An Online Digital Engineering Module Companion using Biomedical Applications

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Abstract

This paper describes the design, development and implementation of an online Digital Systems learning site for a third year undergraduate engineering module, taught in the University of Limerick. This environment forms part of a blended learning experience, with the site complementing the module taught in a traditional classroom setting. An analysis of the class, comprising of both part-time and full-time students, was conducted using two questionnaires – a Learning Orientation Questionnaire (LOQ)[1] and a Learning Styles Questionnaire (VARK)[2]. A third questionnaire was also administered in order to ascertain the student's opinion in relation to the site functionality and content. The analysed data from the questionnaires produced results, which would contribute to the expansion of the site to cater for a second engineering module of similar content.

1. Introduction

The "Digital Systems" website was developed at the University of Limerick, a research-led institution, as a companion for an Engineering module in Microcomputer Systems. It was hoped that by providing a blended learning experience for the students, their depth of comprehension of, and ability to retain and reproduce, the material would be significantly improved.

The Microcomputer Systems module encompasses both the hardware and software of microprocessors, in particular the Intel 8086 model. The hardware aspect covers the internal make-up of a microprocessor and its communication with the outside world – ports and memory attributes. The main programming language covered is Assembly Language. Therefore, the software aspect comprises an account of the Instruction Set and details on program structure and coding.

The target audience was a group of third year Electronic Engineering students, split between full-time undergraduates and part-time mature students. The class was analysed to determine their learning styles and orientations. Research has shown that these individual learning characteristics are linked to learner preferences/performance with online educational resources. The data was obtained in an attempt to discover if the different styles had an impact on the users opinions of the site and its content.

In 1996, Elias N. Houstis of Purdue University made the following prediction:
"The way we search for knowledge and information is undergoing a profound change. The technology and its future evolution has the potential of making Internet based telelearning the new educational paradigm at local and global levels." [1]
How right Houstis was. E-Learning (or "telelearning" as Houstis refers to it) has become a revolutionary phenomenon which has swept the world in corporate, private and educational institutions alike. It has necessitated that all institutions undergo a complete overhaul on their educational strategies. It is an industry which continues to change and improve day-by-day with the emergence of new authoring technologies and improved learning theories making it a most effective resource for today's educational demands.

But often the question is asked whether this e-learning effective enough or not. So what exactly is "good content" in an on-line tutorial and exactly what level of interactivity is required?
"If the content does not teach, it has no value regardless of how high tech it might be". [2]
Masie has a firm belief that most; if not all learners learn best through blended learning which he defines as the utilization of two or more methods of training. The most popular combination by far is the blending of classroom instruction with on-line instruction. Many institutions, especially universities, choose to introduce

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their e-learning environments in combination with their traditional courses. [3] Some universities offer complete on-line courses with no traditional methods involved at all. However, no matter how advanced the "interactive media technologies" become, not all courses can be fully implemented online.

This learning environment was designed to complement the current traditionally taught module. It provides a blended learning experience for students allowing them to utilise a number of learning methods to obtain their knowledge and ultimately prepare for exams.

2. Design and Development

The site was designed with a view to providing a clear, clean looking environment without too many "moving parts". It was also important that the site be easily accessible to the students both on and off campus. Therefore, it was located on a server that allowed the site to be accessible externally. The tools used to develop the site were predominantly macromedia products – namely Flash and Dreamweaver.

The advantage of using Flash, once the user has downloaded the Flash Plug-In, is that the content will look identical on every PC. Flash, the key to designing and delivering low-bandwidth animations, can be described as a bandwidth friendly and browser independent vector-graphic animation technology. [4] It is a powerful development tool that offers scripting capabilities and server side connectivity allowing developers to either draw their own animations or import other vector based images. Macromedia Dreamweaver is a professional HTML editor used to visually design and manage websites and pages. It endeavours to enhance the web design experience by providing many different coding tools and features such as an HTML, CSS and JavaScript reference, a JavaScript debugger and code editors. Dreamweaver allows the user to avoid writing one line of code with its visual editing features. [4]

The site structure comprises of three frames – a top frame (the title), a left hand frame (the menu) and a main frame (the content). The menu is a system of layers that collapse and expand as the user rolls the mouse over a particular area. It provides links to tutorials, a discussion board, supplementary material relating to those topics covered in lectures as well as background information that is needed for the module but that may be lost to the student. Additional features include the option to download past exam papers, lecture notes and slides, as well as a class timetable for the module.

