PRACTICE OF ORGANISATIONAL STRATEGIES OF IMPROVING COMPUTER ROOMS FOR PROMOTING SMART EDUCATION USING ICT EQUIPMENT

Nobuyuki Ogawa[1] and Akira Shimizu[2]
[1]*Department of Architecture, National Institute of Technology, Gifu College*
[2]*General Education, National Institute of Technology, Gifu College*
2236-2 Kamimakuwa, Motosu-city, Gifu 501-0495, Japan

ABSTRACT

This paper describes our concrete efforts to improve the functions of the computer rooms in the Information Processing Center from among several organisational strategies which can assume a large role in the next-generation education, while examining the practice of active learning by the faculty in all classes using ICT equipment. We implemented the strategies to rapidly introduce smart education including e-Learning into all subjects of our college by improving the functions of the computer rooms, increasing the number of the computer rooms, and linking with the "Acceleration Program for University Education Rebuilding (AP)" which is being promoted as a collegewide project. Also, based on the circumstances leading to the increase in the number of the computer rooms, we conducted an aggregate analysis of use of the increased computer rooms and utilized the results for promoting smart education.

KEYWORDS

Organisational strategy, Educational management, e-Learning, Active learning

1. INTRODUCTION

National Institute of Technology (NIT), Gifu College is making efforts geared toward the creation of ICT-driven, advanced and diverse educational environment mainly in the computer rooms of the Information Processing Center. For the purpose of managing this kind of advanced educational environment with limited manpower and time, we have provided users with a stable system operation so far, while increasing efficiency of management and operation in a network boot system. The computer rooms are widely used as terminals for ICT-driven education and e-Learning as well as for practices of programming and CAD.

Our e-Learning and ICT-driven education practiced for more than 15 years being highly evaluated, and as a result, funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) through the "Acceleration Program for University Education Rebuilding (AP)" from 2014, our college has been practicing smart education at a collegewide level. (Ogawa, N. et al, 2015, Ogawa, N., Shimizu, A., 2015) The AP project will be financially supported until 2020. So far, we have created an environment to practice smart education by introducing various kinds of equipment, such as an electronic blackboard system (all 25 classrooms of all the years from the first to the fifth year of all the five departments), wireless LAN (all 25 classrooms), tablet personal computers (more than 160), notebook personal computers (enough units for simultaneous utilization of two classes), LMS and software for creating teaching materials. The details are described in our papers. Also, we have been holding collegewide FD sessions to promote the faculty to practice smart education shown in our papers. (Ogawa, N., Shimizu, A., 2016)

The budget of our AP project was not used for the latest replacement of an educational electronic computer system. Using college expenses we replaced PC terminals which were introduced five years ago with the latest, highly-specified ones, and determined to maintain management and operation with a network-boot system. Moreover, we augmented students' opportunities to use ICT equipment freely by increasing the number of the computer rooms from 3 to 5 and also by closely coordinating with the AP project. An educational electronic computer system was introduced into the 1st, 2nd, 3rd and 4th computer

rooms of the Information Processing Center and also into the 5th computer room on the third floor of Main Building I.

In this article, we describe the improvement of the computer rooms from 3 to 5 conducted as an organisational strategy with an aim to promote active learning (Bergmann, J. & Sams, A., 2012, Bonwell, C.C. & Eison, J.A., 1991, Hake, R. R., 1998, Michael, J., 2006, Prince, M., 2004, Renkl, A. et al, 2002) and smart education (Brant, G. et al, 1991, Hoellwarth, C., & Moelter, M. J., 2011, Westermann, K., & Rummel, N., 2012) or ICT-driven education and e-Learning at a collegewide level.

2. INTRODUCTION OF A NEW ELECTRONIC COMPUTER SYSTEM FOR EDUCATION

A new electronic computer system for education has equipment and technological functions shown below:

(Details of equipment)

1. A network boot server
2. Client terminals (desktop PCs)
3. A monochrome laser printer
4. Document cameras
5. Networking equipment
6. An uninterruptible power system
7. An education support system
8. Floor wiring at the 4th and 5th computer rooms

(Technological functions)

