The Construction of Language Laboratory Based on VOI Technology.

Xiaoqin Shi *

The Department of Foreign Languages, Northwest A&F University, Yangling, Shaanxi Province, 712100, China.

*Corresponding author e-mail: sxq-shi@nwsuaf.edu.cn

Abstract. VOI (Virtual Operating System Infrastructure), a cloud desktop technology, is popular in educational area recently, especially in colleges, because of its many advantages. It widely used in the laboratory which main equipment are computers, such as computer rooms and language laboratory. Language lab equipped computers acts as an important actor for language teaching in many colleges. Constructing a laboratory with high ratio of quality and value is the focus of many laboratory researchers. The study explores the requirement of teaching and learning for labs, surveys market and several other colleges, and designs how to construct NWAFU language labs based on VOI, compared with other prevalent technologies on market, from requirement, cost, deployment and management aspects. The study provides a reference for other type laboratory’s construction and gives some suggestions to a decision maker.

Key words: Cloud desktop, VOI, language Lab, NWAFU.

1. Introduction

A cloud desktop, which is popular on market in recent years, is a computing solution that using a cloud endpoint device to run a remote server desktop via network [1]. It is centralized for the cloud desktop to compute and store data in remote servers, different from what traditional PCs do [2]. Cloud terminals only acts as an actor of input or output operations, like displaying desktop images. Nowadays, there are several prevalent technologies based on cloud desktop on market, such as RDS (Remote Desktop Services), VDI (Virtual Desktop Infrastructure), and VOI (Virtual Operating System Infrastructure) [3], and they are widely used in many companies and organizations [4]. Because of their advantages, more and more colleges are considering to construct their laboratories which are equipped with computers, based on one of cloud desktop technologies [5].

Language laboratory mainly equipped with PCs is an important site for teaching and learning languages in colleges. In China, the language lab is very based required laboratory and Its utilization rate is so frequent [6] that no college student has never used it for his listening class in their first two college years. So, language lab construction is the first consideration by many college construction departments. However, how to construct a cost-effective and substantial laboratory is often discussed by experts and laboratory researchers.

Luo [7] talked about the challenge and opportunities of language lab construction in the “internet +” era. He illustrated the direction of construction of language lab and provided ideas for innovative
language laboratory management. Wang Xinlin and Wang Qiang[8] explored parts and the mode of utilization of language labs and indicated that language lab function meets the mode of teaching is a key direction of constructing a pure digital language lab. Bao [9] put forward a construction of a situational interaction language laboratory. Her study showed that the situational interaction language lab plays a positive role in enhancing situational interaction, stimulating students’ interest and promoting students’ autonomous foreign language learning abilities. Cheng [10] explored the construction of language lab based on network technology and said his scheme can give low efficiency of management and maintenance, especially he provided a new idea for the construction of language labs. Although scholars studied the construction of language labs from various aspects, few studies can explore how to construct language labs based on cloud desktop technology, like VOI.

Northwest A&F University (NWAFU) is a “Double Top” (World-class university and first-class disciplines) university in China. In order to create a good e-learning environment, NWAFU tries to improve the infrastructure construction, especially on constructions of labs. And Language lab construction is one of them. The study explores the construction of language laboratory in NWAFU.

2. The project planning

2.1. Requirements of Teaching for Language Laboratory
With the increase of the pace of information technology, employers need more and more comprehensive talents and more innovative technology. College older laboratories also need to be reconstructed with updated technology, especially IT (information technology). The language laboratory of the university has become key sites for language teaching and learning practices. However, the current situation of language lab in NWAFU doesn’t meet the requirement of language practice. Older hardware and outdated software cannot assist teaching and learning very well. More and more teachers and students complain that they cannot fulfill their tasks in the lab by using old equipment frequently. The management of language lab is more and more complicated and fixed cost is higher and higher. Under this condition, the university consider reconstruct language lab.

