Fundamental Mathematics Education via E-Learning for Undergraduate Students

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Abstract: The author used to work as an assistant professor at the Kogakuin University Academic Support Center for 2 years and the Waseda University Media Network Center for 4 years. At the Kogakuin University Academic Support Center, he and his colleague made some useful teaching materials and e-learning contents about calculus for students major in engineering and poor in mathematics. On the other hand, at the Waseda University Media Network Center, he and his colleague made the mathematics curriculum through the LMS (Learning Management System). In this paper, we shall report these activities and also mention how to make the best use of these experiments for the future.

1. Introduction

The author who is an associate professor in mathematics at the Division of Liberal Arts, Kogakuin University, used to work as an assistant professor at the Kogakuin University Academic Support Center (KUASC, for short) for 2 years and the Waseda University Media Network Center (WUMNC, for short) for 4 years. At the KUASC, he and his colleague made some useful teaching materials and e-learning contents about calculus for students major in engineering and poor in mathematics. On the other hand, at the WUMNC, he and his colleague made the mathematics curriculum through LMS (Learning Management System). We shall report these activities in Sections 2 and 3, and also mention how to make the best use of these experiments for the future in Section 4.

2. Activity at Kogakuin University

From the academic year (AY) 2006 through 2007, the author worked at the KUASC (Kogakuin University Academic Support Center). The KUASC was established in 2005 located in Hachioji campus and Shinjuku campus, respectively, to support students whose basically academic skills are insufficient mainly. There are 16 full-time lecturers in total, and they have basic lectures and individual lessons for four subjects: Mathematics, Physics, Chemistry and English.

Students of Kogakuin University major in engineering, therefore they have to understand and utilize basic academic skills like mathematics in order to be an engineer. The author and his colleague applied a trial-and-error method and established education technique. At the KUASC, the lecturers input precise contents of teaching to the electronic record sheets called "Karte" (see *Figure 1*). Students can be found their own

records as an electronic portfolio.

The lecturers also made some useful teaching materials and e-learning contents for self-teaching. We here mention the good points of the e-learning contents about differentiation. The function of hyperlinks is one of the biggest features of electronic contents. Therefore, we embedded a lot of hyperlinks for the important or elementary words (see *Figure 2*). Moreover, we used a lot of colors in the contents in order to help students for their understanding.
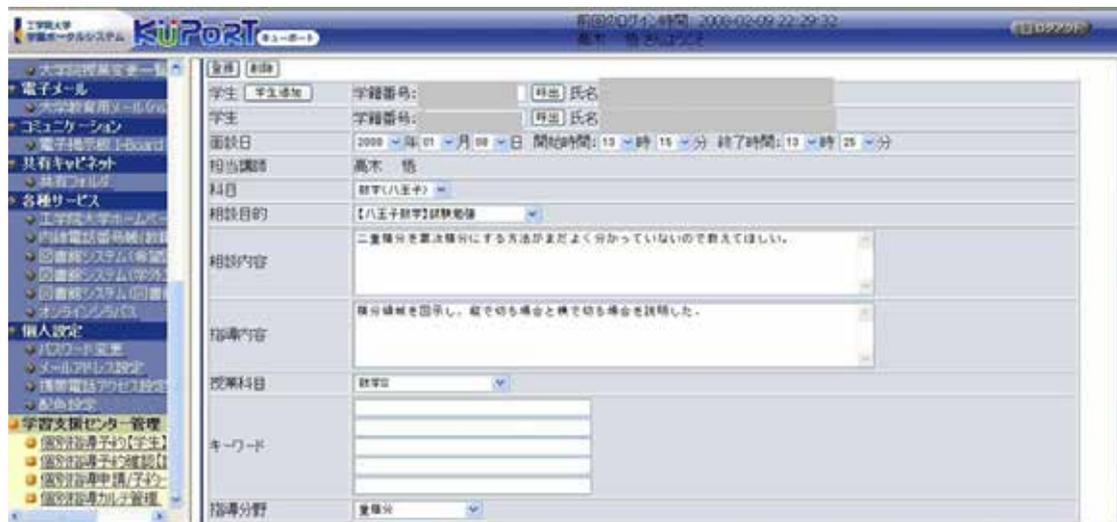

Figure 1. "Karte"

Figure 2. E-learning contents about differentiation

For more precise reports on the KUASC, see the references [1], [2].

