Engagement as a Design Concept for Multimedia

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Abstract: Developers of educational multimedia software aim to design presentations that will encourage and facilitate students' learning. The paper describes how an understanding of "engagement" can be applied to aid in the design process. Engaging interactions make multimedia systems more attractive in ways that support learning gools. We provide a detailed explanation and a taxonomy for engagement based on practical work from our laborotories. We give examples of interactions that are found to be engaging, suggest methods for evaluating their impact on the learner and practical hints for incorporating them into multimedia system design.

Résumé: Les concepteurs de logiciels pédagogiques multimédia doivent élaborer des présentations qui encouragent et aident les étudiant à apprendre. Cet article décrit comment la compréhension du terme <<engagement>> peut aider au processus de conception. En encourageant les interactions, on rend les systèmes multimédia plus attrayants tout en favorisant l'apprentissage. Nous apportons ici des explications détaillées et une taxinomie du terme <<engagement>> basées *sur* le travail pratique fait dans nos laboratoires. Nous apportons des exemples d'interactions que nous considérons *comme* <<engageantes>> et nous faisons quelques suggestions *sur* les méthodes à utiliser pour en évaluer l'impact sur l'apprenant. Nous *offrons* également des conseils pratiques pour leur incorporation au processus de conception *des* systèmes multimédia.

INTRODUCTION

Throughout our lives certain things, people and events attract us and hold our attention more than others. Sometimes we can explain why and other times we cannot. This paper argues that a greater understanding of the reasons why some things we encounter "engage" us more than others will help developers of educational multimedia systems to produce more successful designs. Specifically designing for ***engaging*** interactions has been shown to encourage and facilitate learning. Adelson (1992) for example, used "evocative agents" in a multimedia application to provide an "engaging but not

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distracting environment for learning to analyze and argue with individuals from a foreign culture" (p.356). Hsi & Agogino (1993) engaged students with their multimedia system, using "interactive pop-up *think* questions...to stimulate reflection and critical thinking" (p.257).

To date, there has been little attempt to define, analyse or evaluate *engagement* with computer-based learning materials. Skelly (1991) suggests that an *engaging* computer interface is "seductive" as it will "draw in the user and make interaction with the computer a fulfilling experience" (p.3). Laurel (1991) recognises the benefits of making interactions "pleasurably engaging", saying it is a "desirable — even essential — human response to computer mediated activities" (p. 112).

This paper aims to extend the current understanding of *engagement* by discussing examples of work carried out in our laboratories. Both laboratories design and evaluate the usability of systems with a human-computer interface. The paper provides a definition and a taxonomy of engagement, as well as practical hints on how designers can evaluate *engaging* interactions and incorporate them into their work.

ENGAGEMENT AND MULTIMEDIA

Learners' motivation to use computer systems can stem from two sources: *intrinsic* and *extrinsicgoals* (Malone, 1980). If their reason for use comes from external influences such as obtaining good grades or peer pressure, they are *extrinsically motivated*. If the reason originates from their own willingness or desires, they are said to be *intrinsically motivated*.

While good multimedia system designers will appeal to both kinds of motivation, this paper is concerned with engagement arising primarily from intrinsic motivation. That is, systems which encourage and support users' attention without external pressure. Inherently rewarding interactions increase learners' intrinsic motivation to continue, which can lead to a state of *flow* a condition in which "people are so involved in an activity that nothing else seems to matter" (Csikszentmihalyi, 1992, p.4). However, too much engagement can be a disadvantage. Games for example, can be very compelling (Shotton, 1989) and distract users from their initial learning goal. Conversely, systems that become unattractive during an interaction and do not help to reach learning goals, can lose users' attention, cause them to become *disengaged* and perhaps even conclude their involvement.

Well designed educational multimedia is balanced; it should provide the content and functionality to satisfy learners' needs in a manner that is attractive, yet not distracting. The next section describes some practical examples of design features affecting participants' motivation and engagement.

