Application of Virtual Machine Technology in Computer Teaching

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Abstract. Based on the demand for computer practical teaching activities in higher vocational colleges, we introduced the virtual machine technology to the teaching of some courses as new auxiliary teaching means. It has strengthened the classroom training link, broken through the traditional teaching model, and provided an experimental environment without damage to computer hardware. Through the hands-on operation, the students have improved their skills, and good teaching results are achieved in the courses.

Keywords: Virtual Machine Technology, Computer Teaching, Practical Teaching, Virtual Machine

1. Introduction
Higher vocational colleges are the cradle for cultivating high-quality skilled talents. Currently, the country is rapidly developing towards informatization, industrialization, and modernization [1]. Therefore, the demand for skilled talents is constantly increasing, higher vocational colleges adapt to the requirements of national development, training students into useful talents suitable for the development of the country and cultivating highly-skilled talents with strong hands-on skills are the urgent tasks facing vocational education. And the fundamental mission [2]. However, due to the unique nature of some computer courses, due to the limitations of the experimental environment and experimental equipment, the mastery of knowledge can only stay in the book and ignore the hands-on link. Also, some experiments may cause damage to the original physical computer operating system. The traditional experimental mode cannot be completed, which makes it challenging to achieve the expected teaching effect. Besides, students are currently under enormous pressure for employment. Students are eager to improve their skills and lay a good foundation for employment. There is a significant demand for useful links that can be operated by hands [3-4].

To ensure the quality of practical teaching and construct a good teaching practice environment, this
article takes computer teaching in higher vocational colleges as an example. It is imminent to introduce virtual machine technology into the teaching practice link\textsuperscript{[5\textendash}6\textsuperscript{].} The virtual experimental environment constructed using virtual machine systems can be used in colleges and universities. The public computer room conducts a series of open and expansive experiments without affecting the existing experimental environment. It not only provides an excellent experimental environment for the educational practice of computer courses but also enhances students' autonomous learning ability and creativity while improving the utilization rate of public teaching computer classrooms and saving the related laboratory construction funds.

2. Characteristics of virtual machine technology

2.1. Virtual machine system
A virtual machine system refers to a virtual computer platform established on a physical computer operating system. This physical computer is called a host machine. Through the virtual machine system, several virtual hardware environments can be simulated on the host machine, known as the virtual host, the virtual machine operating system established by installing the operating system through the virtual host can achieve almost the same function as the operating system installed on the physical computer. They use independent virtual CPU, virtual hard disk, virtual memory, and other virtual hardware. The hardware is compatible with most operating systems and applications. At the same time, the virtual host supports sharing the physical hardware of the host, such as an optical disk drive, a floppy disk drive, a USB interface, etc. Users can perform BIOS settings (shown in Figure 1), disk partitioning, disk formatting, operating system installation, application installation, and other operations on the virtual host without affecting the host operating system.

![Figure 1. BIOS settings](image)

2.2. About VMware Workstation
VMware Workstation (as shown in Figure 2) is a desktop virtual computer software with super powerful functions, enabling users to run multiple different operating systems on a single desktop at the same time for testing, development, and deployment of new applications. The VMware Workstation can simulate a complete network environment on a physical computer. Its advanced technology and flexibility have obvious advantages compared to other virtual computer software. At
the same time, VMware Workstation has become an indispensable tool for system administrators and developers to implement functions such as creating real-time snapshots, dragging shared folders, and establishing virtual networks.

![vmware](image)

**Figure 2. VMware workstation**

The characteristics of virtual machine technology include the following:

1. Virtual machine technology can virtualize multiple virtual computers on the operating system of the physical computer. Each virtual machine computer is relatively independent and can install different operating systems and application software.

2. Multiple virtual computers can run simultaneously, and software and hardware resources can be shared among virtual computers, between virtual computers and physical computers.

3. The virtual hardware of each virtual computer is standardized, which can effectively solve hardware compatibility issues. Meanwhile, the same virtual hardware can be virtualized on the operating system of the physical host. Through simple replication, it can be shared among the operating systems of each virtual host. There is no difference between the hardware. When one of the virtual hosts is damaged, it can be quickly obtained and restored.

