USING AN ON-LINE VIRTUAL SERVER
TO SIMULATE NETWORK ADMINISTRATION

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ABSTRACT

Participants in the rapidly changing computer networking arena face the significant challenge of keeping up with technologies that are often expensive to deploy, making it particularly difficult to gain hands-on experience. A survey of current job descriptions indicates that Microsoft systems continue to experience strong interest among employers. Learning alternatives are considered with a focus on a new solution to the problem of hands-on experience that has been provided by Microsoft, a virtual server lab that is available on-line and is free. Features of this virtual lab are explained, and the results of an experiment to integrate this lab into a networking course are discussed.

Keywords: Online learning, network administration, pedagogical study, software for online learning, simulation, Microsoft Technet

INTRODUCTION

Although many computer information programs have been negatively impacted by the dot com bust, recent projections by the Bureau of Labor Statistics bode well for the long-term growth in demand for these skills. Through 2012 the number one growth area among jobs requiring a bachelor's degree or higher is projected to be network systems and communications analysts with a 57 percent growth rate. Other computer related occupations in the top ten include the third fastest growing field, software engineers, the sixth fastest, database administrators, and the ninth fastest, computer systems analysts [3].

The design of courses and the choice of skills to learn in order to prepare for these rapidly evolving jobs present a challenge for teachers and professionals. A recent study examining skills expected for new employees in e-Commerce provides guidance for course design [8]. Ulley [15] describes the advantages of getting hands-on Web experience into the classroom. A number of studies for IT professionals indicate that employers are looking for an increasing number and variety of skills from their new hires [5]. One study noted that while employer's often emphasize "soft-skills" and well rounded business training, actual job requirements and hiring decisions are based more on hard skills [5]. This study finds, "the changing demand pattern for IT professionals necessitates life-long learning skills not only for IT practitioners but also for the academics who teach them." The significant stress on academic faculty to keep up with the explosion of technology skills has also been investigated [13].

In the first section of this paper, the results of a survey of skills required for newly advertised jobs in the network systems, administration, and communications analyst category is presented. In the next section, alternative strategies for delivering this training are considered in the context of research by Olfman [10]. Following that is a description of an elegant new system on

Microsoft's Technet site. Finally, the results of a preliminary effort to integrate this system into a networking class are discussed.

SUVERY OF DEMAND FOR NETWORK SKILLS

Data for the survey summarized in Table 1 were created by doing a search on the job site Monster.com during January 2005, using the keywords: network, analyst, administration, communication. Jobs were restricted to those requiring a bachelor's degree or higher. Among these jobs, 82 percent required experience with operating systems. Although one recent study of e-Commerce jobs suggests a premium on Linux [8], these results indicate that in the area of networking, Microsoft systems account for the large majority of preferred skills.

Table 1. Required Skills for Network Analyst and Administrator Job Postings

Percent of Jobs Requiring Familiarity with Operating Systems	82%
Among Jobs Requiring Familiarity with Operating Systems, Percent Requiring Familiarity with These Specific Operating Systems *	
Windows	74%
IBM/AIX	12 %
Solaris	12%
Linux	10%
Unix	10%
Novell	7%
OSX	5%

Source. Monster.com, jobs posted in January 2005, from a sample of 50. * Percentages sum to over 100% since some jobs require familiarity with multiple operating systems.

The MCSA (Microsoft Certified Systems Administrator) and the MCSE (Microsoft Certified Systems Engineer) certifications were frequently mentioned as documentation for Microsoft skills. Research [1] on these certifications suggests the following ten most important elements to practice for passing the tests: Configure and troubleshoot shared folders permissions; Configure Volume Shadow Copy Service; Run Automated System Recovery; Download and install Software Update Services; Run server backups, restore the backups; Create and assign permissions to printer users; Create a few group policies and explore the different computer and user settings available; Create user accounts in Active Directory; Configure inheritance and inheritance blocking with AD objects; Configure and recover RAID arrays.

ALTERNATIVES FOR ACQUIRING EXPERIENCE

Although many network professionals get their early experience through on the job training by finding jobs as assistants to experienced professionals, this may not be feasible for students, teachers, or even experienced professionals wanting to develop new skills. One common approach is to create a lab with equipment and software safely disconnected from an operational network that can be used for experimentation.

