Lines of Desire: the Challenges of Interactive Educational TV

Rosemary LUCKIN and Benedict DU BOULAY
IDEAs Lab
School of Cognitive & Computing Sciences, University of Sussex
Brighton
BN1 9QH, UK
{rosel,bend}@cogs.susx.ac.uk

Abstract: This paper addresses the subject of interactive educational TV and explores the issues involved in combining the production traditions of TV with the interactive theories derived from AI in Education. Of particular concern are notions of narrative coherence and collaborative learning. We describe initial steps towards realising a system, based on matching a database of tagged media resources to the requirement of different learners as represented in their Broadband Learner Model.

Introduction

Most homes possess a TV set and as a result this technology has been used to deliver motivating, gripping and captivating content to millions of people of all ages. The tradition of broadcast TV is strongly rooted in narrative with TV producers able to tell a good story, to intrigue, elucidate, captivate and engage. These creative qualities that TV uses to fashion an enjoyable experience for audiences and raise their ratings are those same qualities that an effective teacher may use as she guides her students to understanding. These are also the same qualities that are however sadly lacking in many educational technology resources. This is true despite the existence of high production quality video in many multimedia systems and a wealth of skills and experience in effective pedagogy, interactivity and adaptive system design amongst software developers. Two reasons why this enterprise is particularly timely are: (i) the introduction of digital interactive broadband systems that can carry information both to and from the audience thus enabling interactive engagement with that audience as well as peer to peer collaboration and socialization amongst the members of that audience; (ii) the relatively recent arrival of affordable and easy-to-use home video editing software, video capture cards and digital cameras that enable the audience as well as the TV producer to create and share their stories.

However, despite all this potential, the future of Interactive Educational TV is unclear. There are problems concerning the nature of the interactivity itself and of the learning experience that it is appropriate to deliver through this medium. Learners are not yet used to interacting through their TV screens, which, whilst excellent for viewing video, are not as appropriate when it comes to text and navigation. What is required is a learning experience designed for delivery across multiple technologies and interfaces in which the

educational media are integrated into a coherent, non-linear narrative and experienced by the learner through the technological artefact that best delivers the media being used. But how do we create this new sort of TV 'programme' experience that allows learners to use different technologies and maintain a story line, and also allows them to create and integrate their own narrative elements without loss of coherence?

In this paper we describe our interest in how we can bring together the best of the production traditions and expertise that currently exist amongst film and TV producers on the one hand and amongst Intelligent Learning Environment (ILE) developers on the other. The next two sections discuss the issues of narrative and effective collaborative learning. In Section 3 we describe the database of reusable resources that we have built, concentrating in particular on issues of dynamic *vs*. static tagging, description of pedagogical relationships between resources, and the notion of users as resources. Finally in section 4 we briefly describe our design for an interface to this system.

1 Interactive narrative and its relevance to learning

Bruner [1] discusses narrative as "a mode of thought and an expression of a culture's world view". He suggests that we make sense of our own thoughts and experiences, and those of others through the active generation of narrative. In this sense, narrative shapes our knowledge and experience and is central to our cognition from earliest childhood. However, implicit in many definitions of narrative are notions of sequence, connectedness, causality and linearity that present difficulties when we consider the development of interactive narratives. An explicit focus of much postmodern literature is the notion of the members of the audience as being active participants in the production of meaning from the script or text. By contrast, with interactive media the audience, readers or users are active as a direct consequence of the media itself. The fact that we have control over our experience of the narrative forces us to confront issues concerning our relationship to the story line, or guidance within the medium, and how we construct or create meanings from the experience. In the past we have discussed this relationship as that which exists between the processes of Narrative Guidance and Narrative Construction and have suggested that developers of interactive multimedia learning resources need to confront this relationship and provide tools to ensure learners can create their own story from the resources and in this way construct meaning [9]. The beauty of interactivity can be seen as offering the actors in the audience a host of opportunities: pauses or gaps in the narrative (for example) for which they need to create personal bridges. In this way the users become authors both for themselves and for others.

