

New Learning Environment of Linear Algebra in Korea

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(Received March 16, 2005))

We are introducing a new learning environment for linear algebra at Sungkyunkwan University, and this is changing our teaching methods. Korea's e-Campus Vision 2007 is a program begun in 2003, to equip lecture rooms with projection equipment, View cam, tablet PC and internet D-base. Now our linear algebra classes at Sungkyunkwan University can be taught in a modern learning environment. Lectures can easily being recorded and students can review them right after class. At Sungkyunkwan University almost 100% of all large and medium size lecture rooms have been remodeled by Mar. 2005 and are in use. We introduce this system in detail and how this learning environment changed our teaching method. Analysis of the positive effect will be added.

Keywords: learning environment, e-Campus Vision, blended learning.

ZDM Classification: U15

MSC2000 Classification: 97U70

INTRODUCTION

In December 2002, the Korean government established [e-Campus Vision 2007(2003–2007)]. This comprehensive measure for university information utilization is a long-term plan to improve the education and research facilities of the country's leading universities. Department of Education (DOE) of South Korea decided to invest KRW 7,000-billion Won (680Million US\$, KRW 1,100=US\$ 1) over 5 years to innovate educational environment at Korea colleges. This e-Campus Vision 2007 indicated the following 5 goals:

- ① Effective IT use in research and education

- ② Clear and productive college administrative service
- ③ Facilitate usage of IT environment at college with an emphasis on education
- ④ Improve security of cyber space with law and facility
- ⑤ Domestic and international service through advanced IT environment [MOE-Korea (2002)].

In order to achieve the goals, three directions were suggested:

- ① Quality motivation from quantity expansion
- ② Cooperative alliance management from individual college management
- ③ Lead policy from Catch-up policy with member's own and alliance' own motivation. The government support all the above with Pumping Policy.

DOE classified new lecture rooms in the following category:

Classification	Specification	Etc
e-lecture room	Internet connected PC for faculty, Wireless Access Point for students, Beam Projector, Automatic screen, Multimedia lecture room with Audio facility	
Studio style e-lecture room	Lightning facility, Camera for recording, Wireless mike and speaker system, Real time transmitting system, Beam projector, Automated screen, electronic white or black board, Real time sharing of lectures at other e-lecture rooms	
Internet broadcasting room	Internet broadcasting facility including Editorial service on digital contents	
Digital Studio	Internet broadcasting facility including Editorial service of 3-D movie clips, lines and voices on digital contents. Real time transmitting facility of lectures.	
VOD System and Storage System	Internet Video service system and Large Scale DB storage	

Before we start, we may note that Educational Broadcasting Service of Korea have given Internet broadcasting service of K-12 lectures. Recently most of the best classical lectures of high school teachers for National SAT exam has been added on it through internet since 2004, this service was intended to fill the gap of opportunity between urban, rural and island region students. But this system still are using video recording of traditional lectures with the help of cameraman. At Sungkyunkwan University, we did want to overcome the limit of this old system from the beginning. So our new system do not require any extra staff to do all the above and the quality of recorded lectures are as good as original one. In addition, we were thinking about improvement of our regular

off-line lectures not cyber lectures, but we also wanted to add all the advantage of on-line resources to our off-line classroom. Sometimes it is called as ‘Blended-Learning’.

Also DOE suggested the following schedule to be accomplished:

Classification		Initiation	Harmony	Advancement
		2003–2004	2005–2006	2007
Goal of Individual College IT Environment	Build a New Edu & Research Environment	<ul style="list-style-type: none"> • e-lecture room 30% 10~50 Online classes • Build a Standard of Scholastic Data and its Flow • Law of right on Contents • IT Env. at Teacher Edu Institute • Build Scholastic DB connection between University and Private sectors • Build Scholastic DB • Regional centers (6) and Mutual use Start to provide Share lectures overseas 	<ul style="list-style-type: none"> ◦ e-lecture room 50% 10~50 Online classes share of e-learning Environment ◦ Effective use of Scholastic DB connection between University and Private sectors ◦ Regional centers (6) and Mutual use Expand providing share lectures overseas 	<ul style="list-style-type: none"> ◦ e-lecture room 70% 10~50 Online classes Complete e-learning fundamental (Studio style e-lecture room, Internet broadcasting facility including Editorial service of digital contents) ◦ Buy National License on 30 oversea Scholastic DB and share due on 12 others with private sectors. ◦ Scholastic DB Total service Regional centers (6) and Mutual use Provide fair amount of Share lectures overseas

With the financial support from DOE and its own resources, the Sungkyunkwan University utilized its own committee. As a member of the committee, the author and members designed e-Learning and Blended-Learning capable our own e-lecture rooms that meet the most of the above DOE criteria. The significance of our model is we only use our own remodeled classroom and internet resources to meet all of the suggested needs. This means it did not cost much. We named this classroom model to e+ lecture room. We introduce this system and how this learning environment changed our teaching method.