To meet the requirements of teaching and learning is firstly considered by decision maker. So, the language teaching center team conducted a questionnaire among teachers and students to collection information about what they long for. After data is collated and analyzed, some needs from 82% users for language teaching and learning in labs are as following:

- The new network speed needs much faster than before and there is no lag when High Definition (HD) Video playing. (what 95% teachers ask for)
- Teachers can broadcast on the teacher PC and students can watch on student terminals. (what 78% users need)
- Teachers can supervise students’ PC and learn about what they are doing in class. (what 83% teachers like)
- Teachers can easily send out their teaching resources to students or receive students’ files in class. (what 90% students want)
- There is unobstructed interaction between teacher and students or among students during class whatever student number is. (what 95% users request)
- The hardware or operating system can meet the requirements of some new teaching or test software. (what 78% users require)

2.2. Calculating the Cost
Following the users’ requirement, secondly, the term surveyed market and other college language labs to learn about newer information about language lab construction, including hardware and software brands and their using effect. The term visited several colleges around NWAFU in Shaanxi and got some advice about construction of new language lab from them. These advice can really help a lot for the construction of new lab.
Thirdly, several company products are introduced to teachers and let them experience the functions of products, including hardware and software. The main hardware is from HP, DELL, LENOVO respectively. Cloud box, like a student PC, a new product for deploying cloud desktop is also brought into the lab for the experience. Hardware is little different among the companies whether its function or price. However, the software, especially virtual cloud desktop technology, is more various.

At last, the team collects feedbacks from experienced users and calculates the cost of new hardware and software from different companies. Some questions about cost should be considered as following.

- If is the lowest price of products suitable for meeting the requirement?
- Which one of products can be lowest power consumption?
- Which one of companies can give the best post-sale service?
- Can bundled hardware and software be sold separately from one company?

After figuring out answers of these questions, the cost-effective program is made by the decision maker. Fig 1 describes what the team did before making the final plan.

![Diagram of decision making process](image)

**Figure 1. The Steps of Making a Decision for Buying**

### 2.3. Comparison of Main Cloud Desktop on Market

The construction of language lab in NWAFU is considered to accept cloud desktop technology, but what kind of cloud desktop is the best one for the language lab? The study explores several prevalent cloud desktops. There are four main cloud desktop technologies on market:

1) **RDS (Remote Desktop Services, also called sharing cloud desktop).** Its principle is based on multi-user operating system. Software operating and saving the data happen on a server, not on clients.

2) **VDI (Virtual Desktop Infrastructure, also called virtual cloud desktop).** The principle of VDI is that the computing storage network of the cloud desktop is completed on the server and clients connected to the cloud desktop through a proprietary protocol. There is the Hypervisor installed on the server.

3) **IDV (Intelligent Desktop Virtualization).** The principle of IDV is the centralized management of the server, and the virtual system runs on the terminal.
4) VOI (Virtual OS Infrastructure). The principle of VOI is the PXE (Preboot Execution Environment) Diskless + Cache technology. Its architecture is similar to IDV, but without the Hypervisor. Table 1 shows their advantages and disadvantages [11].

| Items                  | RDS                        | VDI                        | IDV                        | VOI                        |
|------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| principle              | OS location                | server                     | server                     | client                     | client                     |
|                        | OS management              | server                     | server                     | client                     | server                     |
|                        | data processing            | server                     | server                     | client                     | client                     |
|                        | data storage               | server                     | server                     | client                     | client                     |
| cost                   | purchase cost              | little lower price than PC | higher price than PC       | little higher than PC      | little higher than PC      |
|                        | maintenance cost           | lower                      | higher                     | higher                     | lower                      |
| user experience        | processing performance     | Optimal physical machine performance | Excellent virtual machine performance | poor client performance | good client performance |
|                        | desktop experience         | good                       | good                       | excellent                  | excellent                  |
|                        | picture display            | part of picture is fuzzy   | part of picture is fuzzy   | original picture           | original picture           |
|                        | Peripheral support rate    | 80%                        | 90%                        | 100%                       | 100%                       |
|                        | support 3D rendering?      | no                         | no, except professional technology | no                        | yes                        |
| security               | assist monitoring?         | yes                        | yes                        | no                         | no                         |
|                        | data security              | high                       | high                       | low                        | low                        |
| function               | desktop management         | support                    | support                    | support                    | support                    |
|                        | user management            | support                    | support                    | no support                 | no support                 |
|                        | Peripheral management      | support                    | support                    | no support                 | no support                 |
|                        | off-line use               | no support                 | no support                 | support                    | support                    |

a: Operating System

After weighed several aspects, VOI is chosen for language lab of NWAFU. Although VOI has some defects, its core technology is very suitable for a language lab. There are some more VOI advantages over others.