The quality and contingency of these pauses and gaps is however a key design imperative; a design imperative that must be translated from current TV and film production traditions into the new tradition of interactive educational television experiences. We need to create this sense of collusion between producers and learners so that they are both active participants in the creation of an educationally effective narrative construction experience. We need to free learners to explore their own 'lines of desire'[1].

[1] An architectural term that refers to the paths people make on new building developments. These paths are often shortcuts that ignore the given route. Often popular paths emerge and more and more people take a particular path in preference to any pre-existing route. As the nature of the building development changes so do the lines of desire as they accommodate new content and changes in the environment.

2 Effective collaborative learning

There are already a few examples of artificial intelligence techniques being used by broadcasters to offer learners adaptive TV. Linear television programmes are broken into sections, each of which deals with various types of activity and offers viewers the opportunity to engage in interactive activities throughout the transmission of the linear programme, in real time. At the end of each section, viewers who have decided to participate in the interactive version, are offered the choice of continuing to view the TV programme, or exploring a particular theme further through interactive enhancements (Exuberant Digital Ltd.). The system tracks the choices of the user and offers users differing versions of the main programme when they return to it, depending on which theme they have explored and to what depth. However, even these encouraging, though rare examples of intelligent interactive TV have not entered the arena with respect to a community of learners. The TV set could now become a focus for personalised and collaborative learning encounters that connect learners across the globe and down the street. So how do we build TV programmes that embody interactive narrative and engage groups of learners in a collaborative meaning making effort? At this point we need to turn to pedagogy for guidance.

Constructivism has been influential within mainstream education and the design of educational technology alike. One brand of constructivism that is particularly appropriate to our current pursuit is that of Social Constructivism, in particular that attributable to the Soviet socio-cultural school founded by Vygotsky, Leonti'ev and Luria [12]. Whilst Vygotsky and his colleagues lived in a computerless world, their socio-cultural theory of human development has been used to good effect by many designing computer systems and has acted as the lynchpin for Learner Centred Design and Software Scaffolding. It is likewise highly relevant to our current endeavour. The socio-cultural approach, relies upon social interaction, internalisation, the inseparability of teaching and learning, and targeting the to-be-learnt to each individual learners' point of learning readiness. We must therefore provide opportunities and support for individuals and groups of all ages to act as both learners and teachers. We do not claim that this pedagogy is complete, merely that it provides a useful basis for translating from theory to practice in a contemporary world of anytime, anywhere digital connectivity.

The emergence of a network of technology savvy learners armed with digital video-cameras, MPEG encoders and other kit to produce their own world of online interactive educational TV resources may seem a far cry from the current situation. However, through addressing some basic technology questions, we may gain some momentum towards this end. Three of the technical problems we are currently starting to consider are:

- The delivery of a range of appropriately tagged video and other learning materials to TV set-top boxes. This requires work with tagging, some of which has already been done by our group. In particular, attention has been paid to the relationships that can exist between tagged elements in order to try and support reasoning about coherence and narrative.
- The implementation of a description of each learner in the audience so that it can be distributed across multiple devices and still support co-ordinated updating.
- The creation of a repository of learning resources that include other learners as well as curricular content. In conjunction with this repository we are developing a tool to match the needs of a learner: with the most appropriate resources with which to build an initial TV 'programme'; and with some other people with who they may like to collaborate.

3 Reusable Resources

In an earlier paper [7] we outlined the educational rationale underpinning a user model, the Broadband User Model (BbUM), subsequently renamed as the Broadband Learner Model in recognition of the central focus on the learner. This BLM framework is designed to support individualisation of the interactions with individual learners, and collaboration between learners, via a system able to deliver a variety of resources in a range of media, including interactive TV. At the heart of such a system there needs to be a database of resources from which learners, educational designers or the system itself, including the learner model, can select.

A *learner* may wish to determine for herself the kind of interaction that she wishes to have. An *educational designer* may wish to use the database as part of an authoring environment in order to compose default sequences of resources, or parts of resources, for a particular class of users. Finally the *system* itself may need to access the database dynamically in order to suggest possible activities to a learner (either following a learner request or following the dictates of its own model of teaching).

