From Synchronous Distance Learning to VOD System: The Perspective for Private Universities

Yo-Ping Huang[1], Min-Yuan Hsiao[2], Gwo-Way Chiang[2], and Huei-Ling Peng[2]

[1]Department of Computer Science and Information Engineering, Da-Yeh University, Changhwa, Taiwan, ROC
Tel:(+886)4-8528469x2400, Fax:(+886)4-8536667, yphuang@mail.dyu.edu.tw
[2]Computer Center, Da-Yeh University, Changhwa, Taiwan, ROC
Tel:(+886)4-8528469x1661, Fax:(+886)4-8535768, vinhsiao@mail.dyu.edu.tw
Tel:(+886)4-8528469x1659, Fax:(+886)4-8535768, fuway@mail.dyu.edu.tw
Tel:(+886)4-8528469x1656, Fax:(+886)4-8535768, amy@mail.dyu.edu.tw

Abstract: Distance learning has been successfully operated for many years. It overpasses the distance problem to provide the students an alternative to learn the new knowledge. In this paper, we discuss how to improve the engineering-based distance learning courses for the students from the viewpoint of private universities. We also investigate how to migrate the distance learning to the video-on-demand (VOD) system to offer a supplementary way for the students to learn or review the contents of some specified courses anytime and anywhere.

Keywords: distance learning, video-on-demand, engineering education

1. Introduction

With the advent of Internet in the late 1990, the trend is that the students are expected to learn more from outside their major. In Taiwan, the students in the private universities may not as active in learning as the students in the public schools. However, the private university graduates play an important role in the growth of Taiwan's economy. We consider from this aspect to offer a general course to help students broaden their own knowledge in engineering technologies. Although almost every university offers many liberal arts courses for the undergraduate students, some subjects focus on the contents encompassing both the width and the depth. From our past experience, this will reduce the students' interest in selecting the course. To provide the students a better way to broaden their own common sense in the current development of engineering technologies, we thus invited 15 College of Engineering professors to offer a general course for the undergraduate students. Each participant only gave a two-hour lecture in this course. Every professor was requested to overview how the technology was formed, where to apply it, and what the future trend is in his two-hour lecture. Since the material may be new to most students, we strongly requested that the professor gave some simple examples for illustration. To provide a better visual effect, all materials were prepared by the Microsoft Powerpoint and the files were stored and can be easily downloaded by the students after the class. Besides, we created an e-mail address for the students to ask the questions or give some comments. The basic structure for the cross-campus distance learning is plotted in Fig. 1.

After finishing the course, we gave students and professors questionnaires to evaluate the learning and teaching effect, respectively [1]. Note that the questionnaire is absolutely unrelated to the students' grades. The student's questionnaire includes four major parts including the motivation of selecting the course, the contents of the course, the facility of the classroom, and the personal learning effect from the course. The statistical outcomes from the questionnaire are shown in Fig. 2a-c. In general, more than 90 percent students gave a positive response (more or less satisfaction) from the course. From the professors' side, the results are plotted in Fig. 3a-c. Since every professor spent a lot of time in collecting the related materials to enrich the content, however, only two-hour pay was obtained. Thus, 4 out of 15 were reluctant to collaborate if the course is offered again in the next year. Actually, no one cares the money. They just care whether they can have some positive feedback from the class. This encourages us to enhance the contents of the course and offer a similar course next year.

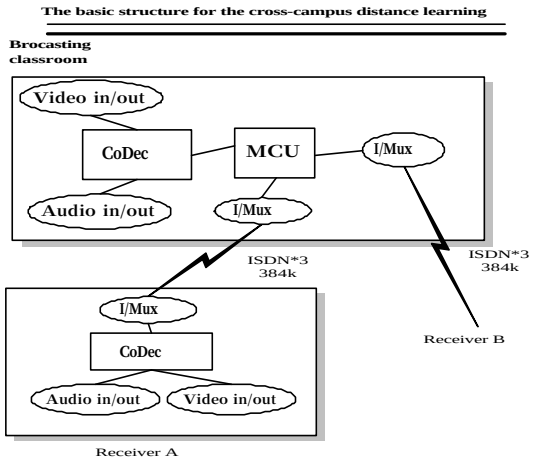

Fig. 1. The basic structure for the cross-campus distance learning.