1. It became possible to provide education of all subjects in the computer rooms in the Information Processing Center and in the 5th computer room on the third floor of Main Building I.
2. A system booted via a network (network boot system) was introduced into the computer rooms in the Information Processing Center and in the 5th computer room on the third floor of Main Building I.
3. A function was introduced which administers OS and application of respective terminals by using virtual disk images.
4. A function which boots the terminals changing over plural virtual disk images was introduced into the terminals installed in the computer rooms in the Information Processing Center and in the 5th computer room on the third floor of Main Building I.
5. Software which makes it possible to display teaching materials displayed on the teacher's monitor on respective students' monitors was introduced into the terminals installed in the computer rooms in the Information Processing Center and in the 5th computer room on the third floor of Main Building I.
6. A redundant configuration was adopted for the network boot system in consideration of administrative operations.
7. A function which makes it possible to view educational information through the Internet under the control of the Information Processing Center was installed in the introduced system.
8. The entire system was designed to effectively and efficiently operate each function with consideration for linkages with the existing campus-wide network as well as the related systems which are expected to be introduced in the near future.
9. A system was introduced which makes it possible to automatically perform environmental restoration via a network or when booting terminals so that the same system would be kept after notebook personal computers are added to the system.
10. The boot-up time, from pressing the power button to displaying a login screen, was set within 120 seconds under the condition that the introduced 45 terminals were booted at a time in the Information Processing Center.
11. The communication speed of the server and switches inside a server rack was set more than 2 Gbps at all times. Windows 8.1 Enterprise (64 bit) was adopted for OS of a client terminal to be booted via the network by a server.

3. NEW COMPUTER ROOMS IN THE INFORMATION PROCESSING CENTER AND AN INTRODUCED SYSTEM

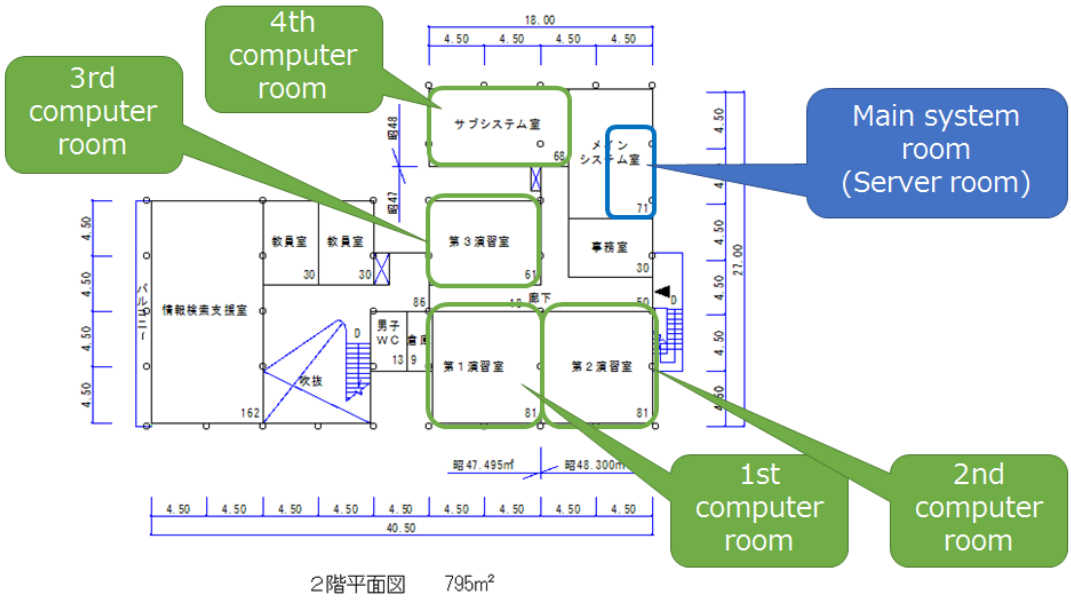

Figure 1. The arrangement of the computer rooms and others on the third floor of the library