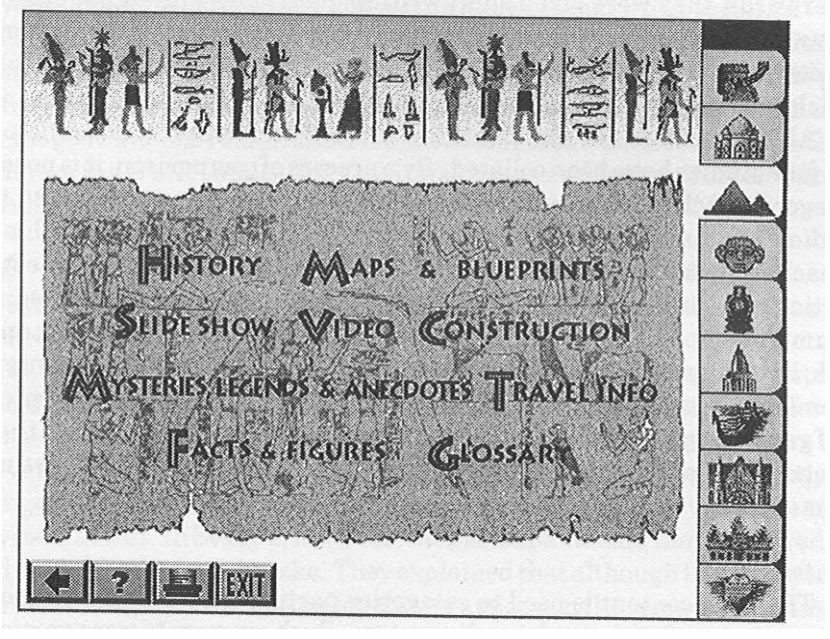
PRACTICAL EXAMPLES OF ENGAGEMENT

The following examples come from four practical studies conducted in our laboratories.

Study 1 (Jacques, 1994a) asked ten novice multimedia users to interact with a multimedia CD-ROM presentation called Great Wonders of the World (GWW). GWW was a software innovation award winner in 1992. It provides history and travel information about ten Wonders of the World using a variety of media, including video, audio, photographs, graphics and hypertext. Figure 1 is a typical menu page for a Wonder of the World and shows the different categories of information and media available to users.

The participants were individually asked to explore GWW by browsing at will and for as long as they wanted. Throughout their interaction they were asked to speak out aloud their thoughts (i.e. provide a "verbal protocol"; Ericsson & Simon, 1993). If they were quiet for too long, the observing Investigator asked them, "What are you thinking?", although avoided entering into dialogue. The study was video recorded to aid the analysis of their comments later on.

Figure 1.
The Pyramids menu page in Great Wonders of the World



Study 2 (Jacques, 1994b) also used the software Great Wonders of the World. Eighteenvolunteersparticipated, whose
terns was rated as "average" on a five point Likert scale from "none" to

"extensive". They were individually asked to spend up to fifteen minutes on each of three tasks common to hypertext type systems (Marchionini & Shneiderman, 1988): browsing (for an overview of the subject content), closed search tasks (find a single answer) or open search tasks (find as many constituents to an answer as possible). After each task, they were asked to complete a questionnaire about their subjective reactions. The questionnaire was mainly in a "check the appropriate box" type of format.

Study 3 (Nonnecke et al, 1995) examined the use of video clips for a future multimedia system. Seven video clips (from 12 to 90 seconds duration) were taken from a six minute video, with the intention of capturing the salient aspects of the storyline. Participants in the study were asked to run and control each clip in sequence and to write down any questions they had about them. Eighteen individuals, typically with "a little" or "average" knowledge of the domain subject, computer software design, participated.

Study 4 (van Aalst et al, 1995), evaluated the learning potential of a multimedia teaching aid recently developed in the laboratory at Guelph. The multimedia module is called FLUID and provides a Framework for Learning User Interface Design. It combines a concept table, tutorials, design work-bench, library and case studies using text, audio, video and graphics.

