A MULTIMEDIA FRAMEWORK FOR EFFECTIVE EXPLORATION OF CASE STUDIES

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ABSTRACT: Case studies are well established as a method for assisting students to come to terms with the practice of a body of knowledge. Unfortunately, any realistic case study is usually voluminous, and often boring to read in a linear fashion. Further, although the case study in principle encourages deep learning it does not easily accommodate different learning styles. This paper reports on work (supported by a 1996 CAUT grant) to develop a multimedia framework for effective exploration of case studies. It is alleged that the non-linear presentation mode of multimedia will manage the aforementioned disadvantages of case studies. From the student’s point of view, the framework provides guidance for exploring the case study (via hyperlinks) while allowing individual students to explore the case study in their own way. From the author’s point of view, the framework provides guidance for the author to ensure answers to possible student questions are made available. Further, the framework provides monitoring information to facilitators and students so they can see the extent to which the case study has been explored. The case study, being on the world wide web, allows distance learning while maintaining some guidance by the facilitator.

INTRODUCTION

Experience and evaluation by the authors [8] has shown that many engineering undergraduates have a poor understanding of software development methodologies. Although the students are able to use appropriate techniques, they tend not to unless explicitly required. This has been traced to a shallow understanding (as distinct from a deep understanding, as discussed in Ramsden [1]) by the students of the need for the techniques which are taught and hence the overall subject context. Investigations with engineering undergraduates over the last few semesters have shown that the students tend to produce low-level outcomes in evaluation tasks. The measurements are levels 2 to 3 - unistructural to multistructural - as measured using the SOLO taxonomy developed by Biggs and Collis [2]. Van Rossum and Schenk [10] showed that students at level 3 or lower almost universally adopted a surface or inferior approach to learning. At present, these problems have been addressed through the introduction of a series of small group-based experiential workshops, including critical investigation sessions, peer reviews, software walkthroughs, and case studies. The case studies illustrate expert solutions of software development projects, and aim to assist the students in developing a stronger appreciation of issues involved in developing a solution. Although the case studies have been useful, a number of problems have become evident. In particular, since traditional presentation techniques rely on a linear presentation, it is very difficult to trace an arbitrary development thread (such as a particular design issue) through the main body of the case study. Additionally traditional case studies tend to be static, making it difficult to fully understand the dynamic nature of the software system being developed. Finally, the students typically do not have the opportunity to investigate the case studies at their own pace and in their own fashion. The result of these factors is that the case studies are not reaching their potential as a tool for effective learning.

Our solution is the development of a framework that presents software development case studies in such a way that the students can interact much more closely with them, while improving their clarity and accessibility.

DEEP AND SURFACE LEARNING

Ramsden [1, p.46] summarises the concepts of, and the differences between, deep and surface learning in the following manner. A deep approach to learning is measured by the student’s intention to understand, their maintenance of the structure of the learning task (eg., assignment) and the relationship of this task to what has been previously learnt. A surface approach is revealed by an intention to only complete the task requirements, a distortion of the structure of the task and to treat the task independently of any other learning task. One of the important ways in which deep learning can be encouraged is to allow sufficient time for the student to encounter the task.

AIMS AND OBJECTIVES OF THE PROJECT

• improve effectiveness of the use of software development case studies
• provide access for distance learning, by using multimedia systems and simulation.
• (also) to produce a framework for others to use in presenting case studies.
The framework provides three dimensions to work with in developing a case study, as shown in Figure 1.

**Figure 1: The dimensions of the framework**

**Lifecycle Phase: the application domain viewpoint Dimension**

Engineering case studies (and in particular, best practice software engineering case studies) are usually presented in a time order, from the inception of the project (the expression of a user need) to the end of the project (either continuing operation, forever, or the end of usefulness, when the system becomes unmaintainable).

**Abstraction: the Educational viewpoint Dimension**

From the educational point of view, we have a further three axes (see Figure 2). These are the What axis, what is the content of the case study; the How axis, how the content was produced; and the Why axis, why would one bother producing the content.