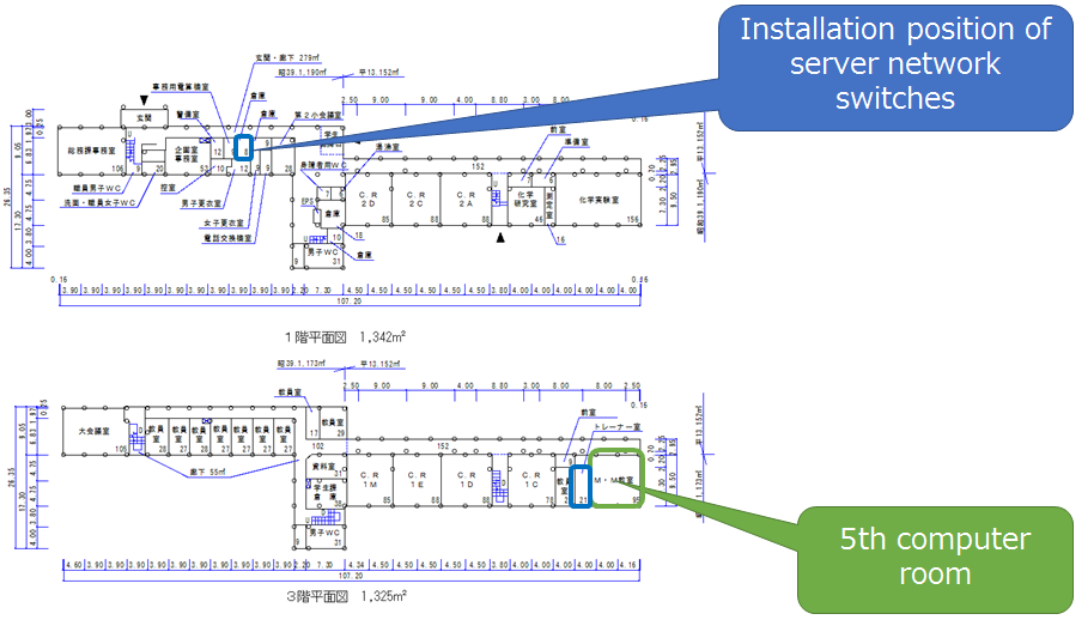

Figure 2. The arrangement of a computer room and others on the first and third floors of Main Building I

ISBN: 978-989-8533-63-0 © 2017

The number of the computer rooms was increased from 3 to 5, and as shown in Figures 1 and 2, the 1st, 2nd, 3rd and 4th computer rooms were arranged on the second floor of the library, and the 5th one was arranged on the third floor of Main Building I. Server equipment was installed in the main system room in the library, and the server network switches were used as the ones for the 5th computer room. The system was configured as shown in Figure 3, and it was linked with the equipment introduced through the AP project.

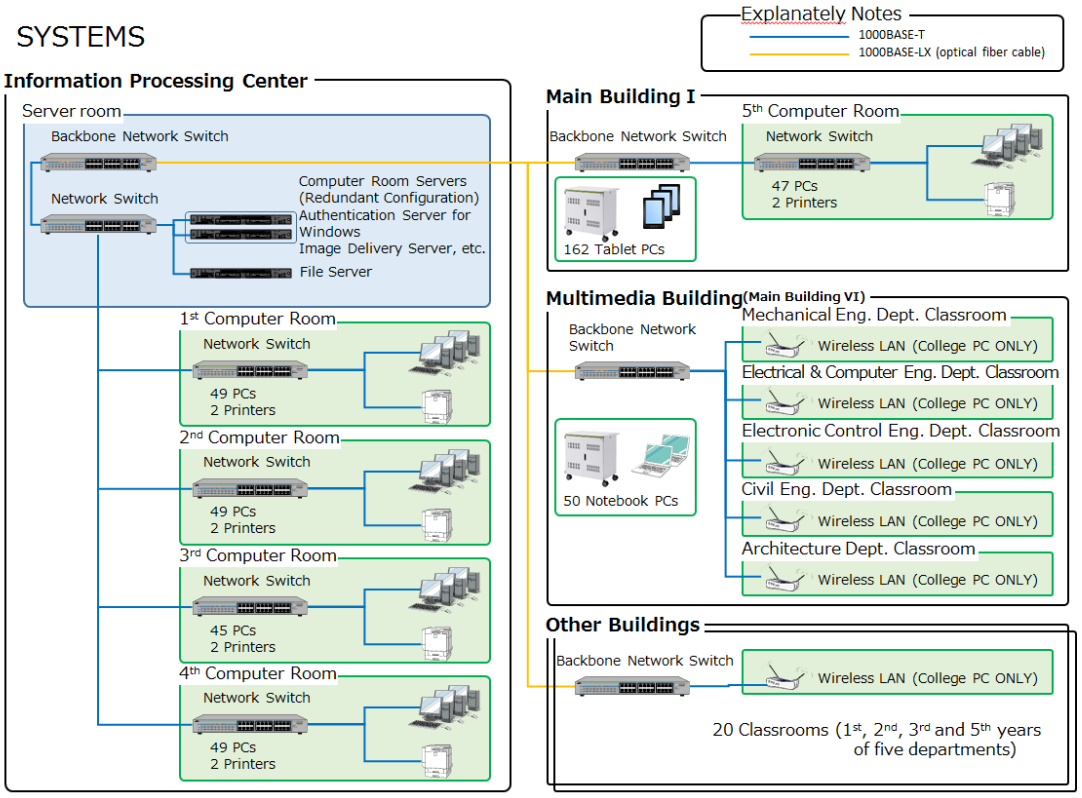

Figure 3. A configuration diagram of a new electronic computer system for education

