Sensational In(ter)⇒action: Designing Creative Learning Environments

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Abstract
Emotion plays an important role in life, both in personal and work life. In fact, it is part of almost everything we do, including artwork, decision-making and interpreting reality in general. Recently developed information technology may create emotionally-arousing sensations in the user, producing motivation and interest, but on the other hand too much emotion can impede use of devices, everyday creativity and learning. In this paper, we discuss how emotion can be used in design in order both to increase engagement and support creative learning. The idea is based on the notion of Perceptually-Seductive Technology (PST, outlined in Waterworth, 2001) and how PST can be applied to support creative learning in classrooms and other settings. Creative learning is characterised as the intersection of creativity (the production of novel and adaptive ideas) and learning (change persisting over time). Sensational in(ter)⇒action alludes to the need for frequent switches between presence and absence, action and inaction, and between the real and virtual worlds according to a design space defined by the three-dimensional Focus, Locus and Sensus model (Waterworth and Waterworth, 2001a).

Keywords: creative learning, evolutionary psychology, virtual environments

Introduction

Emotion is a very difficult and poorly understood topic, yet the appreciation of its importance to various areas of study is gradually increasing. It has always played a major role in psychotherapy, as for example the emotionally toned complex in Jung and the abreaction and catharsis of repressed emotions in Freud's method (Hillman 1962). Sociology uses the concept of emotion to describe and explain, for example, political phenomena, propaganda, family relations, and shadow aspects such as prostitution. In theological research into faith and belief it is often referred to, especially with regard to the questions of enthusiasm and mysticism. Linguists use the term to discuss the meaning of words, as for example within semiotics, which analyses the connotation and denotation of a word. In business economics the concept is often used in discussions about marketing and the motivation of staff. Within human-computer interaction there is a growing appreciation of the importance of emotion, and of the potential of utilising emotional cues in both directions – from user to computer application, and vice versa (Laurel, 1991; Picard, 1997).

Emotion often appears in debates about the conscious and the unconscious. It seems that there exists some kind of relationship between emotions and consciousness versus the unconscious. New insight often seems to pop into consciousness from the unconscious. Several models of creativity and learning acknowledge the impact of unconscious activity. When we learn a new skill, what was initially conscious gradually becomes unconscious. One way to control this two-way traffic between consciousness and the unconscious is through the evocation of emotion, which can act as a gatekeeper between the two. At the same time as emotions could be used to evoke motivation and interest, they could, if used wrongly, impede the use of a device, and hinder creative learning. In designing creative learning environments one has to consider the impact of emotion in order to create motivated students and how to design for emotions so that the effect is sufficient but not excessive.

Theoretical foundation

Sensational in(ter)⇒action is based of the idea of using Perceptually-Seductive Technology (PST) to create creative learning environments by using the Focus, Locus and Sensus model (Waterworth and Waterworth, 2001). We describe this foundation below. Augmented with some ideas from environmental psychology of how we experience and behave in space, this allows us, in the next section, to give some guidelines to design for emotion in order to generate a creative learning environment.

PST and the Focus, Locus and Sensus Model

PST could be viewed as a general class of sensory augmentation that can appeal to multiple modalities. The information is presented in concrete forms, signifying that the information is interpreted non-linguistically and is more directly interpreted perceptually rather than through abstract thinking. This form of presentation is interpreted much faster than information that has to be processed via the intellect, i.e. in a linguistic form. Usually the information in PST is presented in a 3D space. This 3D space could either be a personal or a shared space. Furthermore it could be based on and implemented as physical, virtual or as mixed realities. One approach is to present information in so called memory theatres (see Waterworth 2001, Waterworth and Waterworth, 2001b).