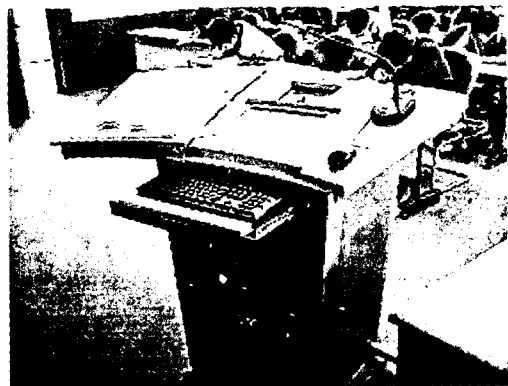
2. MAIN

With the limited budget, we were trying to use minimum amount of hardware and use more of virtual resources that we can utilize. In order to do so, we did try to use our own regular classroom and university's internet resources only. At the first stage, we wanted to be able to show the visualization of concepts in Linear Algebra such as linear transformation. Also we wanted to have our classroom that we can explain, write, read, go, find, see, do, hear, discuss and furthermore students can review the lectures not only text but also real lectures with sound and movie clips of their own instructor right after the class, even can enjoy real time class activity at the remote place.

We did design it in the spring semester of 2003 and remodeled 8 rooms for e+ lecture room over the summer break. First, we needed a right internet system and software and did need an instructor's table that have all required hardware with enough security. We got a help from a designer to make a right one. We heard that he applied a patent for the desk in the figure. We did use them for regular undergraduate classes of Fall 2003. The effect was very positive. Students did love most of the features and their performance was much better than before. The test scores at the final were better than other classes of same title. During the winter break, more than 20 rooms were remodeled and about 260 regular lectures were given from this new lecture rooms over the first year. The university just finished the 3rd stage of remodeling at Mar 29, 2005. At May 29th, 2005, 100% of classrooms (161 rooms) except very small (less than 29 person capacity) seminar rooms in the university are now e-lecture room with projection equipment and electronic teachers desk, tablet PC with internet connection.



(a) e lecture room



(b) tablet PC for instructor

Figure 1. View of new regular e-lecture room

And every 2-4 departments group of size 30-50 tenure track professors have at least one e+ lecture room with projection equipment, Viewcam, tablet PC and internet Database (24 e+ lecture rooms). Usually these rooms are used for Blended-learning. And four extra large classrooms for distance learning are better equipped with more viewcams, one professor can give a lecture for several different classrooms at the same time in this classroom.