4. USE OF NEW COMPUTER ROOMS

The new system made it possible to record the number of sheets printed by each student using a printer placed in a computer room of the Information Processing Center. Though wasteful printing by some students had been a problem, the new system enabled us to identify such students. Table 1 shows the monthly ranking of the number of sheets printed using the printers in the computer rooms of the Information Processing Center. Table 1 gives information only on the number of printed sheets to prevent identification of an individual. In fact, however, the system gives us data on student name, date and place. The high-ranking students are wastefully printing every month, and it was made clear that shared resources are largely occupied by some specific students. We are giving an educational admonishment to those students who are undoubtedly wastefully printing after confirming the necessity of their printed materials.

Moreover, we are also monitoring wireless LAN network load as an item related to an attempt of an educational admonishment on students' use of shared resources. On the basis of our information network security policy, we are restricting access to college wireless LAN by using MAC address in order to prevent access by unregistered devices. Our college regulations don't allow students' devices to get connected to college wireless LAN at present. However, we are considering a switch to recommend "Bring your own device (BYOD)" in the near future. We have an idea that BYOD will be useful for further promoting active learning and smart education in our college. For this reason, in this

academic year, we have eased regulations on network access on a trial basis exclusively for the students at the Department of Electrical and Computer Engineering, and permitted those students who submitted a statement of reason and a special application with information including MAC address to use wireless LAN, while monitoring MAC address of a wireless LAN-connected device. While continuously analyzing the possibility that some specific students will largely occupy shared network resources, with the promotion of BYOD we intend to use the analysis results for designing a system to connect students' devices to wireless LAN and considering a threshold value to limit network communication band.

Table 1. The monthly ranking of the number of sheets printed using the printers in the computer rooms of the Information Processing Center

Ranking	Sheets printed in April	Sheets printed in May	Sheets printed in June	Sheets printed in July	Sheets printed in August	Sheets printed in September	Sheets printed in October	Sheets printed in November
1	271	357	358	260	277	160	152	297
2	246	221	344	176	88	142	97	249
3	172	211	336	169	55	119	83	101
4	172	161	234	169	53	113	81	79
5	171	146	187	150	50	103	80	74
6	165	137	164	135	40	103	68	72
7	147	132	129	132	24	96	56	69
8	126	125	126	126	18	90	56	69
9	114	116	121	120	18	89	56	69
10	90	107	109	110	16	83	56	64
11	90	107	106	108	15	82	56	61
12	82	94	100	83	15	78	54	60
13	81	93	100	75	15	69	51	60
14	80	93	95	75	13	66	50	55
15	79	92	86	74	13	58	47	54
16	74	90	84	72	12	58	47	54
17	71	88	83	70	9	57	46	53
18	61	87	83	67	9	56	45	52
19	61	80	79	66	8	55	42	52
20	60	78	77	65	6	55	41	49

Changing the number of computer rooms in the Information Processing Center from three to five, we decided not to keep about 150 PC terminals which had been installed in students' desks of the fourth-year classrooms of the five departments in Main Building VI (Multimedia Building) for more than 15 years. As shown in Figure 3, as part of "Acceleration Program for University Education Rebuilding (AP)", we installed wireless LAN in each of the 25 classrooms of all the years (from the first to the fifth year) of all the five departments and introduced more than 160 tablet PCs which match wireless LAN, as well as many notebook PCs which match wireless LAN enough to use in two classrooms at the same time, which became one of the major reasons why we decided not to keep PC terminals in Main Building VI.

In the fourth-year classrooms, where every student could use a desktop personal computer for exclusive use for more than 15 years, classes using high-spec computers such as programming and CAD could be practiced. Also, with the spread of active learning classes using ICT equipment in our college, needs for the computer rooms in the Information Processing Center began to increase, which brought too difficult a situation to maintain education under ICT environment. Though not all the computer rooms were entirely occupied by the classes in terms of a time schedule, some kinds of restrictions for making a time schedule invited a situation where we needed more than three computer rooms in a specific period of a specific day. Tables 2 and 3 showing the usage situation of the computer rooms for classes in the academic year 2016 revealed that changing the number from three to five would meet the needs of the faculty. As shown in Tables 2 and 3, in "Period I" (Friday, the first semester), "Period II" (Friday, the first semester) and "Period I" (Thursday, the second semester), four computer rooms were used at the same time. The new computer rooms are the fourth and fifth ones.