Six students with classroom experience of systems analysis and design were given a learning goal and asked individually to meet it using FLUID. Afterwards, they were given short written questions. Throughout the study, they were observedby twoinvestigators whobrieflyinterviewed them afterwards to determine their subjective reactions to its usability and those design features which they did, or did not like.

All the participants' comments andinvestigators' observationalnotes from the four studies have been collated. By a process of comparison, it is possible to categorise each of them into one of the following three groups: content, task or *media*. The distribution into each category is not of significance for this paper as each study had a different objective. For example, Study 2 aimed to establish participants' preferences for different task types, so the content and media were commented upon less. While in Study 1, the participants undertook only one task, browsing, so their comments were directed more towards the content and the media. It is therefore not possible toconclude that one of the three categories is of greater significance to design than the others. An explanation of the three categories is given below using examples from the studies most pertinent to them.

Content

The term content is used to categorise participants' comments about the subject material of the multimedia system. Such comments were particularly prevalent in Study 1, in which participants were invited to browse at will through the multimedia presentation, Great Wonders of the World. Participants would frequently justify their style and choice of interaction in terms of the subject material. For example, "I like the Pyramids section best because I am interested

in Ancient Egypt". Likewise, the information categories within each World Wonder (e.g. Figure 1) were frequently chosen and judged in terms of their content. A typical comment was, "I'm enjoying this because I like History". The method ofpresenting the subject material was also a factor; for example, "I like the facts; they're interesting". Educational content is commonly provided in the form of facts, concepts and skills.

In terms of the content, one World Wonder was not largely more popular than another. This is probably because participants' reactions to content are varied and often diverse, based on personal and individual preferences.

Task

The type of task participants' undertook in our studies was found to have an impact on their opinionof a particular multimedia system they were using. The purpose of Study 2 was to discover their preferences among three tasks; browsing (to gain an overview of the subject content), closed searching (find a single answer) and open searching (find as many constituents to an answer as possible). The results indicate browsing to be the most popular, with typical reasons being "more freedom" and"less pressure"; although some complained they were bored and felt unsure about what they were doing. The closed search task was the next most popular. Some said they preferred it over browsing because it offered more of a challenge. The open search task was the least popular, as participants said they were unsure whether they had all the answers and when to finish.

A few participants commented that if they were to use the same multimedia system again their reactions would be different. Browsing, they said was good for a first time interaction, but with subsequent use they would prefer more of a specific goal. No-one remarked that a particular task was not suitable to Great Wonders of the World, indicating that it was a reasonable choice of software for the study.

Media

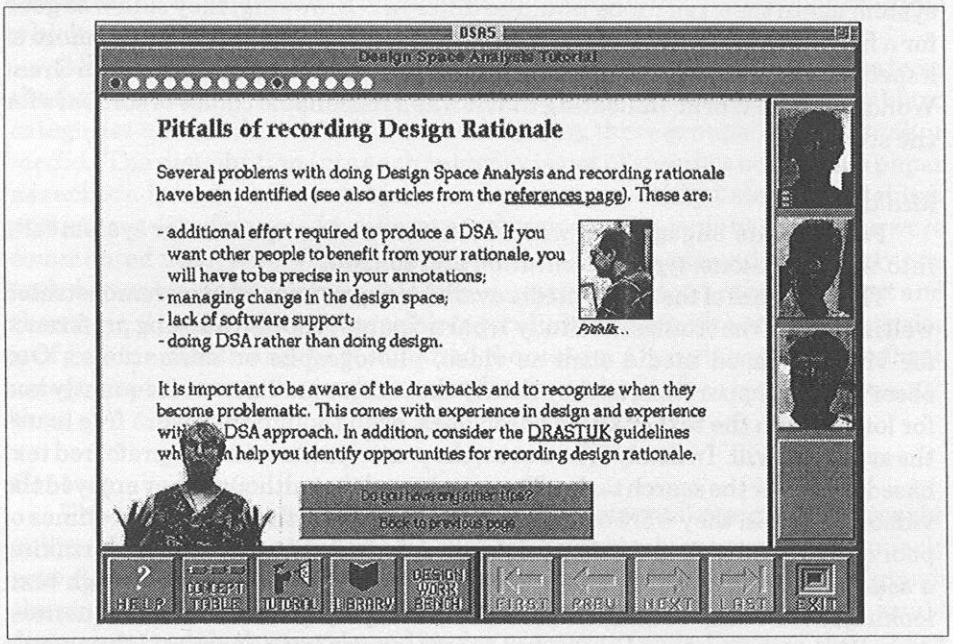
Participants' engagement with the media used in a particular system falls into three divisions: *type, presentation* and *control.*

