

An Attempt of Problem Based Learning by Sharing Method

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Abstract — *This paper reports Problem Based Learning (PBL) of the sharing method in Mechanical Engineering at Kobe City College of Technology. In PBL, a group of three or four students manufactures the work of each theme for fourteen weeks. We have adopted PBL of the consecutive method until 1995-2006. Each group in the consecutive method takes one work for fourteen weeks. A decreasing tendency of the student motivation was observed from the previous PBL report. To improve this tendency, we have introduced the sharing method into PBL since 2007. The sharing method is divided fourteen weeks into three processes which are formed by Plan, Do and Check. In Plan process, students draw the drawings for each group's work. Then students in Do process manufacture works according to the Plan group's drawings at the machine shop. And students in Check process evaluate Plan group's drawings and Do group's work. In PBL of the sharing method, seven abilities of students were investigated in 2007-2009. We found that it was effective to develop the communication ability of students in the sharing method. On the other hand, we investigated the willingness of students on PBL of sharing method in 2008-2009. The willingness of students is evaluated by three steps which are positive, usual and negative. As a result, it was found that the sharing method contributed to improving the willingness of students.*

Index Terms — *Problem Based Learning, Sharing Method, Engineering Education*

INTRODUCTION

Several educators have insisted that a creative education for engineers be important in Japan since 1990's [1]. Therefore, various creative subjects have been started almost of Department of Engineering in the universities and the colleges. We have started a subject which is called creative design and production since 1995. This subject has adopted PBL of a consecutive method in 1995-2006 [2]-[3]. However, PBL of a consecutive method had some faults. For example, there were a tendency which divided into positive students and negative students, and the communication ability was not able to be improved. We have introduced PBL of sharing method since 2007[4]-[6]. And, we have attempted to solve these problems. PBL of sharing method in 2008 and 2009 is reported in this paper. PBL of sharing method has the processes of

Plan and Do and Check. We have investigated seven abilities in each process. Additionally, it was investigated every time whether students had positively participated in this subject.

Outline of Sharing method

Figure 1 shows the relation to each group when PBL of sharing method is done in one class. We are dividing one class into ten groups. Because one class is 40 students, each group is four students. All the drawings which A group designed in the process of Plan are passed to B group in the process of Do. Afterwards, the work which B group manufactured is passed to C group in the process of Check. In addition, C group receives all the drawings which A group designed. Therefore, C group evaluates both of the drawing which A group had drawn and the work which B group manufactured. On the other hand, A group evaluates all the drawings which I group had drawn and the work which J groups manufactured in the process of check. Sharing method needs communications with five times the students compared with consecutive method. Therefore, it is suitable for improving the ability of students' communications. Students of 92% answered sharing method in the investigation which we had executed in 2008 as an effective method [6]. There is an effect to improve the ability of the design and drafting of students because there is a chance to understand a new drawing additionally in each process.

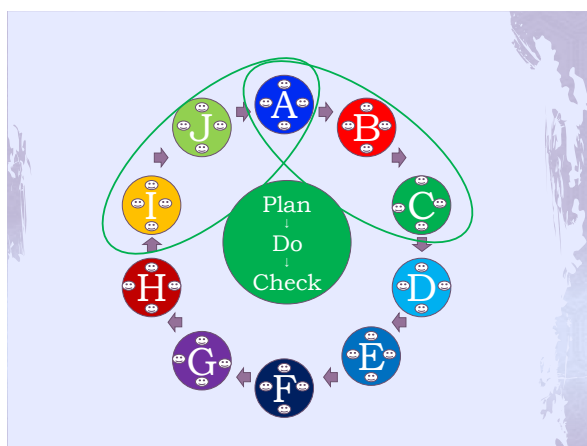


FIGURE 1

The relation to each group of PBL by sharing method

Program of Sharing Method

Table 1 was program of the sharing method. This program is composed between the first week and the 14th week. The seventh week from the first week is the process of Plan. The 13th week from the sixth week is the process of Do. The 14th week from the 11th week is the process of Check. The seventh week from the sixth week is the period of the succession of the group of Plan and the group of Do. Moreover, the 13th week from the 11th week is the period of the succession of the group of Do and the group of Check. The works which groups of Plan designed are done to the meeting

to explain groups of Do on the sixth week. At this time, groups of Do should accurately understand the presented drawings. In addition, it is necessary to point out some mistakes which exist in the drawings to students of Plan. Afterwards, students of Plan should correct the drawings by the eighth week.