Recent technology such as virtual reality (VR) and augmented reality (AR) makes it possible to experience the same information through several senses at the same time. This could be viewed as a simulation of the experience of synaesthesia, although the experience is through the technology, e.g. the technology is presenting the information in several different modal forms to the user. Elsewhere, we have suggested that designed "synaesthetic media" can provide interactive tools for creativity (Waterworth, 1997). This characteristic is important in PST as a synaesthetic experience is also assumed to be emotionally appealing to the experiencer. In Ihde's (1991) terms, there is an embodiment relation between the person and the technology; it is as if the technology were part of the user's body.

Most of today's systems are single-modality even though they may offer new experiences in different ways, as for example a speech synthesiser reading a web page to a blind person, or the visualisation of numerical data as a graphical display. This is very different from a synaesthetic experience since there is no mixing of the senses and the same information is not presented to and expressed in several senses at the same time. This way of experiencing information gives it an additional dimension. For a non-synaesthetic person it is very hard to imagine this kind of experience, which has a life of its own and is emotionally-charged, sometimes even distressing, but always valued.

In order to evaluate and understand the experience in virtual worlds it is necessary to have some kind of model of that experience. The model ought to provide a conceptual space in which various types of virtual experience, and virtual reality applications can be placed. Our model of Focus Locus and Sensus (Waterworth and Waterworth, 2001a) provides a suggestion for such a model and we believe that the model could also provide a basis for richer understanding of the psychological realities of virtual experiences. The model consists of three orthogonal dimensions, *focus*, *locus* and *sensus*. The sense of presence is a key aspect of experience in virtual worlds, but in order to understand and evaluate those experiences fully we need to consider more that mere presence – which we characterise as a conscious emphasis on direct perception of currently-present stimuli rather than on conceptual processing. We consider these two types of conscious mental activity as end points of the *focus* dimension of the model. The other two dimensions are *locus* – that is, whether attention is directed towards the virtual or the physical world – and *sensus* – which is the level of attentional arousal, on a continuum from completely unconscious to fully

conscious. The combination of these three dimensions provides a conceptual space in which various types of virtual experience, and virtual reality applications, can be placed. This has implications for designing and evaluating virtual worlds of various types and with varying aims.

It is possible to loosely characterise virtual reality (VR) implementations of PST as like being in a cave (after Plato) and augmented reality (AR) implementations as more like looking through a telescope (after Galileo). Designs derived from these two approaches were implemented as prototypes – the Cave and the Telescope. Our aim was to begin to develop PST in forms that could readily be evaluated in schools, homes and offices.

The Cave

The Cave was implemented as a desktop virtual reality in two versions. The appearance of the application was either like a typical Shakespearean theatre from the first Elizabethan period, or a direct model of the student's own classroom. In the theatre or classroom different lessons are placed, in accord with ancient mnemonic techniques reviewed (see Yates, 1984). The Cave was implemented in two versions, the Memory Theatre or the Classroom Theatre, as described below.

Both theatres, the Memory Theatre and the Classroom Theatre, were designed to make it fun to learn and to stimulate the student's emotions. They were aimed at engaging the learner, through a sense of presence in a virtual world, and locating conceptual information within an environment demanding perceptual interpretation. In this way, they were intended to evoke the necessary shifts between presence and absence for creative learning.

The basic approach behind the applications was to use two different designs of memory theatre to hold the information to be learned. It could be seen as an attempt to integrate traditional education and some types of computer games, based on old mnemonic techniques.

The two theatres run in web-browsers, which have plug-ins that support both VRML-code, and Flash-applications. The structure of both theatres is as a web-page consisting of two frames, one that shows the VRML-world of the actual theatre and the other that shows the

Flash-movie of the actual lesson (Figures 1 and 2). Once in the VRML-world, the learner "walks" around the theatre to find clues to the lesson that he or she is going to study. The lessons are hidden behind different kinds of objects in the theatre, for example doors, balconies, computer screens or whiteboards. When the learner points to a marker in one of these places a message is shown to indicate which lesson he or she is pointing at. The Flash-movie of the lesson starts in the right-hand frame when the learner clicks on the marker of the lesson.

