

Inherent Flexibility of a Web-based Course in User Interface Design

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Abstract

This paper describes the design of a course on human-computer interaction that uses a lot of resources on the WWW. An inherent property of this design is that the course is flexible in several ways. Due to this flexibility the course can be used in rather different contexts. A number of these contexts in which the course is actually used are described.

Keywords: web-based learning, flexibility, human-computer interaction, project-based education

Introduction

Lecturers and instruction designers have many appropriate web-based resources at their disposal. The WWW offers many suitable papers, chapters of books, complete books, reports, video and audio materials, tools, discussions, etc. The course materials of some universities are even available for free. However, resources alone do not add up to a course. Usually it is not enough to provide the students with a set of URL's. Students need a framework within which they can operate and directions to support them when using such resources. Lecturers must take pains to make existing resources suitable for educational purposes.

This paper describes a model to design a coherent course that uses as many existing resources as possible, preferably resources on the Internet. The result is, as we will demonstrate, a course that is flexible in several ways. For example, the study load can be varied, without affecting the integrity of the course.

First we will very briefly describe the content of the course. Next we will focus on the model we have used. We will also describe in what ways the course is flexible. Finally we will pay attention to the way the course is actually used within very different contexts.

Content of the Course

The course offers an introduction in human-computer interaction (HCI), emphasizing on analysis and design.

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The main objective is that students learn to design the user interface of an interactive system, which may range from a physical device like a PDA (personal digital assistant) to a web page.

The approach we advocate in designing interactive systems consists of three phases (van der Veer, van Vliet, & Lenting, 1995). During the *analysis* phase

the 'current' situation is studied, i.e. the situation in which the system to be developed will have to function. For example, relevant users could be interviewed about the way they perform their tasks in the current situation. In the *global design* phase a conceptual model of the future situation, where the system to be developed would be used, is designed. In the *detailed design* phase the user interface is specified in detail, denoting all aspects the user should be aware of during interaction with the future system.

In our approach it is emphasized that the user should play an important role in all phases. During the analysis phase a user profile and task models should be made, and during the design phases several usability evaluations based upon different methods should be conducted. One of the evaluation methods implies that students build a prototype and test it with users. This prototype should have a relevant part of the functionality, but not necessarily the complete functionality.

Every phase has contributions from a number of disciplines, including ethnography, cognitive psychology, graphical design and ergonomics. Attention is paid to subjects like task models, user profiles, interview techniques, specification of requirements, design space analysis, mental models, metaphors, interaction styles, specification techniques, lay-out design, methods of usability evaluation, etc.

The course and approach as described in this paper were developed in a collaboration project by several Dutch universities.

Model

Our objective was to use as many existing materials as possible, preferably materials which are available on the WWW. To integrate all these different materials we developed a structure appropriate for the course. Figure 1 shows a model of this structure. It should be noted that this picture is only an abstraction, the actual structure is much more complicated.

In this structure the three phases of the design process can be recognized (as phase 1, phase 2 and phase 3). A crucial aspect of this structure is a case that is superficially elaborated. Lecturers from the universities involved composed this case. The goal of this case is to show how contributions from all disciplines involved fit into an integral coherent design process. An important aspect of this case is that it gives references and (hyper)links to all kinds of existing resources.

The elaborated case gives a rough idea of the different activities, but for details one should investigate the resources. For example, the case gives you enough information to understand what task analysis is about. It also shows the ways the resulting task models can be used in the design process. However, if you are to perform a task analysis yourself you are directed to relevant resources. The case also tells you what evaluation is about, why evaluation is important, which possible problems you may come across when evaluating and which evaluation methods are used. However, if you have to perform evaluations yourself, you should study the papers the case refers to.

A typical feature of this approach is that all resources are offered just in time, i.e. when they are actually needed in the design process, according to the elaborated case. In this way the interest of those resources is always immediately clear.

Most important are references to relevant resources about methods and techniques that are mentioned in the elaborated case. These references are preferably hyperlinks to websites with papers, reports and books or parts of books. There are also references to a reader we composed, containing relevant topics we could not find on the WWW.