4. The virtual disk in the virtual hardware is composed of files in one or more physical disks. By backing up the virtual host files in the physical disks, rapid backup and recovery of the virtual host system can be achieved.

5. The operating system of the virtual host and the host is relatively isolated, and operations such as disk partitioning and formatting of the virtual disk on the virtual host will not affect the operating system of the host.

6. The virtual machine system has strong scalability for virtual hardware. Some virtual hardware can be added or deleted as required without reinstalling the operating system on the virtual host.

7. By installing plugins such as the VMware toolbox, the virtual machine system can also implement functions such as dragging, copying, pasting, and moving files between virtual hosts or between virtual and physical hosts.

8. The virtual machine system has robust screen capture and screen video recording functions.

9. Each virtual host has an independent basic input and output system (BIOS). By setting the BIOS parameters, it is possible to achieve a differentiated configuration of the hardware of each virtual host in the virtual machine system.
(10) Each virtual host on the virtual machine system has a relatively independent network adapter, which supports the configuration of independent IP addresses. Each virtual host supports protocols such as TCP/IP, Microsoft Network Virtual Network, Novell Netware and Samba file Sharing, etc.

(11) The virtual switch provided on the main interface of the virtual machine system for each virtual host includes a power switch, a reset start, and a pause button unique to the virtual machine.

3. Specific applications of virtual machine technology in computer teaching

(1) In the practical teaching of computer maintenance courses, the computer classrooms used are often public computer classrooms with various computer-related courses. The software is uniformly installed and maintained by a special person. Students have a hand-held device during the course. As the public computer classroom takes into account that certain operations may change the original configuration of the computer operating system, and even cause a total crash of the operating system, where the computer cannot function properly. With hardware protection devices such as disk protection cards, students cannot install software at will, nor can they partition, format, install operating systems, and BIOS settings for hard disks. It is also difficult for teachers to complete these operations through broadcast teaching software during class. Through the deployment of a virtual machine system, some operations that are risky to the host and the host operating system can be completed on the virtual host, so that the teacher demonstration and student practice can be completed well.

(2) In general, public computer classrooms are equipped with hardware protection devices such as disk protection cards, and to meet general courses, only necessary operating systems and application software are provided to prevent system damage. During the network professional course, some system strategies need to be changed and set. After completing these settings or changing operations, students will be prompted to reboot the computer. As the physical host has a disk protection card installed, after the host restarts, the previous operations will be restored to the initial state, and the configuration information will not take effect. By deploying a virtual machine system, the above problems can be solved effectively. The virtual host under the virtual machine platform can still save the previous configuration information after restarting, ensuring the validity and continuity of the experiment. At the same time, the virtual machine system can also simulate a variety of network equipment such as switches, network cards, etc. to meet the requirements of various network experiments. The virtual machine platform can also be used to set up a virtual network environment such as a domain-based local area network and a workgroup-based peer-to-peer network on a physical host. On this basis, FTP servers, DHCP servers, mail servers, streaming media servers, Web server, DNS server, and other experimental operations can be established. A virtual diskless workstation network can be built by deleting the virtual disks of the virtual machine. In the experiment, through the configuration of a virtual host as a server and some virtual machine hosts as workstations, a cross-platform server configuration experiment can be realized on the same physical host, which can strengthen the student work mode on servers, workstations, and clients. Understanding makes the whole experiment more intuitive.

(3) Professional courses such as software development testing and mobile Internet should be tested in a single machine, network, cross-browser, cross-operating system, and other environments in the process of writing various programs. General teaching computer classrooms cannot meet all of the
above. Environment, through virtual machine technology, the above environment can be deployed on
the same physical host through the virtual machine platform.

(4) In the practical teaching of operating system courses, public computer classrooms generally
only install the Windows operating system, and according to the requirements of the course, students
need to master the installation and configuration of operating systems such as Unix and Linux. Through virtual machine technology, several virtual hosts that can satisfy the installation of various
operating systems can be simulated on the virtual machine platform. The process of installing the
operating system on the virtual host is relatively independent of the operating system of the physical
host, so it is taught by teachers. In the process, the process of installing the operating system of the
virtual host can be operated in the background without affecting the teacher's continued teaching.