Figure 1, The Classroom Theatre

The Classroom Theatre (Figure 1) is a simplified representation of the learner's actual classroom. It includes the main objects in the room, but minor objects were excluded. The Memory Theatre (Figure 2) on the other hand is a fantasy world designed as a Shakespearean theatre from the middle ages, according to Robert Fludd's ideas of memory theatres (Yates, 1984). It consists of brick walls, balconies, pillars and so on.

The learner works her own way through the material, at her own speed; with no time constraints placed on the learner during interactions with the theatre. In addition to the applications, the learner is free to use other sources of help such as the reference book, a teacher or another assistant.

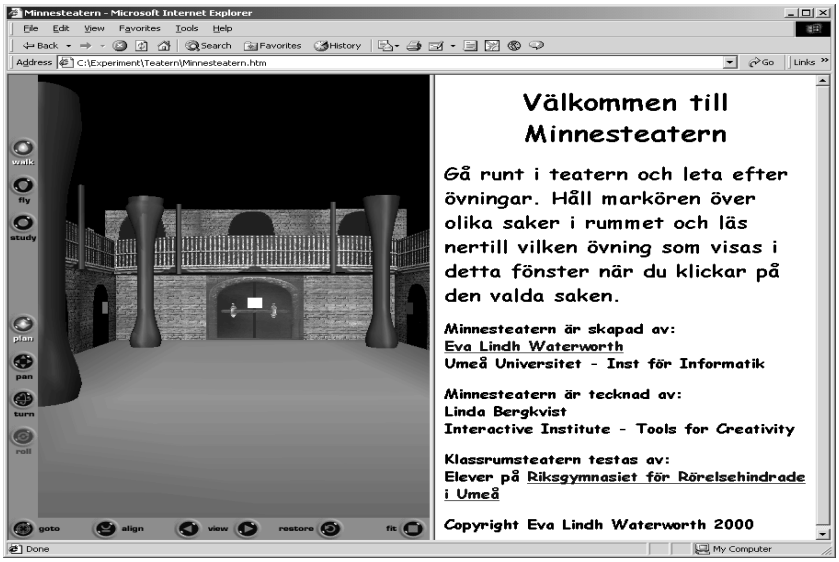

Figure 2, The Memory Theatre

The Telescope

There are several ways in which PST could be implemented as a Telescope. The first, maybe most obvious, is to use see-through glasses, and put tags in the classroom representing objects which trigger the lesson to start when selected. The lessons are superimposed on top of the view of the real world classroom as extra information. One advantage of this is that the student can easily switch between the learning application and the topic to be learned in a relatively unobtrusive manner. On the other hand there are several disadvantages with this approach, as for example the quality of existing see-through glasses is quite poor, and they give a narrow view for the wearer. Another problem with this approach is that it demands that the student moves around the classroom, so that she is relatively near a tag in order for the glasses to display the superimposed sign and selected lesson. That could make it disruptive for the other students. Furthermore this would not make it possible for the student to work at her desk or computer at the same time as viewing the lesson.

Another technique to implement the Telescope would be to use augmented reality glasses that are not possible to see through and show a model of the classroom, or even a filmed version of the classroom that includes the objects that start the lessons. This implementation is very similar to the desktop version of the Cave, The difference is that the desktop version is shown on the screen and the Telescope version shows the virtual world in the glasses. In this version

of the Telescope the student sits at her desk and can at the same time work with the computer even though she then has to take the glasses off.

A third approach to the Telescope would be to implement something similar to the MagicBook (Billinghurst et al. 2001). MagicBook is a Mixed Reality (MR) that, according to the authors, allows for a seamless transition between physical, augmented and virtual reality. It looks like an ordinary book that can be read in the ordinary way. At the same time it has a handheld display that enables the user to view three-dimensional virtual images that appear overlain on the pages. In addition, it is possible to fly into the scenes and experience them as immersive VR worlds. In the suggested implementation for PST in an educational setting, the learner uses a book with text about the learned topic and images that are the entrance to a virtual world. The learner interacts with the book by using augmented reality glasses and, by looking at an image, the learner is transferred into the virtual world, in this case the memory theatre or the classroom.