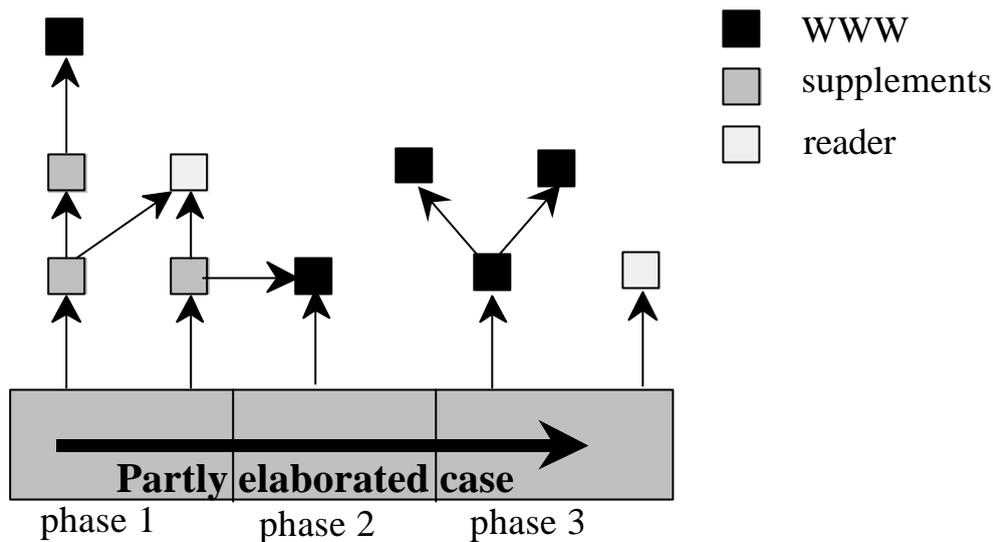


Figure 1: A model of the structure of the course

Besides these references to methods and techniques there are references to other interesting resources. Examples are hyperlinks to websites that give overviews of tools that support the design process, and, as 'appetizers', hyperlinks to websites with very well designed or very badly designed interfaces ('Hall of Fame', 'Hall of Shame'). And there are hyperlinks to websites that contain in turn hyperlinks to interesting websites about human-computer interaction. An excellent example of such a website is the well ordered website associated with the book *Designing the User Interface* (Shneiderman, 1998), with numerous hyperlinks to interesting websites.

As can be seen from Figure 1 the course has a very natural hyperstructure. For this reason the course is offered to the students as a hypertext in electronic form (except for the Reader, which is not available on line, for copyright reasons). The elaborated case is also distributed to the students in printed form. From experience we know that students read texts on paper, not texts on the screen if they have to study written materials (Koppelman, van Dijk, van der Mast, & van der Veer, 2000).

Inherent Flexibility

As a result of the model we described, the course is highly flexible. In this section we discuss in which ways and why this is the case. Due to this flexibility the course can be used in different educational settings. In the next section we discuss a number of rather different settings in which the course is actually used.

Different Study Loads

The lecturers can decide to a large extent which parts of the course materials their students should study. The elaborated case gives a general framework, which preferably everybody should study. This case gives a rough outline of the design process, the methods and techniques that can be used and the way these methods and techniques are linked to each other. One does not have to study the references to get this outline.

Inherent Flexibility of a Web-based Course

Several choices can be made concerning the rest of the course materials. In particular one can leave out resources that the case refers to. The lecturer can decide that for some topics it suffices to study the elaborated case and for other topics the students should also study the resources.

For example, a lecturer can decide that his students should only read the case as to analysis and should skip the involved references but should focus on design activities. Another example is about the number of methods of evaluation. The lecturer can decide whether his students should know about 1, or 2, or 3, or even more methods.

It is not only possible to leave out parts of the course, but also to expand the course. For example, the course as designed ends with specifications and a prototype. This can be extended in a natural way by paying attention to implementation aspects.

Different Levels of Competence

Lecturers can not only make choices as to which resources belong to the courses, but they can also decide upon the level of competence. We give some examples.

A possible level of competence of the subject task analysis could be that students recognize the interest of it and know which methods exist to make a task model. But another level is that students themselves are able to perform a task analysis on the basis of methods that are mentioned in the course. In that case it is necessary for students to investigate the literature mentioned. Yet another level is to compare the technique of modelling tasks as presented in the course with other models as can be found in literature and to discuss the different techniques. In that case the student has to find additional literature. This level is about knowledge management skills such as searching, selecting and synthesizing information, and finding out where to find answers.

Another example involves prototypes. In the course prototypes are meant for communication with users. It is possible to ask just for lo-fi prototypes, with limited functionality and without many possibilities for interaction. But one can also ask for hi-fi (software) prototypes, with a lot of functionality, which can be used for realistic interaction.

