

Teaching Computer Networking Fundamentals Using Practical Laboratory Exercises

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Abstract—Motivating students to learn computer networking concepts is often difficult because many students find the subject rather technical, dry, and boring. To overcome this problem, the author has prepared some practical laboratory exercises (practicals) and other materials. They are designed around a network operating system and a multiuser, multitasking operating system and are suitable for classroom use in undergraduate computer networking courses. The effectiveness of these practicals has been evaluated both formally by students and informally in discussion within the teaching team. The implementation of the practicals was judged to be successful because of the positive student feedback and also because students scored better in the final exam. This paper describes the practicals, their overall effectiveness, and plans for further projects. The impact of practicals on student learning and comprehension is also discussed.

Index Terms—Computer networking education, Linux, NetWare, server-based networking, Transmission control protocol/Internet protocol (TCP/IP).

I. INTRODUCTION

COMPUTER networking is often included as a subject in computer science, engineering, and business courses because computer networks are a fundamental component of information technology (IT) systems today.

The author strongly believes that students learn more effectively from courses that provide for involvement in practical activities, e.g., setting up a customized network, installing and configuring a server, assigning user rights to files and directories, writing and testing login scripts, etc. This view is extensively supported in the literature [1]–[3], [5]–[9]. Yet, only a limited amount of material designed to supplement the teaching of computer networking is publicly available, as searches of the Computer Science Teaching Center [4] and Special Interest Group in Computer Science Education (SIGCSE) Education Links sites reveal.¹

Therefore, the author has prepared some practical laboratory exercises (practicals) and other material that facilitate an interactive approach to teaching and learning computer networking. These practicals are designed around two operating systems: 1) a network operating system, Novell NetWare 5.1 [10], and 2) an open-source multiuser and multitasking operating system, Red Hat Linux [11]. The practicals can be used either in the

classroom as a demonstration to enhance the lecture environment or in the computer laboratory to provide practice at an introductory level.

Computer networking is described in many textbooks [12], [13], and commercial local area network (LAN) design strategy is discussed extensively in the computer networking literature [14], [15]. A number of sophisticated network simulators exist for building a variety of network models [16]–[20]. Nevertheless, by setting up and configuring actual computer networks, the students gain first-hand experience that cannot be gained through computer simulation and modeling. To date, the author has focused on developing practicals to support teaching a traditional computer networking course at the undergraduate level (second year). Such a practical learning approach to teaching and learning computer networking has been successfully applied for two years now in the Networking and Telecommunications undergraduate course (computer and information sciences curriculum) at the Auckland University of Technology (AUT), Auckland, New Zealand. The course covers various aspects of computer networking, including server hardware and software, LAN administration and management, and transmission control protocol/Internet protocol (TCP/IP) networking. The practicals and other materials are revised annually, and the use of the latest version is discussed in this paper.

The main contribution and strength of this paper is the emphasis that practical experience with server hardware and software is crucial to effective student learning. The most innovative aspect of this paper is the structuring of the laboratories and crafting of the specific exercises to be effective in complementing the lecture content of the course. The course context in which the practicals are presented is described next.

II. COURSE CONTEXT: LEARNING OUTCOMES AND TOPICS DELIVERY

The networking and telecommunications in which the aforementioned practicals are introduced has a total of 56 contact hours assigned. This course is at Level 6 or second-year degree level (one quarter of a full semester's course of study) at AUT [21], [22]. The Level 5 Programming I is the prerequisite for this course. The course goal is to produce graduates who will be able to work for networking and telecommunication companies worldwide.

A. Learning Outcomes

The course learning outcomes are listed below.

On completion of this course, students will be able to do the following:

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¹<http://sigcse.org/topics/>

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