Some of these resources will be items that were developed for other purposes, such as self-contained TV programmes, books or simulation programs. Others will be resources developed with such a system in mind. In either case the use and reuse of these resources depends on careful tagging at a level of granularity that enables them to be used both in their entire *original* form as well as *in parts*. Using a part of, for example, a TV programme implies that the tagging system will not just need to know about the domain content of that (and other parts) of the programme. It will also need to encode information about the potential pedagogic *roles* that the part might play when combined with components taken from other sources. This implies a tagging system able to encode a set of pedagogic relationships between parts (see e.g. [3]).

If we look at the large amount of information we need to know about each element in order for it to be used effectively as a part of a larger learning experience it quickly becomes apparent that, not only is this a huge task, but also that we may not be sure about the best description for a particular content element at the time we wish to add it to the storage system. Indeed as more elements are added to the knowledge base of content elements the role of any individual element may in fact change. In addition to standard static information about Content, History, Curriculum position, and Intended end user, further Key Metadata Categories might include:

1. Information about the elements relationship to other elements in the system e.g. Prerequisite / co requisite / post requisite, Analogous, Analyses
2. Metadata specifically associated with the Broadband User Model for each learner e.g. ID, age, gender, Formal education, Confidence, Learning style
3. Information generated by monitoring use e.g. About the element's history once within the system e.g. Proportion used till or beyond duration, Average time when seen till end, How often has this item been used
4. Information generated by asking user for input e.g. User difficulty rating, user ratings enjoyment, user ratings appropriateness

The reuse of electronic educational resources and their associated metadata is not a new idea. For example, Suthers [11] describes useful extensions to the IEEE's Learning Object Meta-data (LOM) (see e.g., http://ltsc.ieee.org/doc/wg12/LOM_WD4.htm) designed to refine the notions of audience, community involvement, discipline, educational level and objectives and pedagogy. Another metadata system in increasing use is SCORM (see for example, http://www.adlnet.org/). Increasing use of the Web also brings indexing, tagging

and metadata issues to the fore in order to facilitate the remote reuse of education resources, see for example, the Easel project (http://www.fdgroup.com/easel/) or the Guardians project (http://www.fdgroup.com/guardians/).

At another level of granularity are schemes designed to enable the interoperability of whole systems such as that presented by Koedinger, Suther and Forbus [5]. All of these schemes imply the existence of some kind of authoring environment that enables the system designer to construct sequences of educational interactions conforming to some pedagogical plan and maintaining narrative and educational coherence (for an review of authoring systems, see for example [8]).

3.1 Dynamic Tagging

We need to consider the different categories of information required by the BroadBand Learner Model pedagogical framework, with the purpose of deciding which categories might have a specification that may be created or changed over time.

Much of the information necessary to define the metadata would be known when the content element is added to the storage system.: Some of this metadata represents an element's identity and must be 'locked-in' to each content element when it is created (either from new or as a result of re-use), for example: a unique identifier, the element's origin, subject title, duration, media type, number of components. This information is readily accessible from the outset and may be useful for the creation of a learning experience with some semblance of individualisation. However, the constraints of this individualisation would make such a learning experience limited. The information contained in categories 3 and 4 above will not be known when the content element is introduced to the knowledge base and can only be added as and when that element is used by learners. These categories of metadata could be created collaboratively with the learner who may be invited into the process of creating and changing a content element's profile as well as their own learner profile [2]. The remaining categories i.e. 1 – 2, offer us an interesting opportunity to borrow another technique already used successfully within the ITS community for learner modelling [4] and apply stereotypical definitions to these metadata fields as the content is first added to the storage system. The use of stereotypes would allow us to increase the adaptivity of the system and its individualisation to each learner from the word go. In addition to which, making these metadata tags editable by the system would then enable us to refine this individualisation as and when that element is used.