Week	Contents	Plan/Do/Check
1 st	Orientation	Plan1
2 nd	Discuss the work in each group	Plan2
3 rd	Design and drawing (1)	Plan3
4 th	Design and drawing (2)	Plan4
5 th	Design and drawing (3)	Plan5
6 th	Meeting to explain works	Plan6/Do1
7 th	Submitting of drawings	Plan7/Do2
8 th	Manufacture (1)	Do3
9 th	Manufacture (2)	Do4
10 th	Manufacture (3)	Do5
11 th	Manufacture (4)	Do6/Check1
12 th	Manufacture (5)	Do7/Check2
13 th	Manufacture (6)	Do8/Check3
14 th	Meeting to report on works	Check4

TABLE 1

Program of PBL by sharing method



FIGURE 2

Photographs in PBL by sharing method

(a)Plan6/Do1

(b)Do3

(c)Check4

Figure 2 (a) is a photograph of the sixth week. The contents which the group of Plan designed are explained in the group of Do. The group of Plan is explaining the works for the group of Do. Figure 2 (b) is a photograph of the eighth week. The appearance manufactured as students of Do see the drawings of the group of Plan is understood. Figure 2 (c) shows the appearance which students own are evaluating in seven abilities and willingness at the end of the 14th week.

Figure 3 is one example of the work manufactured with PBL of sharing method in 2009. The size of this work is 200mm in width, 100mm in length, and 150mm in height. This work is composed of 18 kinds of parts. The motor sets up in the interior of the center, and a front rail moves up and down by this motor. Therefore, the ball of the glass of 12mm in the diameter can roll at any time in X=50mm, Y=50mm, and Z=30mm or more. However, this work was not completed by the 14th week. The works which operated normally in the works which the groups of ten Plan designed was two in 2009. The effect was seen in improving students' abilities though works completed in sharing method were 20%.

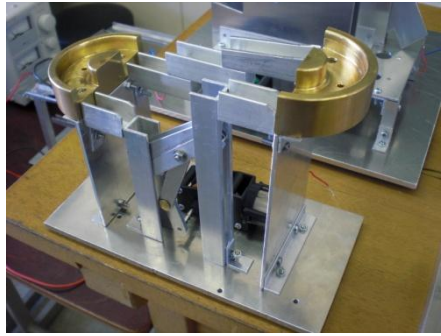


FIGURE 3

A work manufactured with PBL of sharing method in 2009

Investigation concerning seven abilities

We have investigated necessary seven abilities for students in PBL by sharing method. Seven abilities are the ability to set problem, the ability to solve problem, the communication ability, the ability to plan, the abilities to design and drafting, the ability to make report, and the ability to create. Students evaluated these abilities of themselves by five stages. Students of three academic years in kosen executed PBL by the consecutive method at the first term and the sharing method at latter term in 2008. On the other hand, both the first term and latter term were PBL of the sharing method in 2009. Both Figure 4 and Figure 5 were investigated in PBL of the sharing method at latter term. The number of students in 2008 was 38 people, and the number of students in 2009 was 40 people.

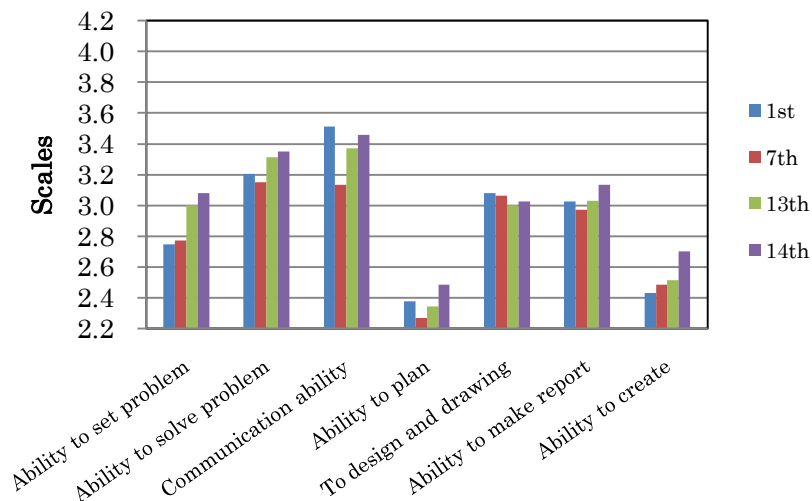


FIGURE 4

Result of investigation concerning abilities of seven in 2008

Figure 4 shows the result of the investigation of seven abilities concerning PBL by sharing method executed in the latter 2008. The vertical axis is an average of the value of the evaluation by five stages for themselves. This investigation was executed on the first week and seventh week in the process of Plan, the 13th week in the process of Do, and on the 14th week in the process of Check. It is understood that five abilities have improved by comparing the first week with the 14th week in Figure 4. These were the abilities to set and to solve problem, the ability to plan, the ability to make report, and the ability to create. On the other hand, the communication ability and the ability to design and drawing have decreased. Moreover, five abilities have decreased from the value of the first week in the investigation of the seventh week which after the Plan process ends. This main cause is that making of the drawings did not end by the seventh week in the process of Plan in 2008.