3. Activity at Waseda University

On the other hand, from the AY 2008 through 2011, the author was in the WUMNC (Waseda University Media Network Center) as an assistant professor. The WUMNC was established in 2000 to promote information literacy education and provide useful environment in information. He and his colleague made the mathematics curriculum through the LMS called "Waseda-net Course N@vi" (Course N@vi, for short) (see *Figure 3*). The aim of this curriculum is to draw out the untapped potential of students by providing academic literacy education.

Figure 3. "Waseda-net Course N@vi"

It is assumed eight lectures in the mathematics course, and each lecture has installed the enrollment period of one each week. Students can attend a lecture when their favorite time of one week. This mathematics course completes a half of semester, which is around two months.

Each lecture is consisted the following contents: video lectures, quizzes, enquete, retry quizzes, advanced quizzes. The video lectures are delivered by dividing into about three to become about 70 minutes in total. We use a blackboard not using presentation software. As for Quizzes, we prepare random setting questions, and the students input the answer with the keyboard. The retry quizzes are relief quizzes to the students who do not suitably or forgot to take the normal quizzes. The advanced quizzes

are unseen passages for the students who are not satisfactory in the class. We execute all lectures including guidance and final examination with Course N@vi, therefore this is the exact "Full on-demand lectures".

There are two-kind subjects "calculating interest" of analysis and "optimization (linear programming)" of linear algebra in the Mathematics course. Two levels of beginner's class "alpha" and intermediate class "beta" are set. We made an own textbook [3], [4], [5], [6] for students which are available at Amazon [7].

The relations between subjects are listed below.

Table 1. Relations among four mathematics subjects

Intermediate class (beta)	Calculating Interest beta (function, recurring series, loan calculation)	Linear Programming beta (rank, duality theorem, linear programming)
Beginner's class (alpha)	Calculating Interest alpha (exponent, logarithm, series, limit, calculation interest)	Linear Programming alpha (matrix, simultaneous equation, linear programming)
	Analysis	Linear Algebra

We are also interested in the transition of number of students in the mathematics course.

Table 2. Transition of number of students

	Calculating Interest alpha	Linear Programming alpha	Calculating Interest beta	Linear Programming beta	Total
2008 Fall	702	---	---	---	702
2009 Spring	581	500	---	---	1,081
2009 Fall	470	423	220	---	1,113
2010 Spring	745	597	174	153	1,669
2010 Fall	773	613	298	199	1,883
2011 Spring	839	655	230	210	1,934
2011 Fall	979	760	373	287	2,399
				Total in 7 semesters	10,781

To study even if there is no knowledge of high school mathematics at the beginner's class level is considered. It designed about the beta level for intermediate to understand even if alpha level was not attended. Each one takes placement test, and which each one attends is judged about divide the level about alpha and beta, and we recommended that a lecture be attended from alpha if not confident.

The followings are good points in the Mathematics course especially.

(1) Making own textbooks

(2) Video lectures of blackboard form

(3) The last review

(4) Enhancement of question system

(5) Retry quizzes and advanced quiz (see *Figure 4*)

(6) Feedback

Figure 4. An advanced quiz on the LMS "Course N@vi"

For more precise reports on this project, see the references [8], [9].

4. For the future

The author now works at the Division of Liberal Arts, Kogakuin University which is the different department to the KUASC, and teaches calculus and linear algebra for students major in engineering. At our university, there is a good e-learning system and the author has a lot of magnificent experiences using ICT (Information and Communication Technology). Therefore, we have to revise and create more e-learning contents for students in order to raise the standard of students' basic skills, and improve the environment through the LMS for students, faculty and staff. Moreover, it is very important to meet students at classrooms directly, so we also have to consider the method of blended learning which combines face-to-face lectures and e-learning.

Reference

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