The influence of the *type* of media available to participants was demonstrated three of the studies. In Study 1, participants reported a strong preference for visually based media such as video, photographs or animations. Our observations support this, as they clearly chose these media more frequently and for longer than the text or audio based ones, even though they were free to use the system at will. In Study 2, however, the participants said they preferred text based media for the search tasks. They explained that although they enjoyed the video and slides, they were often too slow to appear on the screen, sometimes of poor quality and lacked the control they would have liked. When undertaking a search, they said they found it easier to skim back and forth through text, looking for relevant information rather than replay audio or visual sequences. A similar result was found in Study 3, where many participants said they would like to have the information from the video clips available in an alternative

format. Popular choices were on-line text and books. Although we acknowledge this is dependent on the content and the quality of video, it does suggest that the inclusion of video in multimedia presentations is not always an engaging feature. It does however, seem a popular choice when participants have "more freedom" and "less pressure" to browse through the system at will.

The *presentation* of the media, such as the style of the typeface, use of colour in graphics and quality of sounds were found to influence participants' opinions of the system in all the studies. In Study 4 for example, FLUID uses many short video sequences (of up to 2 minutes) of head and shoulder views of "experts" to help the user reach their learning goal. In the early development of FLUID, the video was presented in "pop-up" QuickTime windows at the center of the page. In subsequent versions, this was changed by removing the window surrounding the video image and placing the experts elsewhere (see Figure 2). The experts then became fully integrated into the text and could interact with it. The expert in the bottom left hand corner of the page in Figure 2 moves in front of and behind the text, then points at words or buttons to illustrate what she is saying. Throughout the evaluation stage, participants commented on how much they liked the integrated video, often replaying them to specifically see the sequence again. They found these video clips engaging.

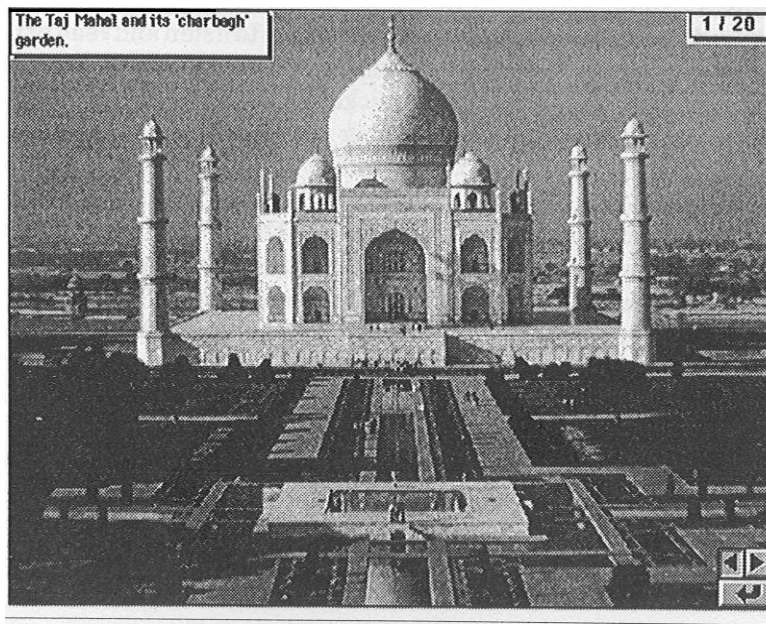
Figure 2.
The Person in the Bottom Left-Hand Corner of this Page from FLUID is Part of a Motion Video Interacting with the Text Behind



The effects ofpresentation can equally disengage and demotivate learners. In Studies 1 and 2, some participants complained of poor video quality and refused to use it, saying that the QuickTime window was "too small and grainy". This is a technical constraint and is one that designers must consider carefully; it may be better not to use video at all, than to use it poorly.