The fifth computer room, built not on the second floor of the library but in Main Building I, is situated closer to the classrooms of all years of all departments than the library. For this reason, it was frequently used. On the other hand, the fourth computer room was not well used because of inconvenience. However, it is expected that more and more active learning classes using ICT equipment will be practiced in future with the progress of our AP project and that the situation will increase the number of classes conducted in the computer rooms year by year. Considering the necessity of covering usage for the next five years by the latest replacement, it was appropriate to increase the computer rooms.

In addition to use in classes, students are allowed to use any of the five computer rooms after school for self-learning as well as some kinds of students' activities related to active learning such as group work. Table 4 shows the students' usage situation in the period spanning April through November, including their usage after school. Though the number of classes conducted in the 4th computer room is less than those conducted in the 5th computer room, more students, as shown in Table 4, used the 4th computer room than the 5th computer room in several months. This doesn't mean students are likely to avoid using the 4th computer room.

Table 2. Use of the Information Processing Center in the first semester of the academic year 2016

Day	Period	1st computer room	2nd computer room	3rd computer room	4th computer room	5th computer room
Mon	Ⅰ			Advanced English B (2SK)		
	Ⅱ		Soil Mechanics II (4C)			English A (3M)
	Ⅲ	English C (1C)				English A (3E)
	Ⅳ					
Tue	Ⅰ	Urban and Regional Planning (5C)				English A (4E)
	Ⅱ					English A (4D)
	Ⅲ	Design and Drawing (4C)				English Practice 1 (1Y)
	Ⅳ		Computer Literacy (2M)			
Wed	Ⅰ	English C (1M)	Information Processing I (2D)			English A (3D)
	Ⅱ	English C (1A)	Environment Design I (5A)			English A (3A)
	Ⅲ					
Thu	Ⅰ	English C (1E)	Instrumentation Engineering (4D)			
	Ⅱ	English C (1D)	Information Processing III (4D)	Information Processing II (3D)		
	Ⅲ	Design Drafting (1E)	Traffic Engineering (5C)			Introduction to Electronic Control Engineering (1D)

	Ⅳ	Electronic Control Circuits (4D)	Spatial Information Engineering (5C)			
Fri	Ⅰ	English A（4A）	Urban Engineering (4C)	Computer Literacy (1C)		English A (3C)
	Ⅱ	Environmental Sociology (5A)	Surveying III (4C)	Design and Drafting I (2D)		Advanced English B (2SK)
	Ⅲ	English A (4C)				
	Ⅳ			Numerical Analysis (4C)		

Note: Regarding the symbols used in Table 2, each of the digits represents a year (grade), and the alphabetical letters, M, E, D, C, K, S, K and Y respectively represent the Department of Mechanical Engineering, the Department of Electrical and Computer Engineering, the Department of Electronic Control Engineering, the Department of Civil Engineering, the Department of Architecture, the Course of Electronic System Engineering, the Course of Architecture and Civil Engineering and the Course of Interdisciplinary Technology Development.

Table 3. Use of the Information Processing Center in the second semester of the academic year 2016

Day	Period	1st computer room	2nd computer room	3rd computer room	4th computer room	5th computer room
Mon	Ⅰ	English B (2A)				
	Ⅱ					English A (3D)
	Ⅲ	Building Equipment II (5A)	Numerical Calulation II (5M)			English A (4D)
	Ⅳ					
Tue	Ⅰ	Information Processing II (4A)				
	Ⅱ	Design and Drafting II (3D)				
	Ⅲ		Information Processing I (2D)			
	Ⅳ			Design and Drawing (4C)		
Wed	Ⅰ	English B (2E)		Advanced Experiment (1Y)		
	Ⅱ	English B (2C)	Wood Structure (3A)	Advanced Experiment (1Y)		
	Ⅲ			Advanced Experiment (1Y)		English A (3A)
Thu	Ⅰ	English B (2D)	Surveying III (4C)	Infrastructure Planning (1Y)		English A (3M)

