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Interaction and Usability of Simulations & Animations: A case study of the Flash Technology

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Abstract When designing and developing simulations & animations for e-Learning purposes, basically two factors are essential: Interaction Design and Graphic Design. Both aspects are well addressed by using different Authoring Tools including the vector-based Flash technology. Although it has improved since its release, Flash still encourages superfluous animation and thus increases the likely hood of poor design. This paper is the result of practical experiences within two large projects (VMC-Graz, iVISiCE) in different domains (Medicine, Civil Engineering) where Flash - amongst several other tools – was used as a tool for creating interactive content. The work is interesting due to the match of experiences of both domains resulting from Usability studies. It is essential that we include the perspective of human-computer interaction as early as possible to enhance design, an approach that is still rarely included in the solutions of traditional programmers and technologically oriented content developers.

Keywords: Usability, Educational Media, e-Learning

1 Simulations and Animations

Access to complex systems for training is usually limited, risky and costly. According to (Guttormsen-Schär and Krueger, 2000), interactive simulations can demonstrate the conditions of actions and events in the real world and support a constructivist learning approach within Multimedia Learning (Holzinger, 2002a). With simulations, developers attempt to provide a rich environment wherein students can explore freely. This is in close accordance with problem-based learning (PBL), which is of great importance in the area of medical education (Barrows and Tamblyn, 1976). This approach also states that learning needs to be student centered (Motschnig and Holzinger, 2002), which influences the motivation of the students positively (Holzinger, 1997), (Weiss et al., 2002). Such an environment places more initiative and control in the hands of the students and makes several different strategic approaches possible. An optimal combination of information and media features should be aimed at in order to support information acquisition. According to Guttormsen-Schär et al. (2001) a combination of media and information based on their specific characterization is feasible. However, more emphasis must be put on the User Interface (Guttormsen-Schär et al., 1997), (Marcus, 2002), and even more importantly, the needs and demands and requirements of the users (Bevan, 1999).

2 Design for Usability

The golden rule of design which (Dix, 2001) repeats again and again is: Understand your materials. As an example Dix suggests taking a metal chair design and building it in plastic (in the same dimension). What would happen? It would possibly break or collapse. Different materials require different designs to achieve the same purpose. In HCI the materials include not only computer hardware, user-interface toolkits, programming languages and tools with which we create interactive software; but also the people who use them – a fact that is often ignored. Thus we need to not only understand the properties of the materials – what is possible and what is not – but we need to also understand the properties of the target users – what they can do and what they can not do. The study of human cognition and psychology in HCI is thus an integral part of our struggle to understand the properties of our raw materials (Dix et al., 1998) and thus also a basis for successful interaction design (Preece et al., 2002).

3 Why Flash?

In this study we focused only on simulations & animations which were created by Macromedia Flash MX (Macromedia, 2003). Flash is one of the premiere tools to create content for the internet. Flash files are referred to as movies and are compact in size. The programming of user-dependent interactivity is possible by using the programming language Action Script (Keating, 2002). It was of interest for us, because it is widely available within our university campuses due to it is not expensive and many teachers use it.

4 Two similar Projects

We gathered our experiences out of two similar projects in different fields: Medicine and Civil Engineering. It was interesting to see the common characteristics, advantages and disadvantages regarding the kind of interaction design and usability.

3.1 VMC-Graz

The general objective of the Virtual Medical Campus Graz (http://vmc.uni-graz.at) is the realization of an tailor-made modular multi-medial Information System to make the new curriculum digitally accessible (Holzinger, 2002b). The content is organized in so-called Learning objects (LO). These LOs consist basically of four parts: pre-knowledge questions, the material itself, self-assessment questions and the relating metadata (Holzinger et al., 2001). Because in this concept the metadata are an essential part to serve as a basis for international education, we entitle our LOs as Reusable Learning Objects (RLO). The material of a LO can consist of almost every imaginable type of content - from simple text right up to interactive simulations & animations. Amongst one of many tools (e.g. Visual Basic, Sun JDK, Macromedia Director etc.) we used Macromedia Flash for the production of simulations & animations and concentrated on multimedia design (Sutcliffe, 2002).

3.2 iVISiCE

The project iVISiCE (http://ivisice.tugraz.at) was started in November 2001 to assist the lecture Structural Concrete of the Institute of Structural Concrete (IBB) of the University of Technology of Graz (Ebner and Holzinger, 2002). The course has been supported by the course management system Hyperwave eLearning Suite, which is based on the Hyperwave technology (Maurer, 1996). Within the project a large number of simulations & animations have been created by using Flash (fig. 1).