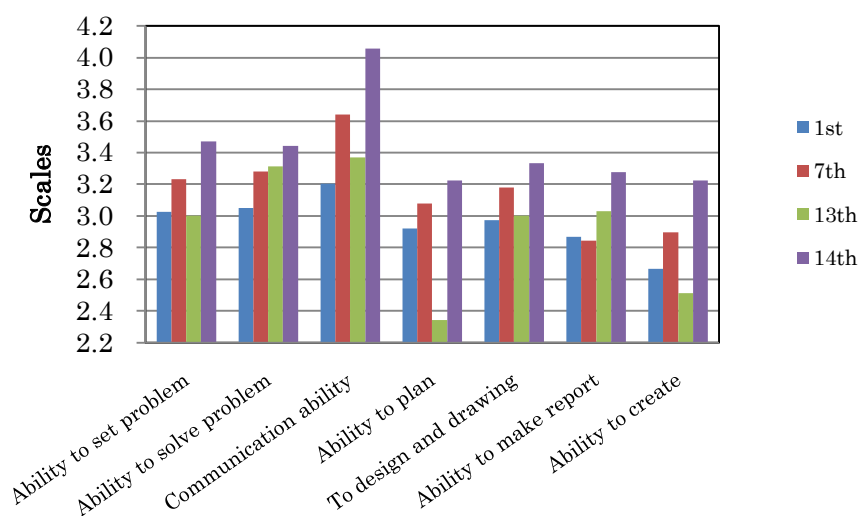


FIGURE 5

Result of investigation concerning abilities of seven in 2009

Figure 5 is a result of investigating seven abilities concerning PBL by sharing method in the latter 2009. It was confirmed that all of the seven abilities had improved by the comparison between the first week and the 14th week. It is understood that the communication ability is especially improved in 2009 by comparing Figure 4 and Figure 5. Moreover, five abilities of the 13th week in the process of Do have decreased. However, these have improved on the 14th week. It is a cause that it was difficult for students to manufacture the work referring to the drawings of the group of Plan.

Students' willingness and concentrated degrees

Figure 6 and Figure 7 show the result of investigating student's willingness to all classes of the 14th week from the first week in PBL of sharing method. Students' willingness was evaluated by them at three stages of positive, usually and negative. These investigations were executed at the end of all individual classes. Figure 6 is investigation of 38 students in 2008, and Figure 7 is done for 40 students in 2009.

The ratio of students who worked positively on the first week is the lowest with 16% in Figure 6. This reason is that time to explain PBL by sharing method is long. Therefore, time that students work is short. Positive students' ratios have

changed between 16% and 53% in the process of Plan. Afterwards, positive students' ratios have changed between 42% and 69% in the process of Do. The ratios were between 43% and 60% in the process of Check. The tendency that students work positively in the process of Do is understood.

