CREATION OF AN ACTIVE LEARNING ENVIRONMENT AND OBJECTIVE EVALUATION OF GENERIC SKILLS AT NATIONAL INSTITUTE OF TECHNOLOGY, SENDAI COLLEGE

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ABSTRACT

National Institute of Technology (KOSEN), Sendai College (Sendai KOSEN) established the educational goal to foster students with global mindset, creativity and GENERIC SKILLs. In order to achieve this goal, we have developed a curriculum incorporating AL and PBL, reconstruction of the educational environment implementing AL and PBL, and ability development of teachers. As a result, the proportion of subjects that introduced AL reached 83.7% at the end of academic year 2017.

In order to evaluate the effectiveness of our reconstruction of educational method, we conducted PROG test to evaluate student's GENERIC SKILLs in an objective way. As for a GENERIC SKILLs growth characteristic of the students of Sendai KOSEN, it turned out that the literacy skills of students grew steadily every year regardless of the grade of the students. On the other hand, the competency skills were not developed apparently until the third grade, but the certain growth was observed after the fourth grade.

In this paper, we introduce the outline of educational environment refurbishing in Sendai KOSEN

KEYWORDS

Active learning, PBL, Refurbishing educational environment, Generic skills, PROG test, Standard 6, 8, 10, 11

BACKGROUND

National Institute of Technology (KOSEN), Sendai College has a history of more than half a century for producing many mid-level engineers following the strong demands from Japanese society at the time of its establishment. KOSEN students learn expertise and practical skills from the age of 15 and become an engineer at the age of 20. Such KOSEN education has been highly appreciated by Japanese industry.

However, with the rapid development of ICT, the diversity and complexity of society has increased, and the changing speed of social infrastructure has become faster. Under such circumstances, in addition to the expertise and technical skills acquired by young engineers , it is important to nurture students with generic skills (GENERIC SKILLs), consisting of fundamental competencies and literacy skills to make good use of these expertise and skills. These days, Kosen is required to provide education programs in which students learn generic skills such as communication skills, collaboration power skills, in addition to being trained in specialized knowledge and skills. The reformation program of educational environment at Sendai KOSEN [1] was adopted as an Acceleration Program for University Education

Rebuilding (AP) [2] in 2014, and it was a driving force for the whole college to tackle the refurbishing of the educational environment.

In this paper, we introduce the outline of educational environment refurbishing in Sendai KOSEN. Moreover, we mention the educational effect accompanying this reformation based on the evaluation of generic skills of our students measured in an objective manner.

REFURBISHING EDUCATINAL ENVIRONMENT

In these days, Japanese society and industry expect KOSEN graduates to be engineers with global mindset, creativity and GENERIC SKILLs in addition to technical skills as mid-level engineers. In order to cope with the new image of the human resources fostered at KOSEN, we have been focusing on an educational method to nurture students' GENERIC SKILLs. At the same time, we also have adopted the good parts of a traditional educational method, namely the lecture followed by related experiments / practices.

We developed a curriculum that is a mixture of traditional lectures, Active Leaning (AL) and Problem/Project-Based Learning (PBL). In particular, in order to bring out autonomous learning attitude of students and realize an education program that fosters GENERIC SKILLs, we introduced AL methodology and PBL in all grades, including introductory courses in the first grade and graduate studies conducted in the final grade (5th grade). In parallel with the curriculum development, we improved our educational environment to implement the curriculum. In particular, we carried out the following educational environment refurbishing:
   1) Educational Infrastructure Refurbishing
     1-1) Refurbishing a special classroom to implement AL,
     1-2) ICT conversion of general classrooms (Installing the whiteboard, projector,
         document camera and wireless LAN access point),
     1-3) student use of campus wireless LAN and adopting Bring Your Own Device (BYOD)
   2) Educational development
     2-1) teaching ability development to increase the number of teachers with educational certification (CompTIA CTT+ [3])
     2-2) FD by outside instructors and cafe style interactive FD

Figure 1 shows the status of infrastructure improvement, the status of teaching ability development of teachers, and the proportion of subjects incorporating AL at our college since 2014.
1) The maintenance process of each item about infrastructure environment is shown below.
    1-1)   We provided 3 AL dedicated classrooms in the academic year 2014, the infrastructure improvement starting year, and refurbished in total 14 classrooms with AL specification at the end of the academic year 2017. Finally, about 20% of all classrooms became AL special rooms.
    1-2)   We have converted all classrooms into ICT usable rooms. Along with the ICT conversion of general classrooms, it became much easier to introduce AL in all subjects.
    1-3)   We had developed student use of campus wireless LAN and BYOD in the whole campus by the end of the academic year 2016.
2) We show the implementation status and effectiveness of each item about the development of teaching ability below.
    2-1)   The number of CTT+ (Certified Technical Trainer+) trainers (including qualification holders and teachers who completed the same level of training) was 16 in the academic year 2014, 30 in the 2015, 38 in the 2016, and the 38 in the 2017. As a result, about 30% of teaching staff acquired practical skills on AL. In addition, these early qualification-acquired teaching staff contributed to an on-campus introduction of AL.

