

Chapter 14

Design and Evaluation of a Web-Based Tool for Teaching Computer Network Design to Undergraduates

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ABSTRACT

Previous studies have shown that motivating students to learn about local area network (LAN) design can be difficult when presented in the traditional lecture format. To overcome this problem, a Web-based tool (“WebLan-Designer”) was developed as an aid in teaching and learning of LAN design at the introductory level. A WebLan-Designer provides a set of learning resources (tutorials, quizzes, network modeling, network design scenarios, key terms and definitions, and review questions and answers) and assists undergraduate students in learning the basics of both wired and wireless LAN design. The tool is Internet-based and can be accessed at any time so that students can study LAN design at their own pace and convenience. This flexible learning approach contributes positively to distance education and e-learning. The effectiveness of WebLan-Designer is evaluated both formally and informally; positive student and peer feedback indicates that the design and implementation of the tool has been successful and that using WebLan-Designer may have a positive impact on student learning and comprehension.

INTRODUCTION

Almost all computer science (CS), computer engineering (CE), information systems (IS), and information technology (IT) curricula include some basic courses in local area network (LAN)

design. Unfortunately, motivating students to learn about LAN design fundamentals can be difficult not only because students find the subject rather abstract when it is delivered using a traditional lecture format, but also because of inflexible on-campus teaching which does not provide students with enough opportunities to engage

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actively in the learning process (Gasparinatos & Grigoriadou, 2011). To overcome this problem, the authors have developed a Web-based teaching suite called WebLan-Designer that gives students an interactive and flexible learning experience in both wired and wireless LAN design.

The principles of LAN design are the subject of a number of widely used textbooks (Fitzgerald & Dennis, 2009; Forouzan, 2007; Kurose & Ross, 2010; Palmer & Sinclair, 2003). These scholarly texts normally include additional study material in the form of review questions and exercises aimed at helping students to understand the theoretical concepts and applications. However, prior research findings indicate that students engage better and learn more effectively if their networking courses are complemented by carefully designed learning tools and resources helping them to achieve the course learning objectives (Chang, 2004; Gotsis, Goudos, & Sahalos, 2005; Midkiff, 2005; Sarkar, 2006).

WebLan-Designer is an example of a Web-based system which provides a set of learning resources (including tutorials, quizzes, modelling, scenarios, key terms and definitions, and review questions and suggested answers) to undergraduate students in CS, CE, IS, and IT programmes; its objective is to support learning about LAN design fundamentals through a simulated hands-on experience. In general, the use of Web-based learning tools for developing flexible teaching and learning models in computer networks and related subjects has been discussed extensively in the literature (Aller et al., 2005; Djordjevic, Nikolic, & Milenkovic, 2005; Garcia & Alesanco, 2004; Hanson et al., 2009; Wannous & Nakano, 2010). It is believed that pedagogical approaches such as experiential learning and simulation motivate students and help them become active learners who are able to construct their own knowledge effectively (Berglund, 2003; Chang, 2004; Chen, 2003; Gasparinatos & Grigoriadou, 2011; Sousa, Alves, & Gericota, 2010; Vargas et al., 2010).

The context for the design and evaluation of WebLan-Designer reported in this paper was provided by the teaching and learning environment at a New Zealand University (AUT University) where computer networks and LAN design fundamentals are taught both in the School of Computing and Mathematical Sciences, and the School of Engineering. WebLan-Designer serves as a student-centred self-paced learning tool as well as classroom teaching tool. This flexible learning approach to LAN design using WebLan-Designer has been applied for several years now in undergraduate computer networking courses in computer science and IT programmes at AUT University. Normally the scope of these courses includes extensive coverage of LAN media, topologies, protocols, wireless technologies, and various aspects of network design.

The main objective of this paper is to report on the development and evaluation of the WebLan-Designer and its usefulness as a teaching and learning tool in the field of computer networking. The study presented here contributes to the computer science education literature by emphasising strongly that the use of interactive and flexible learning experience using a Web-based tool has been crucial in motivating students to learn about LAN design fundamentals. The most innovative aspect of this paper is the development and evaluation of such a tool which may effectively complement both the lecture and tutorial content of an undergraduate computer networking course.

The rest of the paper is organized as follows. In the following section a background review of various network simulation tools is presented. Next, the architecture and features of WebLan-Designer are described, and the value of WebLan-Designer and the way it has been used in the classroom is highlighted. Finally, the system evaluation results are presented and discussed. The paper concludes with suggestions for future research and development.

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