	II		Design and Drafting I (2D)	Information Processing II (3D)		English A (4E)
	III	English A (4C)	Information Processing III (4D)		A la Carte of Experiments (2SK)	
	IV	Numerical Analysis (4C)	Fundamental Drawing (2C)			
Fri	I	English B (2M)	Soil Mechanics II (4C)			English A (3C)
	II	Instrumentation Engineering (4D)				
	III	Design Drafting (1E)	English A (4A)		Exercises in Civil Engineering II (5C)	
	IV	Design Drafting (1E)	Information Processing I (3A)			English A (3E)

Table 4. Monthly number of users of the computer rooms in the Information Processing Center

Month	Number of users (Total of the five computer rooms)	Number of users (1st computer room)	Number of users (2nd computer room)	Number of users (3rd computer room)	Number of users (4th computer room)	Number of users (5th computer room)
April	9520	2906	2452	1672	1302	1188
May	8622	2403	2297	1485	676	1761
June	7371	1793	2504	1386	397	1291
July	6121	1589	1979	1117	568	868
August	1191	201	379	190	229	192
September	3750	911	1133	639	598	469
October	7595	2613	2753	1267	664	298
November	6635	2363	2576	850	512	334

5. CONCLUSION

In our efforts of promoting smart education by all the faculty members using some effective teaching methods such as e-Learning, our college has consolidated a particularly established curriculum called “Model Core Curriculum” by introducing its targets into our syllabuses. The advance in science and technology has increased the contents of what students should learn and also brought the sophistication and subdivision of specialty. Based on these backgrounds, our college has developed a wide variety of educational curriculum, carefully selecting essential learning content. Moreover, we are trying to have all the faculty members familiarized with new teaching methods including active learning using ICT equipment through FD sessions.

In order to realize our organisational strategies where all the faculty members practice next-generation education such as ICT-driven active learning along with the above-mentioned curriculum, it is necessary to improve the campus-wide educational environment by installing some useful equipment and systems. Especially, it is a must to create classroom ICT environment. The computer rooms in the Information Processing Center of our college is operated under the system that in addition to being used as classrooms,

students have access to them after school. The system has created an environment where various types of learning activities such as group discussions and individual learning can be practiced. While promoting the current efforts through linkages with the above-mentioned AP project which our college is promoting and in a mutually complementary framework with the AP project, we are considering promoting BYOD for all students and planning to make flexible responses to operations.

REFERENCES

Book

Bergmann, J. & Sams, A., 2012, Flip Your Classroom: Reach Every Student in Every Class Every Day. International Society for Technology in Education. ISBN 1564843157.

Bonwell, C.C. & Eison, J.A., 1991, Active learning: Creating excitement in the classroom. Washington, DC: School of Education and Human Development, George Washington University.

Journal

Brant, G. et al, 1991, Which comes first: The simulation or the lecture? Journal of Educational Computing Research, 7(4), 469-481.

Hake, R. R., 1998, Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American journal of Physics, 66, 64.

Hoellwarth, C., & Moelter, M. J., 2011, The implications of a robust curriculum in introductory mechanics. American Journal of Physics, 79, 540.

Kapur, M., & Bielaczyc, K., 2012, Designing for productive failure. Journal of the Learning Sciences, 21(1) , 45-83.

Lage, M. et al, 2000, Inverting the classroom: A gateway to creating an inclusive learning environment. The Journal of Economic Education. , vol. 31, no. 1, pp. 30-43.

Michael, J., 2006, Where's the evidence that active learning works?. Advances in Physiology Education, 30(4), 159-167.

Ogawa, N. et al, 2015, Creation of an Environment for Active Learning and its Practices in NIT, GIFU College, *Transactions of ISATE, The 9th Interna-tional Symposium on Advances in Technology Education*, pp.213-217.

Ogawa, N., Shimizu, A., 2015, Promotion of Active Learning at National Institute of Technology, Gifu College. *Procedia Computer Science*, 60: pp. 1186-1194.

Ogawa, N., Shimizu, A., 2016, Collegewide promotion of e-Learning/active learning and faculty development, Proceedings of the international conference e-Learning, Organised by IADIS International Association for Development of the Information Society, pp.179-184, ISBN: 978-989-8533-51-7

Prince, M., 2004, Does active learning work? A review of the research. Journal of engineering education, 93(3), 223-231.

Renkl, A. et al, 2002, From example study to problem solving: Smooth transitions help learning. Journal of Experimental Education, 70 (4), 293–315.

Westermann, K., & Rummel, N., 2012, Delaying instruction: evidence from a study in a university relearning setting. Instructional Science, 40(4), 673-689.