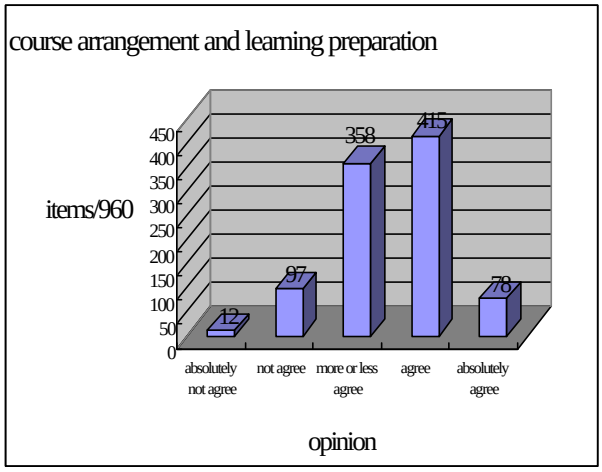

Fig. 2a. The course arrangement and learning preparation.

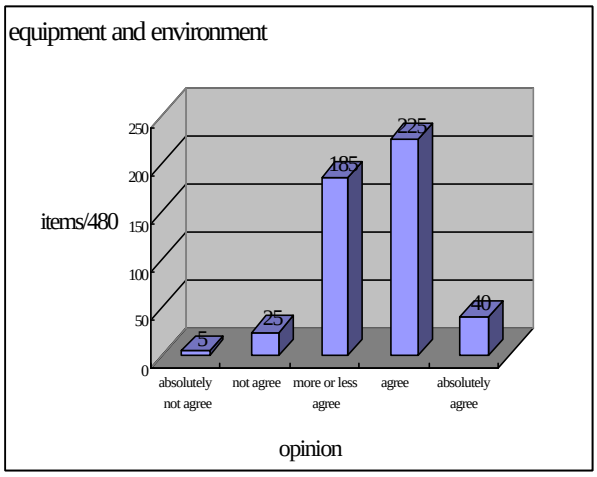

Fig. 2b. The equipment and environment.

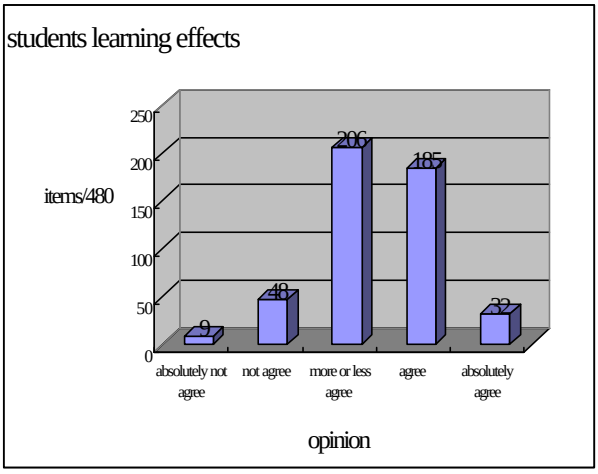

Fig. 2c. The students learning effects.

