

Prototype of a BYOD-style Computer Classroom

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Abstract: - As the internet and computers have become integral tools in everyday life and in business, we face an ever-growing need for education related to computers. Universities and other educational institutions today install vast numbers of computers to setup computer classrooms. This situation leaves universities facing the serious issue of the growing cost of providing computer classrooms. To address this, we evaluated incorporating the concept of BYOD (Bring Your Own Device) as a way to reduce the costs related to establishing a computer classroom and ensure a more enhanced educational environment. This paper discusses our methods and the prototype system we created.

Key-Words: - BYOD, Computer Classroom, Tablet PC, Virtual Desktop

1 Introduction

Education for understanding the internet and computers, and learning to use these as tools has been conducted proactively for some time. This is what is generally referred to as computer literacy, which teaches the fundamentals of computer use. Many universities and other academic institutions establish computer classrooms that house a number of computers based on the size of the school or the number of students in order to create an environment for implementing computer literacy curriculum and other education related to computers. At our own Fukuoka University [1], as is indicated in Figure 1, multiple computer classrooms have been established throughout the university. A list of the number of computers and classrooms is shown in Table 1. Use of these computer classrooms is not limited to computer literacy education. These facilities also are used for learning advanced specialties. For example, courses that teach CAD (Computer Aided Design) software to future engineers as well as computer programming courses are conducted using these facilities. Recently, the procedure for signing up for courses has been made available online via information systems. Computer classrooms are also used by people completing those procedures, as well as students conducting job search activities. Computers are used in nearly every aspect of the educational environment.



Fig. 1 Computer classroom in Fukuoka University

2 Issues related to the operation of computer classrooms

Fukuoka University has a lot of computer classrooms. The detail is shown in Table 1. While the importance of these computer classrooms continues to grow, it is not necessarily the case that these computer classrooms are always in use. At Fukuoka University, course times are weekdays 9am to 6pm but, largely, courses are conducted from 10am to 4pm, which is only 25% of the 24-hour day. The times during which students use computer classrooms for self-study are the same. This is likely

because students tend to use the computer classrooms during the time in between classes and once all their classes are over, the students move away from the university campus to return home and other reasons. Furthermore, periods of heavy use do not occur every day. Typically, this period is from Tuesday through Thursday, which is the equivalent of 43% of the 7-day week. Looked at on an annual basis, of the 52 weeks of the year, Japanese universities conduct classes for 30 weeks, equivalent to approximately 58% of a single year.

Table 1 Detail of Computer classroom in Fukuoka University

No.	Room Name	Opentime		Number of PC
01	Bunkei-A	Mon-Sat	08:50-21:00	30
02	Bunkei-B	Mon-Sat	08:50-22:00	90
03	Bunkei-C	Mon-Sat	08:50-22:00	92
04	Bunkei-D	Mon-Sat	08:50-22:00	44
05	Bunkei-E	Mon-Sat	08:50-22:00	14
06	Bunkei-F	Mon-Sat	08:50-21:00	15
07	Bunkei-G	Mon-Sat	08:50-22:00	42
08	A-A	Mon-Sat Sat,Sun, Holiday	08:50-23:00 08:50-22:00	64
09	A-D	Mon-Sat	08:50-22:00	44
10	B1	Mon-Sat	08:50-22:00	84
11	B2-A	Mon-Sat	08:50-22:00	19
12	B2-B	Mon-Sat	08:50-22:00	54
13	B9	Mon-Sat	08:50-20:00	88
14	B11	Mon-Sat	08:50-22:00	102
15	B17	Mon-Sat	08:50-20:00	150
16	A-CALL	Mon-Sat	08:50-22:00	60
17	B7-C1	Mon-Sat	08:50-22:00	64
18	B7-C2	Mon-Sat	08:50-22:00	48
19	Med	Mon-Fri Sat,Sun, Holiday	08:50-21:00 08:50-16:30	140
20	Bunkei-O	Mon-Sat	08:50-22:00	5
21	A-O	Mon-Fri Sat,Sun, Holiday	08:50-23:00 08:50-22:00	30
22	B11-O	Mon-Sat	08:50-22:00	16
23	B16-O	Mon-Sat	08:50-20:00	16
24	B18-O	Mon-Sat	08:50-20:00	15
25	HALL2	Mon-Sat	08:50-21:00	10
26	Med-O	Mon-Fri Sat	08:50-21:00 08:50-16:30	20
27	Helios	-	-	5
28	Office	-	-	8
29	ITC	-	-	8
Total number of PC				1377

From this perspective, computers and computer classrooms are not used for the majority of a day and, over the course of a year, there are many days when they are barely used. Calculating the total number of hours during periods when the demand for computer classroom use increases, it is likely that this does not reach even 10% of the 8,760 hours in a year. Out of 8,760 hours, 90% of this time is spent operating computer classrooms with few users. And as computer classrooms are closed at night, this further lends to the conclusion that operating efficiency is not good. However, during peak periods, the number of computers and computer classrooms can be insufficient, which results in dissatisfaction among users. As a result, it is difficult to say that the operation of computer classrooms is wasteful. From the perspective of those of use in the position of operating computer classrooms, we continue to operate computer classrooms while facing such a dilemma and harboring a desire to reduce the number of computers even those it is not possible. Evaluated as a possible solution to this situation is the establishment of BYOD-based computer classrooms that incorporate the concepts of BYOD [2-5].