An advantage of this last approach is that the student can stay at her desk during the session and because of that, also work with other applications on her computer. The style of interaction is fairly unobtrusive given that it is rather easy for the student to put the glasses on or take them off depending on the chosen action. Another advantage is that in the book it is possible to mix abstract information expressed in ordinary language with images that represent concrete information where the learned topic is put into practice. This demonstrates how abstract information can be mixed with concrete information in a smooth way. This provides the necessary switches between presence and absence on the Focus dimension.

Design Recommendations for Educational PST

Models of creativity and learning are quite similar, but that does not mean that creativity and learning are identical. Creativity implies novel solutions or outcomes, in the case of everyday creativity novel approaches to personal problems, for example. Learning implies continuation in time, a mental change that endures. One may learn something that is not really a novel solution to a problem. And a novel solution may not endure in time, i.e. it may not be learned but rather immediately forgotten (Waterworth, 2001). Creative learning – producing novel approaches that endure over time – is the main focus of interest here, and emotion plays an

important role when designing a creative learning environment. This section presents some general guidelines based on the ideas presented above mixed with some ideas from environmental psychology about the importance and role of space and spatial features in human psychology.

According to theories in the increasingly influential fields of environmental and evolutionary psychology, the notion of space plays on important role in human life. There is evidence that the portrayed landscape that people prefer - as indicated by emotional feelings of pleasure - is the African savannah (and similar, designed garden landscapes), even though most people have never been there (Orians and Heerwagen, 1992). The suggestion is that this emotional feeling of pleasure reflects the evolutionary history of the human race, since the savannah is where humankind evolved. Almost all young children find landscapes similar to the one shown in Figure 3 pleasurable. They elicit positive emotional responses in a way that transcends culture, because of their evolutionary origins. Adults have typically learned to appreciate other types of landscape, such as pine forests or deserts, as well.

What characteristics of the African savannah could be used when designing a virtual space that evokes predictable emotions in its user? One pleasurable characteristic is openness and readability, signifying that the landscape (space) is open in order that the user can easily get an overview of it. Furthermore the landscape ought to include landmarks, boundaries and edges in order for the user to see the structure and create a mental map over the space easily (cf Lynch, 1969).

Figure 3, A universally pleasurable view?

A second pleasurable characteristic is hide-ability, indicating that it is possible to hide safely and still observe events in the space if necessary. The third attribute is mystery, the environment must suggest some unpredictable characteristics in order to engage the user's curiosity. One may show the audience something they have not seen before or provide something with amazing visual appeal that makes the user want to stay endlessly in order to make sense of it. Too much mystery can feel threatening, however, especially in a portrayed urban landscape. A related technique is to design some imperfections into the environment or in the characters that appear in the environment.

The last, but not the least, characteristic is the design of events in the environment. It is important that events evoke some emotional response in the user. Examples of events that could appear in an environment such as the African savannah, are thunder storms, streams, sea or lakes or noises from animals or objects in nature. These spontaneously attract attention and each produces its own emotional response. The events are unpredictable, but the responses they elicit are not.

In designing and implementing PST, we have found that there seems to be a tension between trying to support creative learning and producing perceptual seduction. But it is possible to imagine a combination of evocative design features applied to education. By monitoring the

learner's arousal level, she could be helped to avoid too high or too low levels over too long a period, and encouraged to switch between the two. The materials displayed could be adjusted to provide alternating periods of intense stimulation and of relaxation. In other words, the suggested elements of sensational in(ter)⇒action would be exercised fully. We suggest that the designed application sensational in(ter)⇒action elements to creative learning environments would erode existing classifications of the relationship between people and technology.

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