2-2) In the 2014 academic year, our FD was limited only to AL methods and mostly explained of implement about AL by the external lecturers, and how to use various tools. From the 2015 academic year, we introduced FD for the purpose of promoting AL in actual classrooms, and also World Cafe Style interactive FD (Fig. 2), where teaching staffs share their activities (including failures) actually conducted in classes. The interactive FD contributed to solve various questions of teaching staffs who were considering introducing AL. Moreover, many AL practice cases were reported in the interactive FD, and it became easier to find solutions for each teaching staff.

With these refurbishment of infrastructure and FD the ratio of AL introduction in classes achieved 83.7% at the end of the academic year 2017. In particular, the introduction rate was 37.8% at the end of the 2014, and then it was increased to 73.0% at the end of the 2015. In the 2015, we have completed ICT conversion of general classrooms and the number of CTT+ holders became doubled. These two factors would be the key contributing factors to the increase of the AL introduction rate.
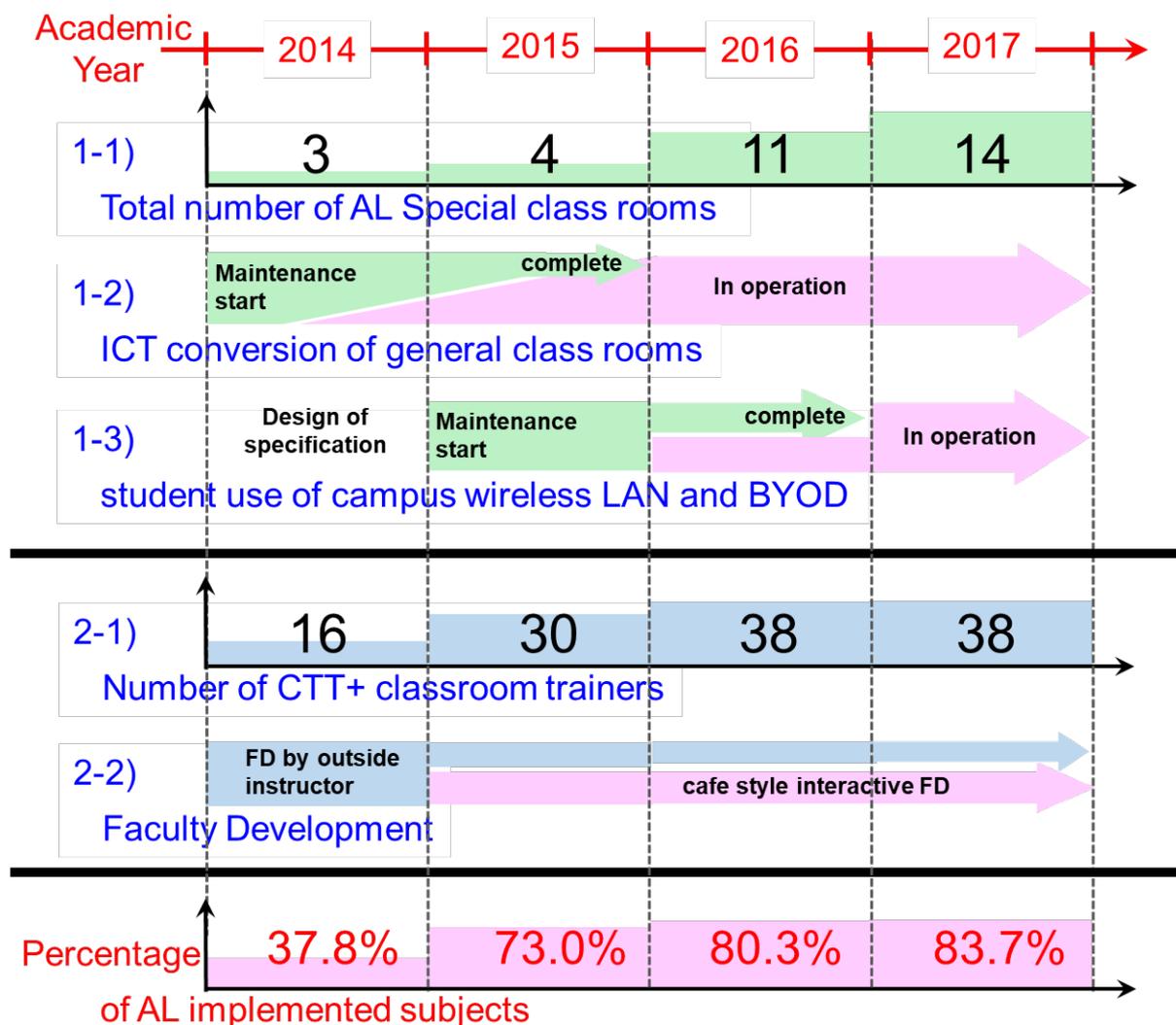