The Lab

On Microsoft's site, the following configuration is recommended: "the lab set-up should have—at minimum—two or more computers with network interface cards and a crossover network cable. If you have one, you can replace the crossover cable with a small network hub. On the software side, for most of the newer exams you'll need a copy of Windows XP Professional and a copy of Windows Server 2003." The basic equipment and software for building this basic lab can be bought from Dell for about $2000 ($500 for Windows Small Business Server 2003). Some savings may be available as Microsoft offers many discounts to universities. Using Linux can also bring the cost of the lab down. Still, this approach presents a significant cost to a faculty member trying to keep up to date or for a university needing to create a lab large enough to handle many students. The larger lab will also incur administrative costs and could face security problems. Lei [7] presents a cost-benefit analysis of alternatives in building an academic network lab. Another disadvantage is the limited variety of configurations that can be explored in this small lab environment.

The Virtual Server

In order to expand the network configuration complexity, virtual machine software such as VMWare (current price of $199 at Amazon) or Microsoft's Virtual Server (available as a free 90-day trial) can be loaded onto each computer to simulate a network of machines by allowing multiple operating systems to run on one computer. This would require at least 512MB of RAM in the computers on which the software is installed. Microsoft relies on the virtual server in the on-line lab that will be discussed in an upcoming section.

A disadvantage of using a lab with complexity built up from virtual servers relates to the difficulty of creating environments related to real work situations. Setting up problems with realistic simulations of work situations can be time consuming and frustrating.

Simulation Software

The use of simulation software for network evaluation is widely discussed in the literature [6, 12]. A few software programs, such as LabSim from Course Technology (about $95), have been available from academic and IT publishers designed to give a hand-on experience on a single machine. Course Technology describes LabSim as offering a "rich, full-scale open Microsoft Windows Server 2003 simulations that allow users to view and practice network configuration and troubleshooting, and develop the necessary skills for the scenario-based MCSE/MCSA exams, even if they don't have access to a network or software."

This software can provide a good tool for classroom demonstration or personal learning. An informal survey of networking classes, however, indicates that students feel the price of the simulation software, in addition to a textbook, would be an unreasonable burden. Another problem is that some students don't own machines on which they can install the software, so some copies may have to be made available in a public lab, creating purchase and support costs. Dixon provides a full discussion of the results of using simulation software in the classroom [4].

The Virtual Lab at Microsoft

The allure of Microsoft's Technet Virtual Lab is that the features of the virtual machine with a variety of software and with rich simulations are combined and delivered over the internet free of charge. Located at www.microsoft.com/technet/traincert/virtuallab/default.mspx, Microsoft indicates that the site is designed to let users test the newest software or new server configurations in a "sandbox environment, without formatting hard drives or dedicating on or more computers to the project [9]."

Users can enter the lab by simply signing up with an email address and can opt-out of any annoying spam from the company. In order for the lab to run, the following minimum technical requirements must be met. Since one drawback of the lab is the sparse diagnostic help available for starting labs, carefully following these and other instructions will minimize frustration.

Table 2. Microsoft Technet Virtual Lab Technical Requirements

1. The labs are best viewed at a screen resolution of 1024x768 or greater. Otherwise you may experience clipping of content.
2. You must have cookies enabled to run these labs
3. When you enter the lab, you may be asked to download the ActiveX Control if you don't already have it installed on the computer.
4. Connecting to the labs require that you have port 3389 open.

Source: Microsoft.com

The Virtual Lab is actually a collection of labs with a number of very robust hands-on exercises. Almost all of the top ten most important elements in gaining a Microsoft certification that were mentioned in a previous section are available here, and much more. The following is a list of the currently available virtual labs: Microsoft Live Communications Server 2005, Desktop Deployment, Exchange, SQL Server, ISA, and Windows Server 2003. There are multiple, detailed exercises for each of these labs.

When the lab starts, a screen resembling the presentation from an actual server is displayed. No software is downloaded. Figure 1 represents a screen shot from one of the labs.

Two experienced network administrators who were asked to evaluate the lab for this paper suggested the simulations were indistinguishable from being on an actual server, except, perhaps, a little slower. The lab provides a much more complex environment than available with simulation software from academic publishers.