Most of these learning objects are interactive, thus we call them Interactive Learning Objects (ILO). One such ILO consists of three major parts: an advanced organizer, the learning material and a problem. The advanced organizer is intended to provide information for the students, to scaffold their learning processes and to support them in navigation through the ILO effectively. Essential is that the students have to solve a problem. Another part of such an ILO is communication. Furthermore, specific discussion forums on the topic of the ILO's support the students. Finally there is always a small examination. Thus the major facts of the ILO have been proven and repeated. The students can check their knowledge by themselves, similar to the self-assessment questions in the VMC-Graz.

5 Flash: Pros & Cons

Some advantages of Flash include:

Scalability. Vector graphics serve the main function of making it possible to zoom in or out on any given image - a feature that is an additional benefit for the animation process and was not possible on the Web before Flash.

Independence from a specific operating system (only a conventional browser and the free plug-in are needed).

Consistency. A tool programmed with Flash looks practically the same in every browser and on every operating system.

Integration of sound made easy via the MP3 format (necessary for some learning objects, e.g. for the simulation of the intensity of a radioactive source etc.).

Small files, because parts of the tool run on the client side, the vector-based technology, the reuse of the same objects and the embedded MP3-files. All our files have around 150 kB (this is different to other authoring tools).

High quality graphics, due to the vector-based technology. We found it convenient to draw with Flash. Its easier as e.g. with Macromedia Authorware.

Small plug-in required (250 kB), free of charge and widely used (on most computers amongst universities the plug-in is already installed - this is not so with e.g. Macromedia Shockwave).

Some disadvantages of Flash include:

Obligatory browser-plug-in is often disliked by the users because of the monopoly position of the producer (A link to the latest version is a necessity).

Misusage of the various possibilities of Flash leads often to "colorful graphic displays". We found it hard to be consistent.

Search engines can hardly find Flash-content (This problem was solved in the VMC-Graz by using consistently separate learning object metadata (IEEE LOM, Holzinger et al (2001)).

Action Script, the programming language, was indispensable to provide user-dependent simulations & interactions of models on-demand. The handling of action script needs some experience. The language itself is rather slow, we needed some tricks (algorithms) to provide running an iteration faster.

Modification of the content is indeed very cumbersome. Mostly the creator of such an animation becomes indispensable, because of complex programming structure when using Action Scripts elements. We encountered exactly this as the most prevalent disadvantage of the Flash approach.

Divergence from the known objects of the Internet. Flash-Objects look different than for example Java-Script. We found it inconvenient that Flash uses the point (.) instead of the comma (,) for decimals, which our target groups are used. We were also confronted with some bugs, especially in binding flash-php.

6 Lessons learned

In both projects we used several inspection methods including thinking-aloud studies, field observations and questionnaires (Nielsen and Mack, 1994), (Rubin, 1994), (Carroll and Rosson, 2001)) with several students using different Flash-Objects.

The objective was to find commonalities within our different projects, allowing us to determine the universal design recommendations which are presented in this paper.

Support goal-orientation: Users usually have a goal in mind when using a Learning Object. Each click must meet their expectations and lead them toward their goal. Thus, the key navigation links must appear first. It must be obvious to the students how to use the Learning Objects.

Consistency is a must. Emulating commonly known windows elements increases usability. Users do not like having a different look-and-feel. Using an inconsistent representation might result in a stimulus conflict for the learner (Weiss et al., 2002).

Provide Logical Navigation: Keep the user oriented, they want to know where they are and where they can go at all times. Users like to have an easy exit and an easy return to their starting point. They appreciated most being able to stop the animations and to start them again when they understand the topic.

Provide extensive help: Our users, especially in medicine, were neither experts in Computing nor experts in their domain. As novices they need help and they want a comprehensive and easy to understand introduction similar to an advanced organizer (fig. 2):

Include Users in the Design. Unfortunately, exactly this is often neglected. Professors often think that they know best what poses problems for their students. From the viewpoint of Usability and HCI it is essential to bring in the end-users as early as possible in the design phase.

Test for Usability. It is astonishing what came up from untested Learning Objects. Usability testing must never be ignored.

Goal-Oriented Design: It is a necessity with Flash to know in advance exactly what the animation should look like: The script must be planned on paper in close accordance with the domain expert and the Flash expert. Alterations afterwards are not as easy as with other authoring software tools.

7 Conclusion

The version of Flash introduced in 2002 (Flash MX) has solved many of the usability problems in

previous versions of Flash. The standard set of interaction controls is now appropriate. Among other things, Flash now supports the use of the back-button, which most of the users want to use. Programmers and content developers (domain experts) think and behave differently than the standard user. In medicine the users have a low level of computer literacy, want simplicity and success and accepts less control in contrast to the students of civil engineering. Simulations & animations can help clarify abstract relationships, in both areas of medicine and civil engineering, that might otherwise be difficult to understand and learn. Often it isn't possible to explain complex connections in just a few words or with one drawing, but a dynamic simulation can easily display such models.

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