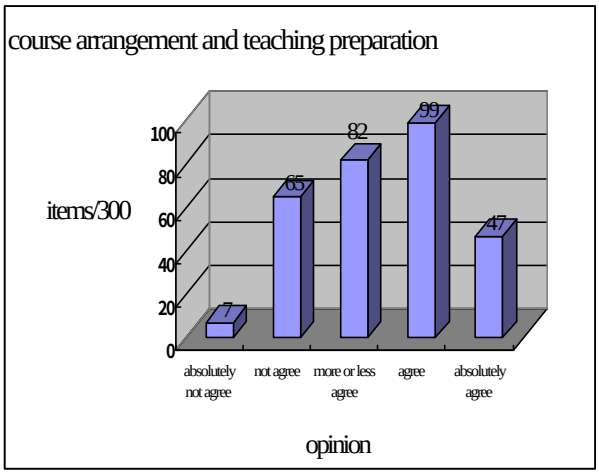

Fig. 3a. Course arrangement and teaching preparation.

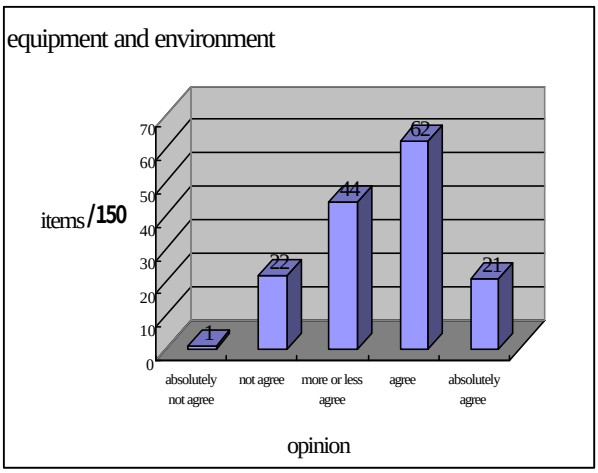

Fig. 3b. The equipment and environment.

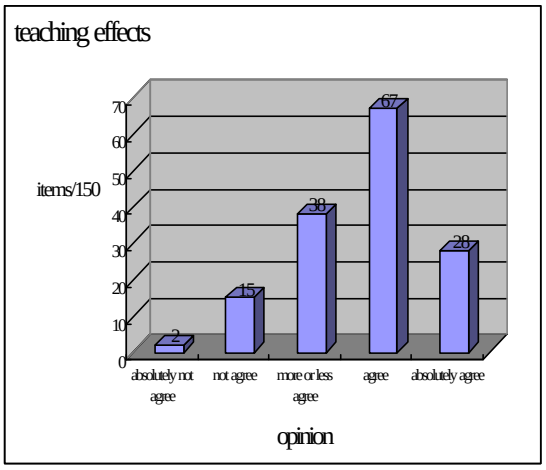

Fig. 3c. The teaching effects.

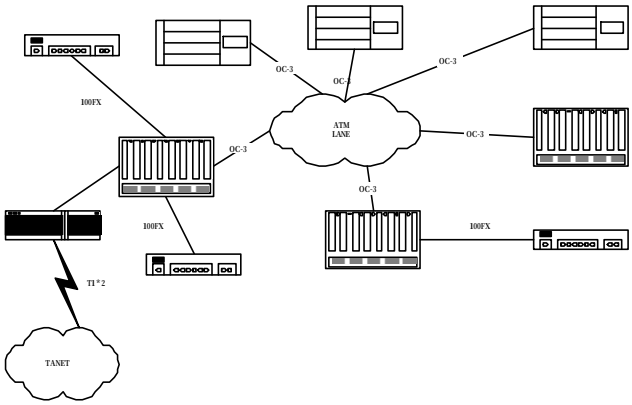

Fig. 4. The structure of campus network.

2. The structure of the distance learning system

In June 1997, the Executive-Yuan of Taiwan granted a four-year project of distance learning in middle range development program [2]. From then on, we applied part of the financial support from the Ministry of Education to establish a classroom for distance learning. Till now, we have many courses broadcasted to or received from other universities in the central Taiwan.