<http://matrix.skku.ac.kr/sglee/03-Note/index7.htm>

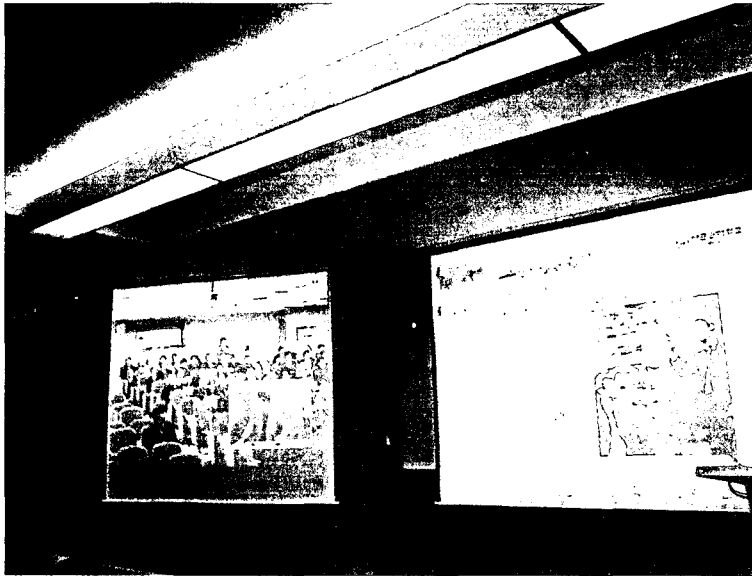
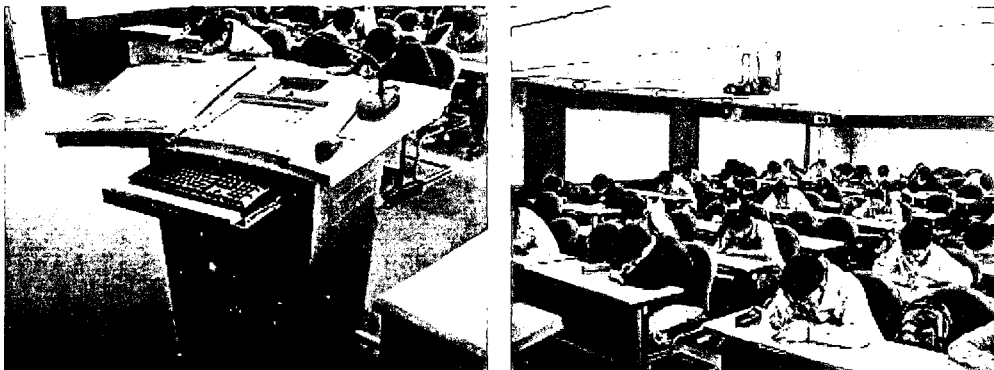


Figure 2. Four extra large e+ classrooms for distance learning

We now show how the system looks like at e+ lecture room that I am using.



Internet Connected Tablet PC for instructor, Beam Projector and Speakers

Figure 3. View of new e+ lecture room

Lecture Table *WizarDesk* WDX-M4700

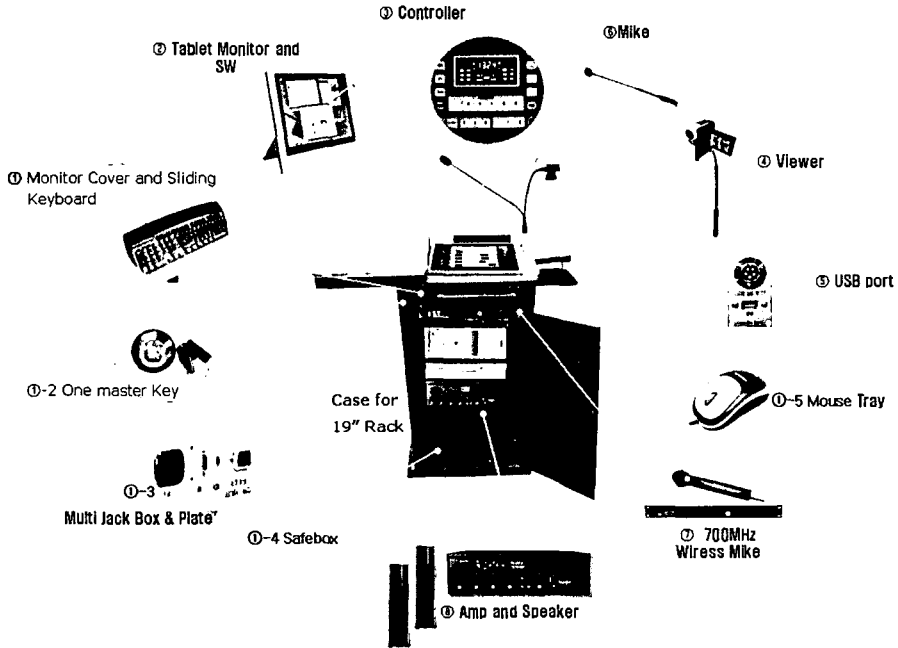
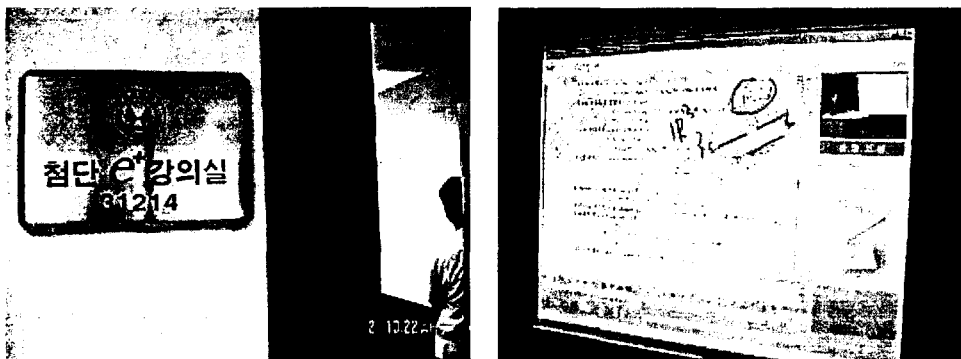