3 Characteristics of a BYOD-style computer classroom

In order to resolve this problem, we examined a system of eliminating computers from the computer classrooms and, instead, having students bring computers. There are two main characteristics to the BYOD-style computer classroom we are considering. Those points are indicated below.

- Students use a Tablet PC with a screen size of approx. 8-inches and bring this device to school.
- Computer classrooms are equipped only with monitors, keyboards, mice, and LAN cables. In place of the main computer unit, the students bring their own tablets to use as a computer.

With conventional BYOD, most cases involve the use of a notebook computer equipped with a keyboard. However, our concept involves having students use a Tablet PC that has no hardware keyboard. The students bring those devices to the computer classroom and connect the Tablet PC to a monitor to use as a desktop-like device. Our reasons for consider this style of BYOD are as follows.

Many students at Fukuoka University travel to school from significant distances. Also, the majority

of students do not commute to school via car or motorcycle, and instead use public transportation such as the bus or subway. For such students, having to carry a heavy notebook computer with attached keyboard from home to school would force too much of a burden on the students. Also, notebook computers are not cheap and this would create a financial burden on students. However, having students use a Tablet PC that includes Microsoft Office yet still is relatively inexpensive provides numerous benefits. As such, considering having students carry Tablet PCs would have significant value for Fukuoka University.



Fig. 2 Size comparison of letter-size paper and Tablet PC

4 Prototype of BYOD-style computer classroom

In order to evaluate the operation of a BYOD-style computer classroom, we created a model of a system for utilizing Tablet PCs as desktop-like terminals. That system is indicated in Figure 3 and Figure 4.

There is a need to connect a monitor, keyboard, mouse, and LAN, etc. to the Tablet PC. Those connections are made using a docking station. The docking station and Tablet PC are connected by a single USB cable, making the process converted a Tablet PC into a desktop-like terminal simple. This would create an environment in which users have the input convenience of a keyboard and mouse for smooth control of the computer. This system structure is shown in Figure 5 and Figure 6. By setting up only these computer peripherals in the computer classroom and having user bring their own computer, it will be possible for the university to greatly reduce its cost burden related to operating computer classrooms.

Furthermore, because the Tablet PC can be used as a stand-alone device, it can be used in classrooms other than the computer classroom, which would enable the use of a computer in various classrooms without restrictions. For example, it would be possible for students to use the Tablet PCs to study during their commute. Also, if the students setup a monitor and keyboard in their own homes, then they can also use the Tablet PC as a desktop-like terminal at home as well. In other words, students have access to a computer anywhere at any time, cost reductions are achieved, opportunities for computer utilization are increased, and cost-effectiveness is improved.



Fig. 3 Prototype of BYOD-style computer classroom



Fig. 4 The docking station and Tablet PC are connected by a single USB cable

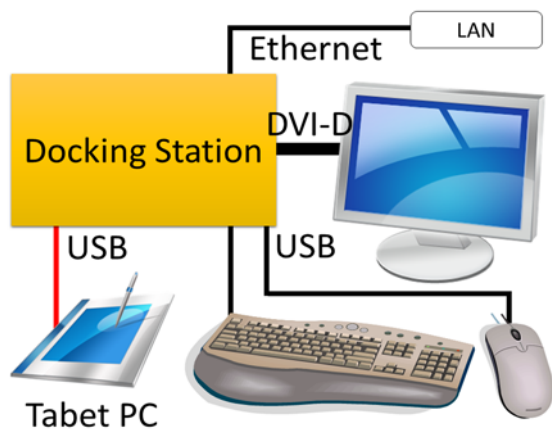


Fig. 5 Connection diagram



Fig. 6 Tablet PC connected by a USB cable

5 Problems and resolutions

The use of this system would likely present certain problems. That would be the differences between the Tablet PCs used by each student and the low performance ability of the Tablet PCs. First, differences in the Tablet PCs used by each student would result due to the fact that the students would be able to install software onto the Tablet PC based on their own discretion, which would mean no consistency between the software types and versions used by each student. Conducting classes in a BYOD-style computer classroom with such differing operating environments on each Tablet PC would result in the high likelihood of students who are unable to properly perform the operations indicated by the instructor even is doing as instructed. The resolution to this problem is the use of virtual desktop technology. Regardless of the Tablet PC, it all students access the school's common virtual desktop environment from their own Tablet PCs, they all students would be able to partake in courses in a common environment. This

would prevent cases of different operating procedures for each student. That system is indicated in Figure 7.

The problem of the low performance of Tablet PC is something that can be resolved through the use of a virtual desktop. The latest virtual desktops provide suitable performance even for the low performance of a Tablet PC. Even when using software like CAD, which requires significant computing power, the use of a virtual desktop enables smooth use on a Tablet PC. And using a monitor with a screen size that is larger than a Tablet PC enables smooth operability. When attempted operating a virtual desktop using the remote desktop software included in Microsoft Windows [6]. Using a refined pre-packaged virtual desktop will ensure performance that is suitable for use in an educational setting [7]. In this way, we confirmed that combining a Tablet PC with a virtual desktop will provide an education environment that is no different compared to typical computer classrooms.



Fig. 7 Prototype of virtual desktop system

6 Conclusion

This paper proposed a BYOD-style classroom where students bring 8-inches Tablet PCs to school and connect those Tablet PCs to monitors and other peripheral equipment to change the Tablet PC into a desktop-like terminal. Future validation testing plans will include establishing a small-scale BYOD-style computer classroom within the school and having students use the facility to identify issues related to the operation of such a classroom. This process will be used to validate the feasibility of the evaluations discussed in this paper.

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