2.1 Synchronous distance learning

Interconnected through the Chunghua Telcom six BRI (2B+1D) ISDN lines, which provides a total bandwidth of 768K, the classroom of distance learning in Da-Yeh University has the real-time group broadcasting function due to its MCU cards. With the help of the Codec system, the whole device system can also provide the mutual transmission and receiving of the audio and image. All the materials taught in the class are available in the Internet. The discussion section allows the students to ask the questions and the teachers can answer the questions. Students use e-mail to send their homework. Besides, we have a course discussion section in the BBS system for those students who are interested in the contents of the course to discuss in public. Teachers can receive some feedback from the BBS and understand the learning situation, answer some questions, post news, and assign the homework for the students.

To enhance the teaching quality, we created a web site which includes a self-evaluation section for the students. Teachers can input some problems and their solutions for students to self-test their learning effect. Since some questions may be frequently asked, the section of frequently asked questions allows the teachers to prepare more supplementary materials to explain the contents in more detail.

2.2 Basic structure of campus network

The ATM network of Da-Yeh campus is the star structure as shown in Fig. 4. Based on the ATM switch, each building in the campus is interconnected by the multi-mode fiber optics. The bandwidth between two switches is at least OC-3 (155Mbps). The campus has two T1 lines connected to TANET and six BRI (2b+1d) ISDN for synchronous distance learning.

2.3 The status of network load and bottleneck

Based on the network flow analysis, over 90% of the bandwidth of our two T1 lines are always in use. This is where the bottleneck is. As we know, the bandwidth of TANET is much less than enough, especially since the

infrastructure of information education issued by Ministry of Education. Therefore, how to create more bandwidth and the corresponding network quality are the important problems to be solved. The other problem is how to improve the delay and data loss between the Ethernet frame and ATM cell.

2.4 Migration to the Gigabit system

The ATM switch can support the bandwidth from 25Mbps, 155Mbps, 622Mbps, and 2.5Gbps. Due to the ratio of cost to performance, the 155Mbps is used commonly. On the other hand, the Ethernet can support 10Mbps, 100Mbps, 1Gbps, and 10Gbps. Therefore, the Gigabit Ethernet is more suitable for the campus LAN structure, while the ATM is suitable for the WAN structure.

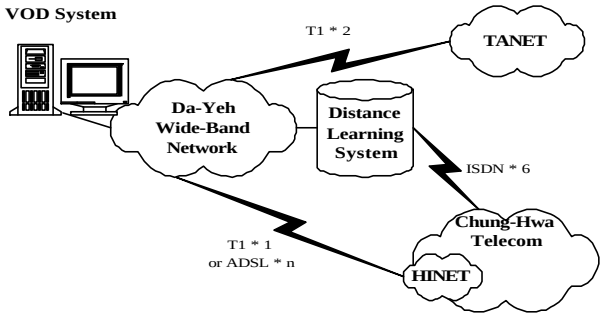

Fig. 5. The constructing VOD system in Da -Yeh University.

3. The wide-band bi-directional interactive distance learning system

3.1 The merge of synchronous and asynchronous distance learning

Although the synchronous distance learning encompasses the distance problem such that cross-campus learning becomes possible, students must take the course at the specified time and at the dedicated classroom [3]. In case either the broadcasting or receiving time has a conflict with other courses, students may not be able to select the course.

If a student was absent from a class, he/she can watch the recorded tapes to make up the course if a classroom has such a recording facility. Since our dormitories cannot accommodate all the students, to give our students who lodge outside the campus or our community a better learning environment, we are establishing a VOD system as shown in Fig. 5 now. The recorded tapes from the synchronous distance learning can be digitized and stored into the powerful VOD system. Through the functions of scheduling and broadcasting in the VOD system, the purpose of studying in advance and reviewing the contents after class can be easily achieved. In the future, the VOD system can combine the wide-area network to provide the whole community and alumni a lifetime learning target.