Figure 4. System of new lecture table equipments

With our lecture note, we can write on tablet monitor, the viewcam transmit instructor's activity and PC transmits everything on the Tablet PC with writing and sound. And same lecture can be viewed in real time, everywhere through the internet. Furthermore all are saved and can be reviewed right after the lecture over and over again.



(a) e+ lecture room

(b) Screen and board

Figure 5. Lecture room and board

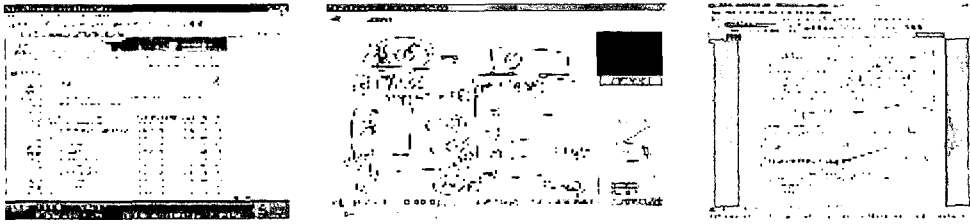


Figure 6. Questions and answers, Whiteboard, PDF file with marks in a classroom

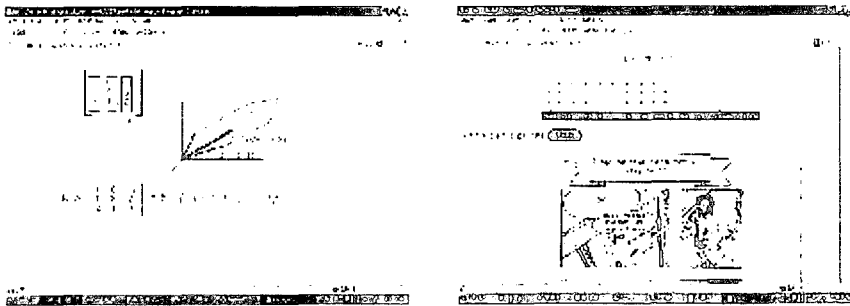


Figure 7. Visualization materials, JAVA tools to be used

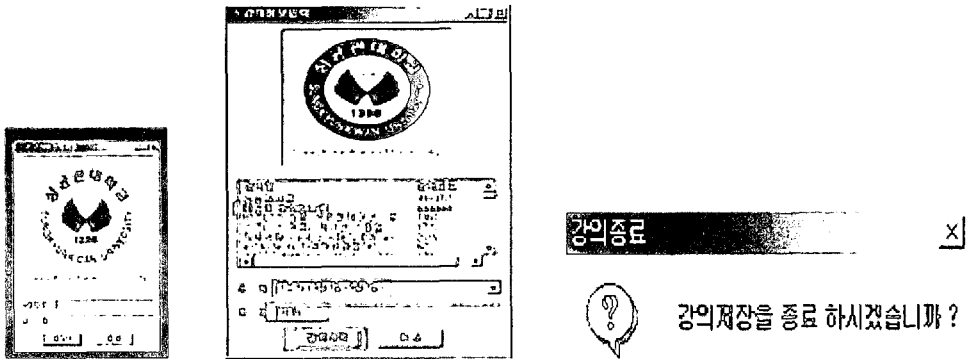


Figure 8. PC program to save and review lectures

Beside this change, there has been cyber space (i-campus) for reading materials, hand in homework and questions on every classes of the university. After we did set up the facility, we did use the new system for our own linear algebra class to add real lectures. We tried to put up more information on the web before the class, and brought PDF or PPT file of each lecture. Then we precede our lecture on the lecture file, we did fill the gap

and write proofs on it. We could show and use every possible resource for the lecture. And all of our activities in the class were saved for students. Students could review the parts that they did not fully understand over and over again after the class. We gave some incentive for good questions and answers of students for raised questions. After two weeks of teacher's help, students were getting involved to answer in most of cases.