Different Degrees of Openness

The preceding sections show that in a specific situation a number of choices can be made and have to be made about the content of the course. These choices concern the topics to be studied and the level of competence required.

As to the choices to be made one option is that lecturers determine exactly and in detail which parts of the course materials should be studied and what the corresponding learning objectives are. In this option it seems appropriate that the lecturers give lectures and that there are individual examinations.

Another option involves a more open approach, within a less traditional educational setting. In such an open approach students themselves can make a number of choices about the course materials they will study. They are provided with global learning objectives and a set of references to resources. It is up to the students themselves to make choices. And they are stimulated to do so.

A natural setting for this open approach is to work with team projects. Team projects fit well into the multidisciplinary field of human-computer interaction.

From the description in the section called Model it follows that our model supports project-based education to a high degree. The elaborated case with all its just-in-time references plays a central role in this approach.

In the next section we give examples of working with team projects in an open approach and we describe some of our own experiences.

Obviously there are many possible variations in which the teacher can give the students more, or less freedom to make their own decisions and to be responsible for what they learn.

Updating Is Easy

The course is also flexible in the sense that it can easily be updated. For example references to relevant websites can be replaced by references to other websites. So, if a new, useful resource on some topic appears somewhere on the web, it can easily replace an existing reference in the elaborated case. Or it can be added to an existing reference. For example, we recently added to the elaborated case a reference to an interesting paper about typography. Also, we recently drew the students' attention to a website where relevant questionnaires could be found, the use of which the students could consider when conducting usability tests.

Implementing such changes in the elaborated case is all the easier because it is electronically available.

It is also possible to add new topics to the course, i.e. topics that previously were not part of the course.

New topics that fit within the design-like approach of the course can be incorporated into the course.

For example the original course paid no special attention to the design of websites. But rules and guidelines to design user-friendly websites fit well within the existing framework of the course.

Another example pertains to usability evaluation techniques. New techniques can be added to the course straightforwardly.

Using the Course: Four Contexts

The course has been used at several universities in rather different educational settings. In this section four ways of using the course are discussed. In all cases this course has been meant as a first course in human-computer interaction. No pre-knowledge of this discipline is needed. It should be noted that the course materials are the same in all cases. Differences are brought about by providing the students with a study guide that contains detailed instructions how to use the course materials.

Context 1: Project-based, Face-to-face Education

The context is face-to-face education for undergraduate students of the University of Twente. The study load is 120 hours. Teams of about five students are provided with the course materials and with a study guide. The study guide contains, among other things, a detailed assignment, which describes an interactive system the teams have to design for a 'client'. Each team covers all the phases and activities as mentioned in the section called Content of the Course. It is up to the students to divide the different tasks.

The formulation of the assignment is rather open. Neither the solution nor the way to reach the solution is fixed in advance. The assignment is also realistic, amongst others because there is a client the teams have to deal with and because the teams have to carry out evaluations with persons who meet the user profile.

The teams carry out the project and use the elaborated case as a framework. The study guide contains specifications about the deliverables and also a time schedule with milestones.

By specifying deliverables the lecturer partly determines the resources the teams have to investigate. However, a lot of choices are left up to the teams. The students are presented with an assignment and with an open envi-

ronment in which they can find numerable resources but in which they have to make their own choices. The students are stimulated to search for interesting websites or papers.

Every team has a lecturer as its coach. There are no lectures. The teams co-operate by having frequent face-to-face meetings. At the end of the project, teams are given marks by the lecturer. These marks are for a large part based upon the qualities of the deliverables. But the quality of the teamwork and the quality of interaction with the client contribute to the final marks as well.

Context 2: Project-based, Distance Education

The context is distance education, as offered to adults by the Open University in the Netherlands. Otherwise the setting is the same as in the former example, including the study load, except for one important aspect: usually face-to-face meetings are hardly possible, because these would demand too much travel time for the students. To compensate for this a number of electronic tools is offered to the teams, to support the communication between the members of the team. These tools and the way they were used to make distance teamwork possible are treated in (Koppelman, van Dijk, van der Mast, & van der Veer, 2000).

