastructure and content of the new technology.

Important design characteristics of ITV programs suggested by the respondent were relevance of the interactivity, that the interactivity should make sense, and that it must be important to the viewer. Previous use of technologies with similar language was listed as an advantage for persons adapting to use of the new technology.

**Summary interpretation regarding HM\_ResFellow’s comments:** HM\_ResFellow discussed the programs he had observed in his overseas travels. He said that he had noticed that interactive television was hampered by the current state of the technology. He qualified this by saying

“however, that is a rapidly evolving thing in itself in that things we can’t do this year we can probably do next year and you need to keep a really open mind about that.”

HM\_ResFellow discussed technological restrictions relating to ITV, stating that there were many, including that there was no really specific way of putting applications together, and that it had been found in the UK that producing an interactive show disrupts the production timeline. This extended timeline resulted in children’s interactive television being restricted to several shows per year, according to HM\_ResFellow.

HM\_ResFellow stated that interactive television was at a certain level of technology, cost, and ability, and that this would change and evolve, so that costs would come down, time lines would reduce, and people would become more capable of using it. He stated that ITV had not yet reached its enormous potential. Finally, HM\_ResFellow re-iterated that “[ITV is] merely a tool, a tool that is developing in its sophistication but the most important thing is the quality of the product that you use this tool to create”.

**Summary interpretation regarding DV\_ITRI’s comments:** DV\_ITRI stated that ITRI had staff responsible for developing the “traditional”, not interactive, audiovisual functionalities in use at ITRI, computer programmers, and a person who worked on engineering projects such as building recording boxes for a particular study. The latter recording boxes were capable of recording people watching TV in their home environment, and keeping track of their remote control use by “automatically planting meta-tags throughout the experience”. The data would be automatically encoded, file transferred, then archived at ITRI.

One of the rooms shown to the researcher by DV\_ITRI was a viewing room. DV\_ITRI stated that everything was highly controlled within the viewing room, with multiple cameras so that the researchers could watch participants’ viewing behaviour. An innovation developed at ITRI was to have a coffee table which could move up and down, and which contained an eye-gaze camera. DV\_ITRI said that this was designed to be fairly unobtrusive, while enabling researchers to track the eye movements of viewers.

DV\_ITRI described how the post-viewing survey was in the process of being automated. He said that at the end of the viewing process a code would appear which indicated how the participant had interacted, hence determining which version of the post-viewing survey would be automatically uploaded onto a computer for the individual participant to fill in.

Other rooms which DV\_ITRI showed to the researcher included a room which was being converted to a combination sound booth for production of audio recording, and debrief room, an observation room which provided the researchers with camera feeds, and the rack room which contained various computerised systems.

DV\_ITRI discussed interactive TV authoring environments, stating that the main ones resulted in boundaries that were problematic for the needs of ITRI, so ITRI was developing its own systems and simulation environment. These enabled ITRI to test many things, and gained ITRI a global reputation for audience insight projects.

DV\_ITRI described his favourite interactive ad, stating that what made it so good was that it was well researched before it was deployed. He described it as being simple, with the viewer clicking to enter a low tech “micro-site”, the purpose of which, according to DV\_ITRI, was to extract information about the person’s lifestyle, and product needs.

In regards to educational television, DV\_ITRI commented that it was “still caught in the old paradigm of education” and was “still curriculum centred”, qualifying these comments by saying that this was mainly attributable to the nature of technology. However, he continued that, as technology entered a domain where interactivity became feasible, this suddenly allowed television to “make that shift from being curriculum centred to being child centred and that’s a very exciting shift”.

DV\_ITRI touched on the difference between the levels of complexity of interactions which older viewers were capable of compared to younger viewers. He stated that the key was that if the technology could be intuitive, so that users did not need to think about what they were doing, then it could be considered viable. Regarding ITV technology’s impact on education in the future, DV\_ITRI described it as “huge”.