Figure 1. Yearly change in the status of refurbishment of infrastructure, teaching ability development, and the percentage of AL implemented subjects

Figure 2. Cafe Style Interactive FD

EVALUATION OF THE EDUCATIONAL EFFECTS

We evaluate GENERIC SKILLs of our students using the Progress Report on Generic Skills (PROG) test [4] to analyze the educational effect after refurbishing the educational environment. We show our detailed results of the PROG test in [5] [6]. Thus, in this paper, we only show the outline of the PROG test and the yearly change in the total score of the students' literacy and competency.

The PROG test was developed at Kawai-juku [7], which is one of Japan's biggest learning cram school. PROG test consists of two parts, the literacy part that evaluates the practical ability to solve problems by utilizing their own knowledge and the competency part that evaluates the ability to build good relationships with other people and their surroundings. The evaluation items of the PROG test are selected by referring to the key competency determined in OECD's DeSeCo project [8] and by examining the adoption selection criteria in Japanese companies. There are 6 major items in the literacy part and 3 major items in the competency part. Regarding competency, we categorize three major items into 9 middle items. Moreover, these 9 middle items are categorized into 33 small items. The questions in the literacy part are similar to those of SPI [9], while large part of the competency test contains questionnaire style asking the characteristics of people's behavior. Each competency part element is evaluated based on a comparison of statistically processed exemplary answers from highly rated Japanese business persons and answers of examinees. The score of the PROG test is evaluated with values from 1 to 7 (some elements up to 5) for both literacy and competency, and a larger number represents a better result.

We explain our result of the PROG test. Sendai KOSEN consists of five years of associate undergraduate course (Associate Degree Course) consisting of seven departments and two years of advanced course (Bachelor's Course) consisting of two course. We have conducted PROG tests every year for our students to evaluate their GENERIC SKILLs quantitatively since the 2014. Table 1 shows the grade of students who took the PROG test. As for the result of the 2018, some of test results are not available at the moment yet and we decided to omit it from our analysis in this paper.

Table 1. The Grades of Students who took the PROG Test in each year

Grade	Year			
	2014	2015	2016	2017
Regular 1	○	○	○	○
Regular 2	○	○	○	○
Regular 3	○	△	○	○
Regular 4	○	○	○	○
Regular 5	○	△	○	✕
Advance 1	△	△	○	○
Advance 2	△	△	○	○

○: Students of every department and major took the PROG test
△: Only students of some departments and a major took the PROG test
✕: Students did not take the PROG test
*In the analysis in this paper, the data of △ are not included
  because the numbers of samples are very different.

We show the PROG results of our students from the 2014 to the 2017 in Figure 3. Figure 3 (a) shows that in the literacy part the students' ability is steadily growing every year regardless of the grade. From the figure 3-(a), the significant growth was observed in all grades from the 2015 (blue bar) to the 2016 (green bar). Year 2015 was the year that ICT conversion of general classrooms was completed, and interactive FD was started. The question of whether these two factors contributes to the improvement of literacy ability requires further analysis.

We show the yearly changes in the competency of our students from the 2014 to the 2017 in Figure 3 (b). In the competency part, noticeable growth was not observed until the third grade, but obvious growth was observed in and after the fourth grade. In part, the growth of competency part in upper grades has been observed. The differences between the upper grade curriculum and others are the internship and large-scale PBL (one-day), thus these might be contributing factors.