- Realize Centralized management easily.
- Buy cloud boxes (terminals), a kind of clients, with server free.
- CPU is exclusive and can realize real-time feeling.
- Can support 3D/video playing, realize hardware acceleration and display clear pictures.
- Have good software compatibility.
- Have lower bandwidth occupation.
- Has been used most for language teaching.
The structure of VOI operating principle is shown in figure 2.

![Figure 2. The Architecture of VOI Operating Principle](image1)

3. Deployment of VOI

3.1. Hardware Deployment

After some extra hardware like cables, were bought, the main hardware equipment, cloud boxes with free server are brought into the lab. In order to match NWAFU’s network speed, fiber optic switches are needed, one switch per room. Every student’s PC or terminal is connected with the switch, so does the teacher PC in every lab. The switch of the laboratory is connected with the main switch that is connected to the server group. The main switch is also connected to the network center of NWAFU. We use the CAT6 network cables to replace older CAT5 cables for connecting hardware devices. In addition, we bought 400 new PCs for English listening teaching. The architecture of hardware deployment is shown in the figure 3.

![Figure 3. Hardware Architecture of Language Labs](image2)
The language labs shown in figure 1 are consisted of three different functions of labs for teaching and learning. Laboratory 1 is for teaching college English and for non-English college students. Laboratory 2 is for English major class. Laboratory 3 is a simultaneous interpretation lab for interpreting class. Some laboratories are open for all college students.

3.2. Deployment of VOI System

Main software and VOI are supplied by Lingji, a company whose main products for computer-based laboratory, especially for language labs. Lingji VOI cloud desktop software is consisted of three parts mainly software, Mysql databases, VEMSserver and VEMSmanager Web respectively. They are installed in the server whose minimum required operating system is Windows 2012 for Server. The structure of Lingji’s system is shown in figure 4.

![Figure 4. The structure of VOI system of Lingji](image)

The core layer of VOI is deployed in the server. The core layer is protocol center administration. The core functions of the cloud desktop are virtual protection, behavioral control and desktop management. The module of the protocol center administration may set some protocols to realize high strength encrypted function and this function can protect the communication between client-client and client-server. The virtual operating system infrastructure (VOI) is like a platform on which administrators can manage all clients or the local server in any one of the PCs in any one of labs. On the platform, an administrator also can easily perform other functions. For example, they can manage resources saved in cloud disks, and realize hardware simulation and virtual application. Moreover, they can reset any one of computers in the local network, control the divers, and monitor the network flows. Similarly, a manager can use this platform to manage the asset and update patches and virus databases in time for the server and clients. A webmaster may also monitor the websites which students browse, check the condition of peripheral applications, and give a remote assistance on the platform.

4. Management

After deploying the VOI, the server and clients are tested. The Lingji’s VOI give a lab assistant who works at language lab a fantastic management of labs.

- Controlling the any one of clients at anytime and anywhere.
  
  If an administrator sits in front of any one of cloud boxes and logs on web address of the server, he can control any one of clients. For example, he can turn on and off the clients or reboot them and can set permission for a client to become a super master PC.

- Using a master client for installing or updating software on all other clients.
Only if clients are set connect with the same one server by network, can the master client install new software, generating an image files on the server, and next time when the clients are turned on, the image files are sent out to all clients and all clients can have the same software with the master client.

- Setting various image files on the server.

An administrator can set a several different image files on the server, and named them with functions, such as, TEM (Test for English Major) test image, CET (College English Test) oral test image, oral practice image, and so on. Then, he can install such software in a master client one by one. Next, he can set image files to be sent to clients of labs with different functions or switch boot menu to reboot clients for different tests or teaching needs.

- Selecting favorite system for learning.

For a user (a student), he can turn on a client and select his favorite operating system for his practice from boot menu. For instance, someone selects windows 7, and others choose Windows 10 to practice what they learning. Even through users are in the same lab, they can choose different system for learning. In a word, using the VOI, an administrator can easily realize student autonomic learning by setting image files on the server.

- Don’t worry about a system crash

Managing a computer-based lab is a tedious and painstaking work for an administrator before. He often spends a lot time on maintaining software. System crash often makes him a heavy headache. However, after using VOI, he doesn’t worry client’s operating system crash and the data is damaged anymore because the system can be recovered when the client being turned on next time.