Although there is no discussion on Microsoft's site of how the content from the virtual servers is delivered, an internet search revealed that the system relies on specialized software from Surgient (www.surgient.com). On the company's website there are a number of excellent white papers explaining how the software works and how it was deployed for Microsoft in an earlier application for training on Visual Studio. The company's VP of marketing asserts, "Surgient's Virtual Demo Management System is changing the way the software industry thinks about marketing and selling products [14]."
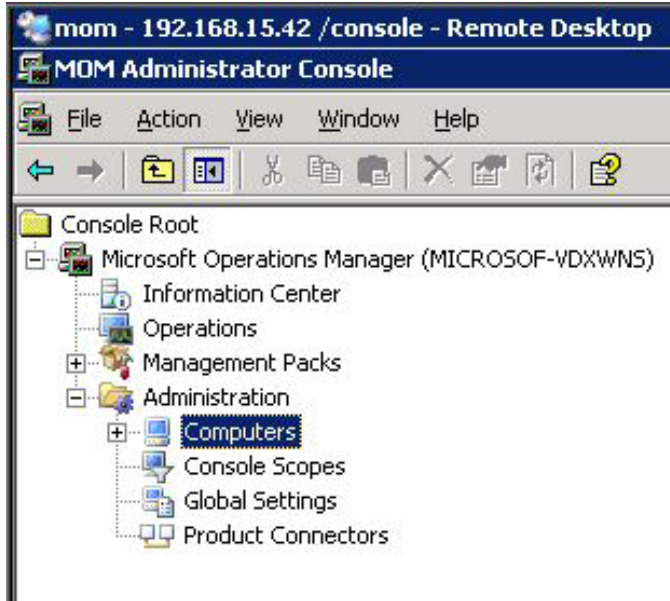
Figure 1. A Screen Shot From the Virtual Lab

RESULTS OF A CLASSROOM EXPERIMENT

Over several years of surveying students taking networking classes in our MIS program, the most common suggestion to improve the class has been increased hands-on experience. As an experiment to achieve this, students in an introductory networking class were given a lab assignment to complete the Windows 2003 virtual lab exercise at Technet that involves configuring a server for file, storage, and print. As part of the assignment they completed an assessment survey of the lab. Some of their responses are summarized in Table 3.

Table 3. Results of a Survey of Students Using the Virtual Lab as a Course Assignment

Question:	Question:
Were you able to start the lab?	Would you recommend continuing to use the lab in this course?
After first assignment By end of class	After First Assignment By end of class
Yes 65% 100%	Yes 83% 96%
No 35% 0%	No 17% 4%
How would you rate the lab? (some non-responses since all couldn't start the lab)	
Very Useful 17%	
Useful 61%	
Not Useful 6%	
Too difficult 17%	
Does not sum to 100% due to rounding	

Source: Sample of 27 students in an introductory networking class

In the classroom, students who had difficulty with the lab were very vocal. The survey indicates, however, that about two-thirds of the students were able to run the software in their first assignment without assistance. One problem encountered, as suggested by the Microsoft support group who was contacted about the experiment, was that the labs were available on a first-come first-serve basis. As a result, demonstrations can't be scheduled for specific in-class sessions because the lab may be busy. In addition, students can't be taken into the school lab and asked to run the software all at the same time because that will tend to overload the system and result in few successful attempts. By the end of the class, all students had successfully run the lab.

General comments from students indicated that those who carefully followed instructions were able to run the lab, although sometimes several attempts were required because the lab was busy or there were some other unknown problems. Some students who made a less careful attempt, as evidenced in the write-up they were asked to provide describing problems, concluded that the program did not work or that there was a glitch in the program. With good attention to detail, students were generally able to make the lab run. This process also provided the students with a good sense of the importance of documentation in supporting applications in a job environment.

Asked which of the available labs they would like to include beyond the basics of Windows Server 2003, they overwhelming choose labs related to security. Many students feel that this is where the best job opportunities are.

CONCLUSIONS

Although students encountered some problems and were frustrated having restricted ability to see demonstrations in the classroom, an overwhelming 96% indicated they would recommend continuing use of the lab. Some of the best students in the class were extremely enthusiastic about the virtual lab. As an instructor in the area, I am able to improve my own technical skills in a realistic, simulated environment that I can run from home on my laptop while sitting out in the garden instead of in a stuffy lab.

The delivery of hands-on training over the internet is growing as indicated by another lab that is currently under construction at www.Firewall.cx, a site for networking professionals. There, work is underway to build "the world's first Free Cisco Lab." The lab will allow access to Cisco's latest routers, switches, and perhaps a VPN concentrator. One big advantage over the Microsoft lab will be a booking system that will allow members to schedule lab sessions of up to three hours. Creating and supporting an on-site lab at our university that actually has fewer capabilities than this proposed free lab has been expensive and fraught with administrative problems.

Another advantage of using the on-line labs is related to the growing sense that the utility approach to computing--where processing power, storage, or software is delivered through networks—will become increasingly important in the future. Former Oracle President Ray Lane believes that the utility approach is "the future of the industry [2]." In addition to providing an excellent technical experience, the lab provides a sense of what may be the future of computing.

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