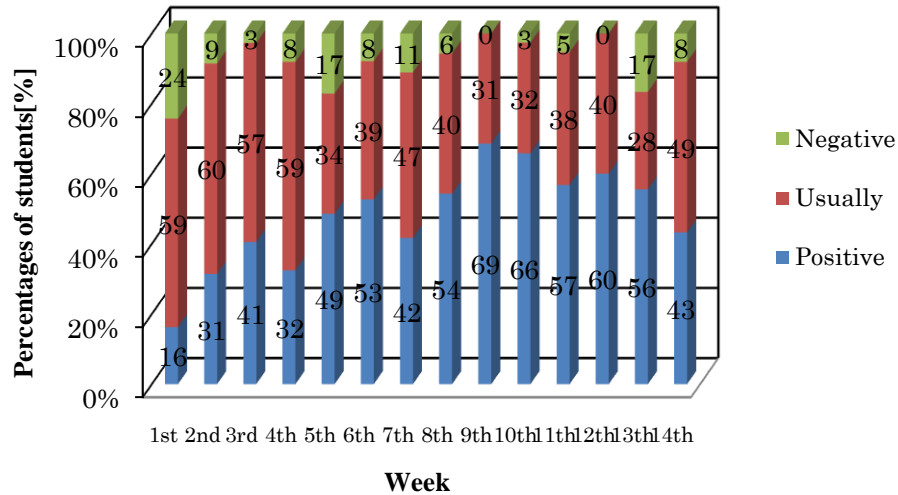


FIGURE 6

Change of students' willingness in 2008

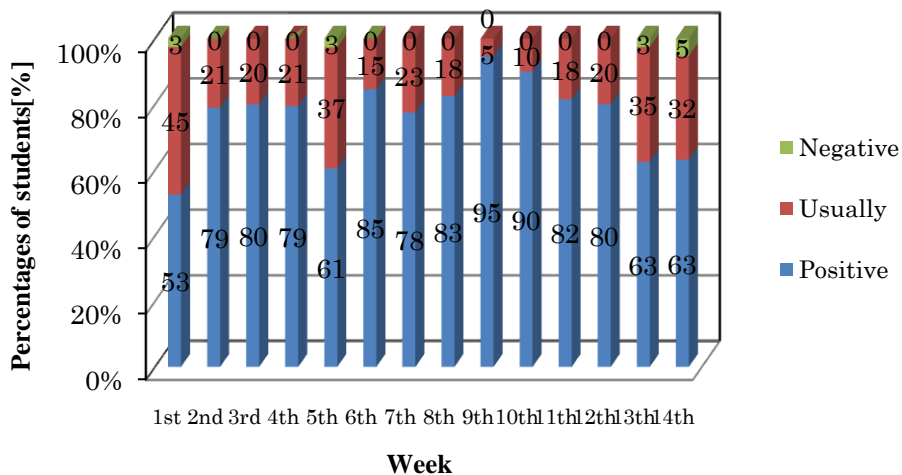


FIGURE 7

Change of students' willingness in 2009

Figure 7 shows the change of students' willingness in 2009. Students' positive the first week of 2009 ratio is high with 53%. This value is three times or more in 2008. Moreover, positive students' ratios have changed between 53% and 85% in the process of Plan. Positive students' ratios have changed between 63% and 95% in the process of Do. The ratios were between 63% and 82% in the process of Check. Therefore, it is understood that positive students' ratios were greatly

improved compared with 2008. This reason is in the execution of PBL of sharing method by both the first term and the latter term of 2009. Additionally, all groups were able to submit the drawings by the eighth week in the Do process of 2009. As a result, we think that the manufacture of students' works advanced smoothly.

Conclusions

We have investigated students' seven abilities concerning PBL of the sharing method practiced in 2008 and 2009. When students in 2008 executed PBL of sharing method for the first time at latter term, various problems were caused. For example, students of Plan were not able to explain their drawings in the group of Do accurately. In addition, there was being not able to pass the drawings from the group of Plan to the group of Do by the eighth week. Therefore, there was a tendency of decreasing in the abilities of students of the seventh week in the process of Plan. To improve these, we had PBL by the sharing method experienced to students at the first term and latter term in 2009. As a result, we succeeded in the achievement of a remarkable educational effect in students' seven abilities and willingness. The improvement in the future is needed because there is a tendency of decreasing in the abilities of students of the 13th week in the process of Do.

References

- [1] Morooka Koji, "Creative Education ", *Journal of Japanese Society for Engineering Education*, Vol.38, No.3, 1990, pp13-17
- [2]Ishizaki Shigetoshi and Sugimori Kazuoki, "An Approach Creativity Education by Manufacturing Machine Products and its Evaluation",*The 75th JSME Spring Annual Meeting*, IV, 1998, pp346-347
- [3] Ishizaki Shigetoshi, "Consideration of Technology Education for Making Objects in Kobe City College of Technology", *Japan Society for Precision Engineering, Proceedings*, CD-ROM, September, 2005
- [4] Ishizaki Shigetoshi, Ozaki Jun-ichi and Hanabusa Takao, "Art and Crafts Eduation using DC Motors –Engineering Education in the creative design and production -", *Japanese Society for Engineering Education, Proceedings*, 2007, pp660-661
- [5] Ishizaki Shigetoshi, Ozaki Jun-ichi, Saito Shigeru, Nakatsuji Takeshi and Hanabusa Takao, ""Monodukuri Education" practiced by Consecutive Work and Segmented Work", *Journal of Education in the Colleges of Technology*, Vol.33, 2010, pp589-594
- [6] Ishizaki Shigetoshi, Ozaki Jun-ichi, Saito Shigeru, Nakatsuji Takeshi and Hanabusa Takao, "An Attempt of "Monotsukuri Education" by Sharing Method", *Journal of Japanese Society for Engineering Education*, Vol.58, No.2, 2010, pp64-69