There are a lot of good functions for management of language labs by using VOI, the study only explore several ones of them. But VOI really makes the management of computer-based labs very simple and convenient, and it saves a lot time for the maintenance of computer rooms.

5. Conclusion

The study concluded how to construct language labs in NWAFU. Before making a decision, the main steps are shown in Fig. 1. Firstly, conducting a questionnaire to get what teaching and learning needs are. Secondly, surveying market or several other colleges to get more information about construction. Thirdly, experiencing products of several IT companies to get feedbacks from users. Fourthly, calculating the cost and thinking about comprehensive factors. At last, a decision is made and using cloud desktop technology for constructing language labs in NWAFU.

Cloud desktop is prevalent in recent decade years. It is a solution that using a cloud terminal, like a smartphone, a IPAD, a PC or a cloud box, operates desktop computing on remote desktop via network. For example, an administrator can sit at one of cloud terminals to process a set of operations via network. Cloud desktop consists of Cloud clients, cloud desktop software, and a cloud server. Although there are several different popular cloud desktop software, such as RDS, VDI, IDV and VOI on market, VOI is the best for the language labs, compared with others from the cost, user experience, security and function aspects. The study explores the deployment of VOI structure, language lab architecture, and Lingji’s VOI System structure, and they are shown in Fig 2, Fig3, and Fig4. After deploying hardware and software, an administrator tests the management of labs using Lingji VOI. It gives a big change, compared with using old managing software. It really provides much smarter and more convenient management for language labs.

Although it is a construction of language lab, it can give decision marker of other lab’s construction some suggestion that meeting the requirement of teaching and learning is firstly considered, and before making a suitable and cost-effective blue print, costs, functions, performances and managements of hardware should be considered. In addition, how to build a sustainable laboratory will be explored by the further study.

Acknowledgements

Firstly, the study has been approved by the project “the Study of Language Lab Management Mode Based on Cloud Computing” (No. SGH18H024) from Shaanxi Provincial Scientific Planning Office.
The authors thank the departmental Office for the support. Secondly, authors also thank the technicians from the Lingji company for their helps to solve technology problems in the study. At last but not least, the author appreciates what assistants and other persons have done for the study.

References

[1] C. Rao, M. Lee, YR. Kumar. “Cloud: Computing Services and Deployment Models.” Vol. 2, pp: 3389–92, 2013.

[2] Z. Chen, W. Zhou, in: The intelligent application of cloud desktop in University Laboratory, Information Technology and Informatization, February 2015.

[3] Ch. Jiang, H, Tao Q. Huang, et al. “Application of Desktop Virtualization Technology in Campus Network Environment.” Experimental Technology and Management, vol. 28, pp: 103-105, may 2011.

[4] F. Wang, F. Jiang, Ch. Li, “Analysis of Virtual Desktop and Key Technologies” Telecommunication Technology, vol 58, pp:24-26, January 2011.

[5] CA. Mayoz, Da. Silva, AL. Beraldo, A. Villar-Martinez, “Remote laboratory: Experience in Upna and Unifesp.” [International conference on remote engineering and virtual instrumentation. Springer; p. 112–27, 2020].

[6] H. Lu Haibing, P. Guo, “Discussion of domestic language laboratory Development.” Laboratory Science, Vol. 3, pp:4-6, 10, June 2015

[7] N. Luo. “Discussion on the construction and management of university language laboratories in the era of ‘Internet +’”. Computer Knowledge and Technology, vol.15, pp:186-187, March 2019.

[8] X. Wang, Q. Wang, “Analysis on the Composition and Application Mode of Pure Software Digital Language Lab”. China Educational Technology, pp:122-124, June 2013.

[9] S. Bao, “Construction of a Situational Interaction Language Laboratory.” Research and Exploration in Laboratory, vol. 32, pp:195-198, June 2013.

[10] X. Cheng, H. Dai, X. Chen, “Design and construction of foreign language phonetic laboratory based on cloud network technology.” Experimental Technology and Management, vol. 35, pp: 134-137,141, May 2018.

[11] Blogger, “Comparison of mainstream cloud desktop technologies in desktop virtualization” online article, https://blog.csdn.net/looknm/article/details/88364941, March, 2019.