3.2 Pedagogic Relationships

We are interested in the idea of finding ways to exploit the many existing resources in the form of TV programs, books, newspaper articles etc that could be employed to assist home-based learning. The work of adding a new resource to the database proceeds in three stages. First of all the resource needs to be notionally subdivided into parts of sufficient size that they could in principle form building blocks that could be reassembled in a different order or intermixed with parts of other resources. In dealing with a book, for example, this subdivision might be at the level of a section of a chapter. In dealing with a TV program this subdivision might be a sequence of a few minutes. Each of these parts needs to be accessible in its own right and associated with metadata about the media type, duration, ownership etc (e.g. as in the LOM or SCORM systems mentioned above. Whilst these schemes have fields for specifying relationships between items, the exact specification of such relationships is still under development). The second stage is that each part needs to be indexed for domain content in terms of some general scheme, for example the National Curriculum (see for example, [10]). The third stage is to tag each part in terms of the

pedagogic relationships it plays within the resource it originally formed part of. This is needed so that parts can be recombined in ways that provide a coherent new narrative.

For example, imagine that a TV programme is being indexed in this way and that it consists of a number of items, originally in a chronological sequence from item 1, at the beginning, to item 70, at the end. The kinds of relationships between items that we have experimented with are shown in Table 1. Labelling the items in the TV programme using the above relationships makes explicit some of the implicit pedagogic relationships that underpin the design of the original programme. This enables the possibility of recomposing the TV programme in some other sequence that reflects a different overall pedagogical structure to the original.

Table 1. Examples of Relationships between resource items

RELATIONSHIP	EXAMPLE: this item
Prerequisite/Corequisite	Must be preceded by Item 34 or must be accompanied by Item 36
Analogous to	Is like Item 56
Analyses	Analyses Item 57
Background for	Provides background information for Item 49
Recasts	Is an alternative view of item 67
Applies	Applies ideas/principles from item 44
Modifies	Applies extends or modifies item 44
Assesses	Provides a test of item 44
Reflects	Provides a means of reflecting on item 44
Generalises	Is a generalisation of item 44

Other resources will have been tagged in a similar way, both in terms of the domain and in terms of the relationships above. This opens the possibility of constructing a new internally and pedagogically consistent programme made up of parts taken from a variety of resources.

3.3 Users as resources

In order for this methodology to be compatible with the notion of a Broadband Learner Model the metadata profile needs to contain information that relates to each of the elements in the Broadband Learner Model of each learner. For example, we may specify a field in the learner profile that specifies her interaction style: e.g. lots of hints; few hints; feedback throughout; feedback at end; more activity; more material to be viewed etc. The metadata associated with each content element would then need to contain an equivalent field that specified the nature of the interactivity that might be engendered when this element is used. By adding slightly to the metacognitive metadata descriptors of each learner (such as their ability to plan, goal set and reflect as well as their preferences to seek and provide help), we can factor in the collaborative potential of each learner to provide help on particular topics to other individuals or groups. Each time a user (learner, system or teacher) of the system requests some resources they are then presented with information about the human resources that can be called upon as well as the media resources that deal with a selected curriculum area and level, as illustrated in Figure 1)