Throughout the practical work, we noticed that the multimedia presentations affording a poor degree of control and navigational support for the user caused many complaints. The issue of control presents itself to users early on. If they do not feel the system is navigable or are uncomfortable with its structure, they will not be sufficiently engaged to continue using it. The slides' category in GWW illustrate this point. Each category consists of around 15 narrated slides, all having forward, reverse and return buttons in the bottom right hand corner (see Figure 3). When each narration is complete (after 10 to 40 seconds), the program automatically advances to the next slide. This caused many participants to comment and they were divided as to whether they liked it. Some said they enjoyed being able to sit back from the computer and allow the slide show to run, while others were frustrated and wanted to view each one in their own time. Like most engaging or disengaging features, their reactions are dependent on other factors relatedto their motives for use. In this instance, it seems that the participants were influenced by their task; they preferred the automatic slide sequence if they were undertaking a free browse, but when searching for a specific piece of information they wanted to control it themselves.

Figure 3.
A Slide from Great Wonders of the World Showing the Forward, Reverse and Return Buttons in the Bottom Right Hand Comer



DISCUSSION

The previous section discussed the types of engagement we identified participants having with some multimedia systems. The Discussion describes how the different types relate, which is shown diagrammatically in Figure 4 and the implications this has for designers.

When using multimedia systems for learning, students' main motive is to satisfy a knowledge requirement, so feelings of engagement are intrinsically based. Designers must ensure that the information *content* which learners are expecting to find is present. Our practical work suggests that the learners' ability to find and use information is heavily influenced by their subjective opinions of their task and the *media* available to them. Many educators recognise the importance of interacting with technology to encourage learning (e.g. Laurillard, 1993) and to facilitate this, designers should aim to make users' interactions thoughtful and challenging (Adelson, 1992). The *control of the media* must be intuitive, flexible and as supportive as possible. Users should be able to choose the *typeofmedia* they wouldlike for their learning task, presented in a manner they find aesthetically pleasing and functional. While we agree with Laurel, Oren, and Don (1992) that "[Designers] must optimize the powers of all media types by making them accessible to users with equal ease" (p.58), we urge designers not to use a variety of choice as a means of making their products more engaging, but instead to use the most suitable ones anticipated for learners' needs. For example, video can be very attractive, but in addition to current technical constraints, it is demanding on the user as it requires both audio and visual senses. Audio media lack the "state-of-the-art" appeal of video, but are more easily utilised with other media. It is possible to listen and read or perhaps type or write at the same time (providing the content is matched). Text lacks the dynamism of video and audio, but it is quicker to read than to listen and usually it offers more control; it can be skimmed or read in detail.