Upon reflection we realised that these appear to be good measures of any case study.

**Level of Content: the multimedia Dimension**

The level of content in each of the possible other dimensions has a nominally hierarchical structure. This structure is not imposed on the user, but it is well recognised as the simplest intuitive guide to suggesting that there is an extended level of detail to explore.

**Figure 3 shows the content structure in the lifecycle, education and multimedia (hierarchical) dimensions.**

**NAVIGATION**

**Case Study Paths**

Typically case studies explore a single path of development for a project. Within the hypermedia framework we have developed, it is possible to expand a case study to include alternative solutions to a project. This allows the student to explore the different impact of choices made at various stages of the software development process (Figure 4). For example,
in our test case study, the development methodologies being used are both a structured and an object oriented approach, and the implementation is being done in C, C++ and Eiffel.

Figure 4: Case study paths

Navigation Paths

Navigation paths allow the author to link a sequence of pages that have no connection in terms of the structure shown in figure 2, but when viewed together help the student build a deeper understanding of a specific concept. These navigation paths, or hypertrails, allow the student to view pages relating to a specific concept without compromising their ability to move freely within the content. At any point the student may follow any hyperlink within the page currently being viewed, and jump back to the hypertrail with a single mouse click (Figure 5).

Figure 5: Navigation Paths

POTENTIAL PROBLEMS

Interaction

We have some confidence from previous work on multimedia [4,5,6] that the navigation provided will make exploration of the case study easier, and that it will facilitate deep learning. This is especially ensured by the path function described earlier.

The interaction possible with the case study will be to allow users to participate in a selection of preprogrammed scenarios (similar to programmed learning texts) which alter the process, and the outcomes.

The concern that arises is does a ‘preprogrammed’ interaction preclude learning, does it limit the learning, and in what ways?

This concern is exacerbated in an emerging discipline such as software engineering. Software engineering is still not commonly practiced, and it has been our experience that to ensure students are content to try the ideas of software engineering, they need the opportunity for discussion. We hope to be conducting experiments to attempt to answer this question.

Multimedia

One of the problems we face when developing such a complex hypermedia structure is the fragmentation of our content into pages. Most content available that is suitable for inclusion in such a case study has been developed for paper based presentation, and as such is not always in a suitable format for the World Wide Web. Care must be taken when reorganizing data into a suitable a format that the original meaning of the content is retained. This is of most concern where diagrams may have to be redrawn; care must be taken that the author does not super impose their own interpretation of the diagram over that of the creator of the diagram.

When dealing with the World Wide Web, it is important to consider some of the technical limitations imposed by the network and by the browsers used by the students. Limited bandwidth restricts the amount of information that should be sent with each page. This requires that the content be broken into chunks; however it can be difficult to find logical points within the content where these breaks should be inserted. Care must be taken to ensure there is minimal loss of context or interruption of the flow of reading caused by these breaks.

Another issue that arises is the limited presentation capabilities of internet browsers. It can be difficult to display complex diagrams because they must be scaled down and converted into a bitmap in order to be displayed on the World Wide Web. This scaling and conversion can result in the image becoming difficult or impossible to read.

Test Case Study

The test case study is based upon a collection of University assignments. The test case study was redeveloped according to the plans included, but there was no real customer, and no political imperatives. It is rather a complete, large worked example, than an industrial case study. Our concern is that there is a danger that the resultant multimedia framework, the development of which always has an eye on the test case study, will be too simple, or awkward, when we (or others) try to fit in a ‘real’ case study.

PROGRESS TO DATE

At the time of writing the author’s framework and the student’s framework are complete, and the first case study is being installed into the framework. By the time of the
conference, it is expected that initial trials will be completed which should indicate something of the efficacy of the framework.

CONCLUSION

The effective use of case studies is acknowledged as a key factor of significant learning. However, the development of case studies is a very expensive process, and it is often the case that the case study is not effectively used. By providing a framework for the navigation of case studies on the world wide web we have sought to make a considerable contribution to the effective use of case studies.

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