This way of learning process and facility may not work well with some math courses, but our linear algebra course was quite well matched with this new learning environment. Because we could visualize concepts of linear algebra, and we could use tools to calculate determinant and eigenvalues of large size matrices in the class just after the hand calculation of small size matrices. Students asked more questions, and were actively involved in this learning process, and students were eventually being able to answer most of questions each other. We finalized those answers in the class. Some good questions of their own were given in the midterm exams as well. This activity finally made big changes on the performance of students. They started to participate in his class as a big part. As a consequence, student's satisfaction and their performance in the final exam were far better than any other classes. But we all know this new system don't do all works on behalf of us. We have to design the whole lectures first, and then we must be able to manage each lectures and extra works of students (*cf.* Park 1994; Park 2003; Uhl & Davis 1999; MAA 2004).

We wrote our lecture note for each class, and then we made some of multimedia contents of it and put it on the web (i-campus of Sungkyunkwan University <http://gingko.icampus.ac.kr/>). So students can study before the class and ask any possible questions each other. We checked those activities before the class, and give some answers to finish up the discussions on the web. Then we go to the classroom and turn on the system, and explain some important ideas from those discussions, then start the lecture with PDF or PPT file of our lecture note.

We could write and mark on it. And whenever we need, we could use every possible internet resources to help student's understanding and show any references needed. After the class, all of our lectures are saved on the web, so students can review any part that they want to review. Obviously, students cannot miss any part of class work, and almost all questions that were raised through the class could be answered by each other or by teacher. They learned by themselves, so they did not forget. We found that students could not find anyone to blame in any case.

The verification was appeared at the evaluation after the class. Since then, it was known among students that this course is much harder than other similar classes, but they can learn more. So more students are trying to get into the class even though their grade can be lower because of the competition. And the teaching evaluations of these classes were the best in the whole university a couple of times. The following was an example of

the Teaching evaluation that showed the change. Since then, most of the student evaluation on our type of linear algebra class was higher than 90. That gave our appreciation to our students as well.

<Example>

<Teaching evaluation, 2003>

Score: 97/100

Course	Number	No of Students who answered	Score
Linear Algebra	2005082-II	67/ 67	97/100

<Number of students for each Questionnaire>

Course No.	Answer	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	Q.9	Q.10	Total
2005082-II	S. Agree	2	4	3	7	5	2	2	1	8	6	10
2005082-II	Agree	4	3	4	5	6	3	3	1	3	6	28
2005082-II	Average	1	0	0	4	2		0	2	3	1	12
2005082-II	Bad											2
2005082-II	Worse											
2005082-II	No Answer											0

<Teaching evaluation, Fall of 2004>

Score: 96/100

Course	Number	No of Students who answered	Score
Linear Algebra	2005082-44	28/29	96/100

In Jan. 2005, government also announced that they would like to make Korea to be a Hub of e-learning. In order to do so, they decided to invest KRW417,100,000,000—in the year 2005 for IT industry and schools. This investment will also effect on our educational environment at college as well. We believe our new educational environment of college will be effectively used over all level of education without much cost.

3. CONCLUSION

What we did try in our new lecture room environment was not “lecture- memorization —tests”, but it was “visualization (intuition)-trial-error-speculation—explanation”. From the first, our goal was to improve the quality of our education. We did put our course materials on the web before the class as much as we could, so students knew what to do in the earlier stage, and asked questions before the classes and discussed them as well. When we met the class, we cleared up those questions first, and did precede regular off-line lectures on white and black board type tablet PC. We could go anywhere when we need, for more on line information. We could visualize any possible mathematical concepts, and do large size calculation to verify facts and get new conjectures. And all these activity on tablet monitor were recorded as clear as original lectures with sound. So students could review any parts that they missed whenever they need right after the class. Finally we made them to explain by themselves what they could do. In addition, we could write a book and web content from this process.

<http://matrix.skku.ac.kr/WebLA/index.html>

In our learning process, students found professor’s roles as not only a teacher but also an Innovator, Mentor, Facilitator, Coordinator, Director and Producer. We found that student’s satisfaction and their performance were much better than before. We finally found we now lives in future educational environment already.

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