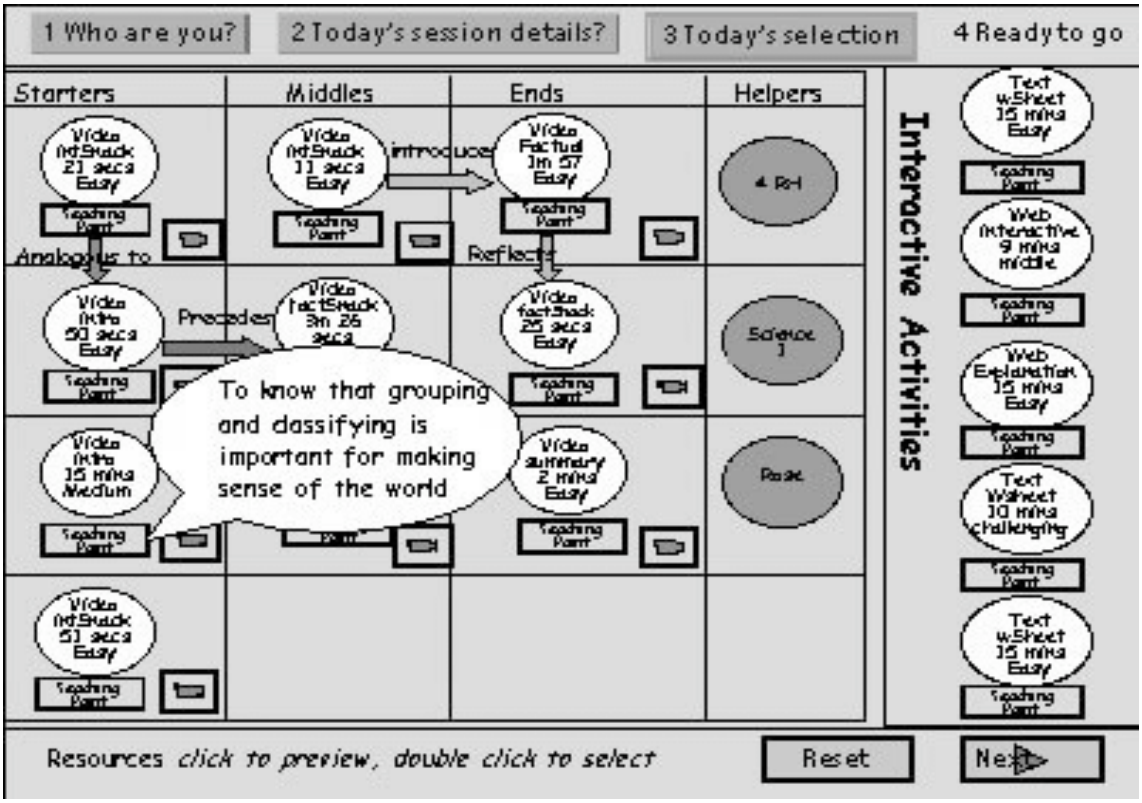

Figure 1. Prototype interface to database of resources.

4 Conclusion

We have implemented a small database of reusable media fragments, each of which has static tags and static inter-fragment pedagogical relationships[2]. This database can be searched by entering a user profile and retrieving those fragments potentially suitable for assembling into an educational interaction. A prototype of the interface to this database is shown in Figure 1. This shows the way that retrieved fragments can be organised into a coherent whole. We are also able to store individual users and groups of users, who can be retrieved by a search mechanism as possible sources of help. This system is an initial step towards addressing two particular issues in relation to the development of engaging educational experiences for learners. On one side we are interested in the issue of how to support producers of intelligent interactive educational TV so that their products embody the best of both the narrative tradition and that of intelligent learning environments. This support is aimed to produce systems that adapt to the user or group or users, that adjust for delivery on various platforms and, crucially, foster collaborative, meaning-making activities amongst learners. On the other side we wish to support learners in their own meaning making: in particular, going beyond simply recording notes in an online "answerpad" (say) to using some of the same sorts of digital tools and resources available to producers of the original materials.

[2] We thank Dr Hilary Tunley for her work on this.

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Rosemary Luckin: I am a Reader in Computing Science and Artificial Intelligence and Director of the IDEAS Laboratory in the School of Cognitive and Computing Sciences. My research interests focus upon Learner Centred Design and Software Scaffolding. The projects I manage involve the design and evaluation of educational systems both within and beyond the desktop PC. I am currently particularly interested in the educational potential of digital toy technology, mobile communication devices and Interactive TV. I am particularly concerned with engaging learners through collaborative work.	
Benedict du Boulay: I am a Professor of Artificial Intelligence and Dean of the new School of Science and Technology. Before becoming an academic I worked in industry and as a school teacher. My general research area is in the applications of artificial intelligence in education. My specific interests include the role of representations in learning to program and in learning radiology, and modelling motivational teaching tactics in intelligent tutoring systems. Recently I have become interested in the interplay between intelligent learning environments and the narrative possibilities of interactive educational TV.