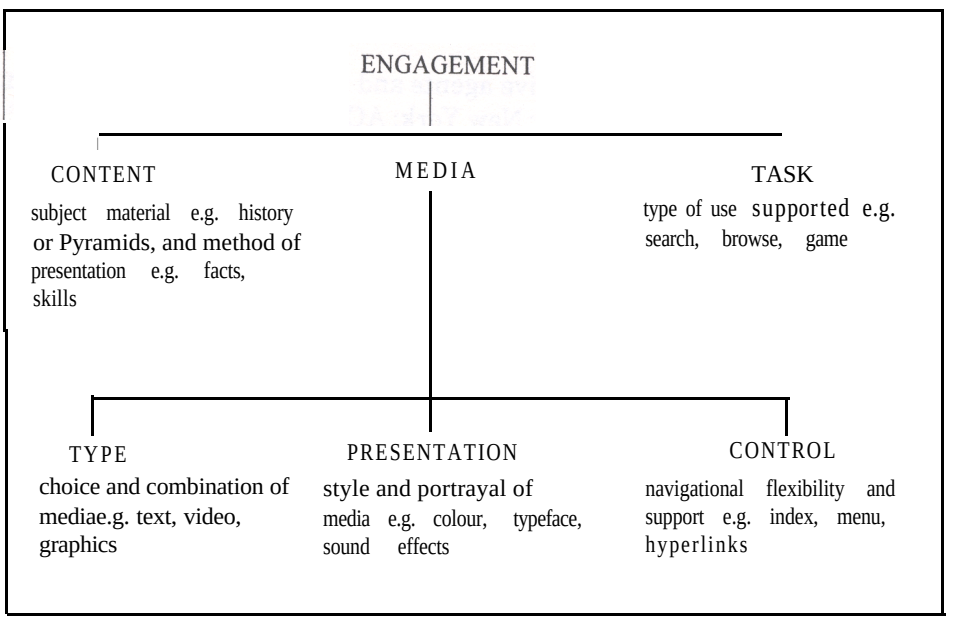
The relationships between the different types of engagement learners experience with multimedia systems can be complex. Typically, more than one factor will engage them at any one instant and as the interaction progresses, the balance will change. For example, a learner may be equally engaged with the presentation and control of a video clip. As the time progress, they discover it does not have the ability to "pause" when they need it, they consequently become less engaged with the function of control even though they remain engaged with the style of presentation. If they are sufficiently dissatisfied, they may terminate their interaction altogether.

Engagement must also be used judiciously. In the FLUID system used in Study 4, the video experts become less friendly if students continue to access their advice without investing effort in their required exercise. In the final video clip in the sequence ofresponses, one of the experts walks away from the simulated conversation and closes his office door on the student. This sequence was

engaging in an unproductive way: students who encountered it enjoyed it immensely and went on to try the patience of the other experts to see if they had similar responses. This wasted time that could have been spent on the task; it also wasted the contextual advice the experts video clips offered at that point in the exercise.

The most assured way to produce successful educational multimedia is to make the design user centred and the process of its evaluation iterative. Evaluating for learners'engagement is an important component in this formula. Engagement describes their intrinsically motivated attraction and is expressed in cognitive, behavioural and affective terms. We suggest that it is difficult and impractical to consider them all at one instance and the most rewarding approach is to ask users for their subjective reactions. Popular methods to be considered are verbal protocols (Ericsson & Simon, 1993) and observation during interaction, and interviews or questionnaires afterwards. It is not possible to truly determine levels of engagement by examination of learners' knowledge: users who know they are to be examined may become sufficiently motivated extrinsically to learn the subject matter, without having found the interaction engaging at all. Additionally, a measurement of time spent on the interaction is not a good determinant, as some users take longer but are equally engaged, while some take longer because they are bored and not paying attention.

Figure 4.
A Taxonomy of the Factors that Engage Learners with Educational Multimedia



Evaluators have a further decision: either to examine learners' engagement with particular features of the multimedia system such as the presentation style or interest in the content, or take a holistic approach and analyse their subjective reactions to the system overall. We recommend at least part of the evaluation in the iterative process be holistic as the "effect of multimedia is more than just the sum of its parts" (McKerlie & Preece, 1993). Consideration must also be given to the fact that features engaging learners the first time, may do so because they are novel; in subsequent interactions they may lose their appeal.

SUMMARY

Learners are "engaged' with educational multimedia when it holds their attention and they are attracted to it for intrinsic rewards. If their engagement is in alliance with learning goals, then the pedagogical potential of the system is increased. To facilitate this, designers should consider the *tusks* users will undertake, the *content* they need and the effectiveness of the media available to them. A user centred design and an iterative approach for evaluating these factors both individually and collectively is recommended. Well designed educational multimedia systems will draw learners in, motivate interaction and help them accomplish learning goals without distraction.

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