(5) For network security-related courses, traditional teaching models can only stay on books when
introducing the destruction methods and transmission channels of network viruses, and it is difficult
for students to get an intuitive experience during the learning process. Due to the relative isolation
between the virtual host and the physical host of the virtual machine system, in the experiment, a virus
file can be implanted into the virtual host operating system, and experiments such as system attacks
and security defense can be performed without operating the physical host so that students can obtain a
more intuitive operation experience.

The following evaluations are performed on computer courses:

Assuming that a multi-index evaluation system consists of \( n \) evaluated objects \( u_1, u_2, \ldots, u_m \). \( m \)
indicators \( x_1, x_2, \ldots, x_n \), \( x_y = x_j (x) (i = 1, 2, \ldots, n; j = 1, 2, \ldots, m) \) is the observation data evaluation
data matrix (decision matrix) of the evaluated object \( u_j \) and the index \( x_j \) can be expressed as shown in equation (1):

\[
A = \begin{bmatrix}
x_{11} & x_{12} & \cdots & x_{1n} \\
x_{21} & x_{22} & \cdots & x_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
x_{m1} & x_{m2} & \cdots & x_{mn}
\end{bmatrix}_{m \times n}
\]  

(1)

The data in \( m, n \geq 3 \) and \( A \) are normalized after pre-processing.

It can be transformed into equation (2):

\[
y_i = f(x_{i1}, x_{i2}, \ldots, x_{in}), i \in N
\]

(2)

Where \( f \) represents a positive transformation function; \( y_i \) represents the comprehensive
evaluation value of the evaluated object \( u_i \). \( u_1, u_2, \ldots, u_m \) are sorted according to the value of
\( y_1, y_2, \ldots, y_n \) from large to small, and you can complete the comparison of the advantages and
disadvantages of \( u_1, u_2, \ldots, u_m \).

If there are two evaluation objects \( u_i', u_i''(i', i'' \in N, i' \neq i'') \), assuming that \( u_i', u_i''(i', i'' \in N, i' \neq i'') \)
is a random variable that obeys a distribution on the interval \( \min (w_{ij}, w_{ij}), \max (w_{ij}, w_{ij}) \), and call
\( s'(u_i' > u_i'') \) the superiority of \( u_i' \) to \( u_i'' \), as shown in equation (3):

\[
5
\]
s(u'_i > u'_j) = p(f(u'_i > f(u'_j)) + 0.5 p(f(u'_i = f(u'_j)) \tag{3}

In the equation, the aggregate function indicates the event probability as shown in equations (4) and (5):

\[ f(u'_i) = \sum_{j=1}^{n} \lambda_j w_j (i', i^*) \tag{4} \]

\[ f(u'_j) = \sum_{j=1}^{n} \lambda_j w_j (i', i^*) \tag{5} \]

(6) Some computer courses should be taught in multimedia classrooms through projectors and other equipment due to conditions, and some operations cannot be demonstrated on-site, which makes it difficult for teachers to teach some operations through simple language expressions and written courseware. Using virtual machine technology, teachers can record the operation process in advance through the video capture and screen capture functions of the virtual machine platform, make it in relevant courseware, and show it to students during the lecture.

4. Conclusions
Virtual machine technology is a practical approach to improve the teaching level of computer practice in higher vocational colleges. It can not only simulate the real experimental environment properly, offer students more opportunities for practical operation to achieve practical experimental results, and enhance their practical skills, but also improve the efficiency of experimental equipment while reducing the damage rate of experimental equipment and saving experimental costs at the same time. Without increasing the investment of hardware equipment, it has met the scalability requirements of some course experiments. The application of virtual machine technology to computer practical teaching in higher vocational colleges has the advantages of practicality, security, and economy. Hence, it is of considerable significance to promote virtual machine technology in computer practical teaching.

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An empirical study on the promotion of teaching level by teaching competition —— A case study of young teachers participating in the National Competition of teaching ability of vocational colleges in Jiujiang.No.19ZD091.

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