In the final lecture questionnaires were distributed to obtain user opinions and suggestions on the site, the results of which are discussed below.

3. Results

3.1 Learner Questionnaires

Research has shown that students most probably have preferences for the modes in which they receive information. VARK[2] is a questionnaire that has been developed at Lincoln University to discover the preferences of students for particular styles of information presentation. The learning preferences are divided into four groups – visual(V), aural/auditory(A), read/writers(R), and kinesthetics(K). [5]

V – These students prefer information in the form of graphs and charts etc.
They work easily with symbols.
A – These students prefer to "hear" the information e.g. lectures, tapes etc.
R – These students prefer their information in the form of printed words.
K – These students prefer to learn their information through its application in the real world i.e. it must somehow be connected to reality.

Although these are four distinct divisions it is often the case that students will have an equal preference in two or more of these sections. Fleming terms these as "multi-modal". These students will often need to receive their information in at least two different group formats in order to understand it fully. Those who have a strong preference should gain a full understanding from one format of information. [5]

The results of the VARK questionnaire distributed to the class are illustrated in Figure 2. It shows that the majority of students are kinesthetic learners, with over half having a very strong preference for this style. The second most popular preference was multimodal (MM) while none of the students were found to prefer visual styles.

3.2   Website Evaluation

The students were given a questionnaire to evaluate the website in four different areas:

1. The overall site
2. The design/look and feel of the site
3. The effectiveness of the tutorials
4. The usefulness of the site as a course companion.

They were also asked for general comments and suggestions for improvements. The results are illustrated below in Figure 3. The overall site got a majority rating of "Good". A significant majority of the students found the design/look and feel of the site to be "Good" or "Excellent", while the effectiveness of the tutorials seems to be only "Average". This could be due to a number of reasons. First of all, none of the students surveyed were found to have "visual" preferences. The tutorials, while providing a textual summary of what is happening, are predominantly a series of graphical representations of the information. Secondly, the majority of students were found to be kinesthetic learners. The tutorials for this module had no real-life applications therefore may not have been as effective as they could have been. General suggestions for improvement included the inclusion of answers to exam papers, more tutorials on programming, more exam papers, and the ability to download the content in pdf format.
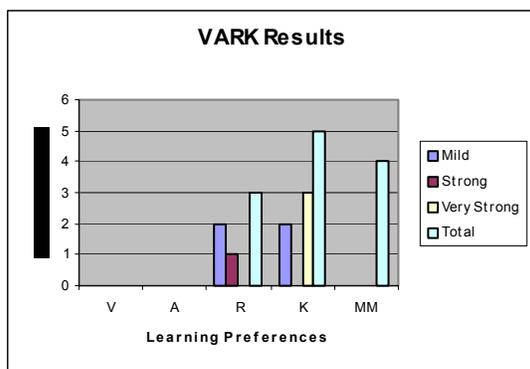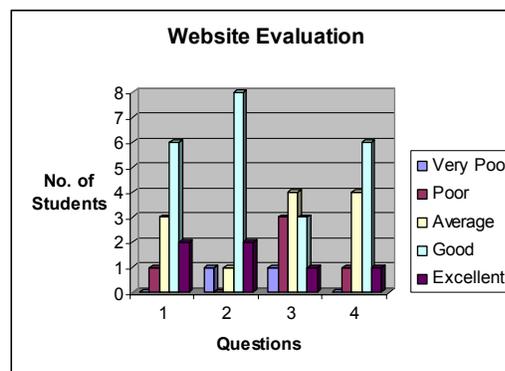

Figure 2: VARK Results

Figure 3: Website Evaluation Results

4.   Conclusion

It is hoped to now review the results of the learning orientations questionnaire (LOQ[1]) and determine if its results influence the evaluation of the site. In addition it is planned to extend the Digital Systems Website to cater for a Bachelor of Technology module, called Digital Systems 2, which covers similar material as the Microcomputer Systems module. The site will stay the same including the content for the previous module with a section added to the menu for this new module. From the suggestions and general comments received from the students that used the first version of the site, an improved environment can be provided catering for more of the students' needs.

References

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