Context 3: Project-based, 'Relay' Model

The context is a course for high school teachers that study for a teaching qualification in computer science. The setting is roughly the same as in the preceding examples, except for one important aspect: the study load is only 40 hours. Because of this each team covers only a part of all activities. There are four teams of about five students. The first team covers the phase of analysis, the second team the phase of global design, the third team the phase of detailed design and the fourth team performs activities that are connected with usability evaluations. Every group hands over its products to the group(s) who needs it as input. So the analysis group hands over its products to the global design group, and so on.

One of the consequences of this setting is that there has to be communication between the teams, in contrast to the settings as described in the contexts 1 and 2. Another consequence is that not all teams are active at the same time.

The members of a team collaborate by having a few face-to-face meetings, as well as by using electronic tools.

Each team gives a presentation at the end of its activities. The main objective of this presentation is to inform the other teams about the deliverables and about the methods and techniques that have been used. In this way the presentations contribute to giving an overview of the course to all students involved as well.

Context 4: a Hybrid Approach, Face-to-face Education

The course is hybrid in the sense that it has aspects of project-based education and at the same time aspects of a more traditional approach. It is offered to undergraduate students of the Delft University of Technology. The study load is 80 hours.

Teams of four students have to carry out a project, much in the same way as in the settings described in the contexts 1 and 2. The main difference is that the study load is less, so a number of subjects had to be skipped. Among the skipped activities are building an electronic prototype and using the prototype in usability evaluations.

The course also has some traditional aspects. During the project the lecturer gives a number of lectures about important topics. Moreover, after the project has been finished there are individual examinations about parts of

the course materials. The lecturer points out topics which all of the students should study. At the end of the course individual students are given marks, based upon the results of the examinations.

Experiences

The courses have been evaluated by questionnaires, in all of the four contexts mentioned.

The evaluation results of context 4 are described in (van der Mast, Koppelman, van Dijk, & van der Veer, 2000). One of the conclusions is that the students in this context are very positive on the course, especially on the project-based part of it.

We discuss here some of the results of the most recent analyzed evaluations of the contexts 1, 2 and 3. Almost all of the students responded to the questionnaires. The number of respondents was 61 in context 1, 31 in context 2 and 45 in context 3.

In the contexts 1, 2 and 3 two of the items of the questionnaire were:

- The course is challenging.
- The course is interesting.

In both cases there was a 5-point scale, from 1 (disagree) to 5 (agree). The mean scores on these questions were about the same for the 3 contexts, and ranged between 3.9 and 4.2.

The students also were asked to list in an open section perceived strong and weak points of the course.

In context 1 the most frequent positive points were:

- involvement of client (20 times)
- realistic/practical (15)

Most frequent negative points were:

- not challenging enough (7)
- some aspects of the course were not clear (6).

In context 2 the most frequent positive points were:

- working together (10 times)
- realistic (6).

Most frequent negative points were:

- role of the client was not clear (6)
- takes much time (4).

In context 3 the most frequent positive points were:

- interesting/instructive/challenging (12 times)
- realistic (9)
- working together (9).

Most frequent negative points were:

- some topics were underexposed at the lectures (4)

- only a part of the course was covered (3).

For the sake of interpretation it should be noted that group work, which was listed as a strong point in contexts 2 and 3, is rather uncommon for these students, while common for the students of context 1. Some negative points ('role of the client is not clear', 'some topics were underexposed at the lectures') are incidents and can be improved easily. In context 1 the persons playing the role of client were from business and had real life experiences with their role. The teams appreciated this, which explains the number of times it was mentioned as a strong point in this context.

It appears from the evaluations that the students of contexts 2 and 3 have the tendency to spend too much time on the course. These adult students do not need stimuli to use the open character of the course. The younger students of contexts 1 and 4 spend less time. They are more pragmatic and do not have to be reminded not to spend too much time. On the other hand, we have the impression that teams of these students are more robust and can handle more challenging projects.

So the way of approaching the students in the study guide, the deliverables we ask for and the nature of the project should be dependent on characteristics of the teams

Conclusions

We designed a course that uses a lot of existing resources, preferably resources on the WWW. These resources are integrated in an elaborated case, used as an illustration of a user centred design process. As a result of this structure, the course is flexible in several ways: different study loads, different levels of competence and different degrees of openness are possible, and it is easy to update the course. Due to this flexibility the course can be used in rather different contexts, of which we described four. In all those contexts the course materials were the same. The course was adapted to the characteristics of the contexts by composing specific study guides, with information about the assignments, about the procedures, about the importance of the parts of the material, about the deliverables, and so on.

The reactions of the students in all the different contexts were mainly positive.

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