Many universities conduct PROG to evaluate generic skills of their students. Thus, we show a brief comparison of the PROG scores of our students and university students who study science and engineering below. In the literacy part, the average score of the university first grader studying in the science and engineering departments in the 2017 is 4.80, and then the score of 2nd grade students of our regular courses (corresponding to the 2nd year high school student) is higher than 4.80. In the competency part, the average score of the university first grader studying in science and engineering departments is 3.07. Therefore, the scores for the 1st to 3rd year students of regular courses is the same as the average score of the university first grader. Also, the score of students in the 4th year of regular courses, whose ages are the same as those of first grader in universities, is much higher than the average score of the first grade of the university students.
Based on the above results, our educational improvement and educational environment reconstruction implemented in this project may increase the potential for great improvement of students' GENERIC SKILLs.
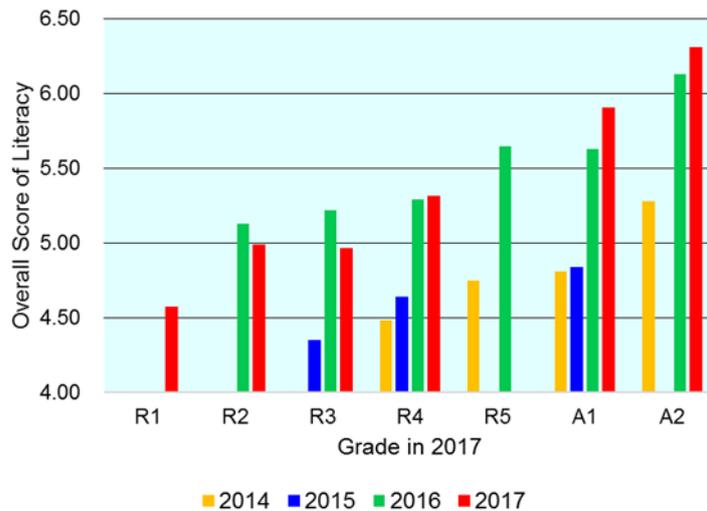
(a) Yearly changes of the overall scores of the Literacy part
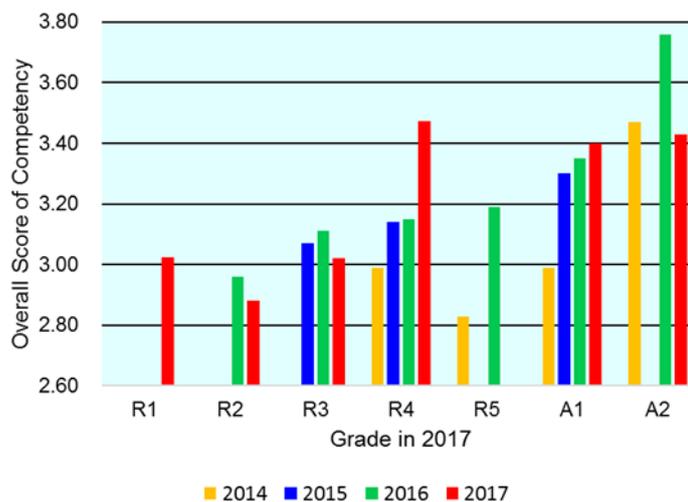
(b) Yearly changes of the overall scores of the Competency part

Figure 3. PROG results for four years from the 2014 to the 2017.

SUMMARY

Along with changes in society, the requirements by companies for Sendai KOSEN graduates have changed. In order to meet to such requirements, Sendai KOSEN reestablished the educational goal to nurture students with global mindset, creativity and GENERIC SKILLs. In order to achieve this goal, we have conducted 1) development of a curriculum incorporating AL and PBL in a well-balanced manner, 2) reconstruction of the educational environment implementing AL and PBL, and 3) ability development of teachers (including acquisition of implementation methods of AL) since the 2014. As a result, the proportion of subjects that introduced AL was 83.7% at the end of academic year 2017. In particular, there was a remarkable increase of the rate at the end of the 2015. In the 2015, we have completed ICT conversion of general classrooms and the number of CTT+ holders became doubled. These two factors would be the key contributing factors to the increase in the AL introduction rate.

In order to evaluate the effectiveness of our reconstruction of educational method, we conducted PROG test to evaluate students' GENERIC SKILLs in an objective way. As for a

GENERIC SKILLs growth characteristic of the students of Sendai KOSEN, it turned out that the literacy skills of students grew steadily every year regardless of the grade of students. On the other hand, the competency skills were not developed apparently until the third grade, but the certain growth was observed in and after the fourth grade. A part of the large increase of literacy score for all grades in the 2015 can be the result from our efforts but it is necessary to keep tracing future results to make any conclusion. On the other hand, internship and PBL programs seem to be quite effective to improve the competency of students and we must analyze the detail of these programs for further improvement.

Furthermore, in comparison with the PROG result of university students and those of our students, the average score of literacy and competency of Sendai KOSEN students are not inferior compared to the average score of university students.

Our future works are 1) analysis of details of contributing factors of rising competencies in upper grades, and 2) improvement of education methods in lower grades based on analysis results. Analyzing the difference between the upper grade curriculum and the lower grade curriculum, will give us hints of rising competencies. Then, we will clarify the causal relationship by improving the education method of the lower grade based on this consideration.

ACKNOWLEDGMENTS

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