Due to the financial situation for the private universities and the existing bandwidth problem, the process to construct the VOD system is divided into three stages. The first stage is to construct an independent Gigabit Ethernet for the dormitories to connect to the VOD server such that all the students lodging in the dormitories can use the system. The second stage is to increase the capacity of the Gigabit switch as well as to combine the ATM network structure with the Gigabit Ethernet. The service will also be extended to each college and department in this stage. In the long run, the outgoing bandwidth should be increased. Besides, we can utilize the wide bandwidth provided by the ADSL or Cable systems to serve the whole community or everywhere in the country.

The structure for the complete VOD system is plotted in Fig. 6. After completing, our students can review the contents of some courses through the Internet. We hope the system can help the students learn more anytime and anywhere. Instructors can also use this system to enhance their course contents. As a result, a virtual campus can be formed in the near future.

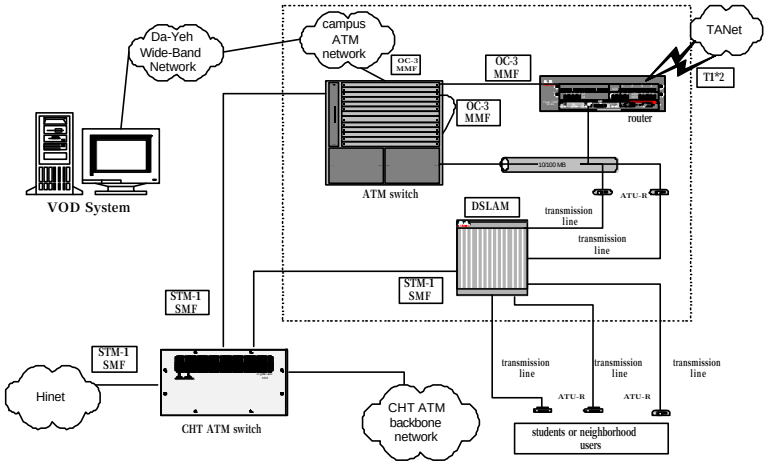

Fig. 6. The structure for the outgoing connection in the VOD system.

3.2 The standards for the audio-video transmission

The following describes some standards for the audio-video transmission required in the VOD system.

- H.323：the reference structure and technical requirement when the local area network cannot guarantee the quality of service.
- H.261：the algorithm for audio-video compression and the representation of the compressed data.
- H.263：the definition of the coding method for the audio-video data when the transmission speed is lower than 64Kbps.
- G.711：the definition of the 64Kbps, 300~3.4KHz voice compression (PCM).
- G.722：the definition of the 48/56Kbps, 50~7KHz voice compression (ADPCM).
- G.729：the definition of the 8Kbps voice coding compression.
- T.120：including a series of standards for the operation of document sharing, file transmission, and the electronic board.

As we know, most of the compressions of images, audio, and videos follow the MPEG (Moving Picture Experts Group) standard from the ISO. To play a 30fps (frame per second) MPEG-1 (with a resolution of 352x240) file, we need 1.5Mbps bandwidth. If the MPEG-2 (with a resolution of 720x480) is played, about 4 to 9Mbps bandwidth is required. Consider from the aspect of bandwidth and receiving quality, the MPEG-1-based format is preferred at this stage in the campus. For the outside-campus viewers, the real player format is suggested because less bandwidth is required. In the future, if the wide bandwidth in the WAN becomes available, the outside-campus viewers can receive the same quality as the inside-campus students can.

4. Conclusion

In this paper the distance learning in the engineering education is proposed. Since 15 engineering topics were addressed in the course which differed from most courses, students can learn more fundamental concepts and future trends of engineering development. The statistics from the questionnaire verified that our course satisfied the expectation of most students. Based on the results, we found that our course can provide some common sense for students to learn the engineering technologies. How to migrate the synchronous distance learning to the asynchronous learning was also discussed from both the viewpoints of finance and network technology. We believe that the course of distance learning will become more and more important in the information age.

5. References

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