The Twenty-Ninth KKHTCNN Symposium on Civil Engineering
December 3-5, 2016, Hong Kong, China

Practice and Verification of Project Based Educational Program for Kenyan Students

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ABSTRACT

Lack of civil engineers is one of the problems to develop infrastructures in Kenya. We focused on education to try the problem. In particular, we use an idea of PBL (Project Based Learning) as reference, and carried out a workshop to help to discipline engineers and verified learning effect. As a result, we confirmed an increase of academic ability and motivation to study.

1 INTRODUCTION

In Kenya, lack of civil engineers is a social issue. Kenyan government established JKUAT in 1981 of which mission is training engineers to develop Kenya. Kenyan people rely on developed countries to construct large infrastructures such as dam, port, highroad and bridge. By contrast, they construct smaller ones by themselves. Therefore, it is hard for them to maintain important infrastructures. There are problems of a rough dirt road (Fig.1), black cotton soil (Fig.2), blackout and so on.

We are exploring how we can help Kenya as students studying civil engineering. And we focused on education which is one of the cause of shortage of engineers.

Fig. 1. A rough dirt road

Fig. 2. Black cotton soil

2 CONCEPT OF PBL

PBL (Project-Based Learning) is one of the education method which people deal with particular problem among team. It is said that PBL enhance practical abilities to think by considering well through a solving process of real problem. Even though we have knowledge we learned from books and lecture, it is difficult to apply them to something like a real structure. It is possible for us to learn knowledge and practical application comprehensively through PBL. Learning how to apply the knowledge also makes you understand how important it is. This enhances motivation to learn.

And, in PBL teacher is just an adviser or a facilitator. Teacher doesn't teach a lot. Therefore, group discussion necessarily increase more and more. Because of this process, students can improve their creativity and practical skills by themselves.

3 METHOD

3.1 Making a paper bridge

We held a workshop of making a paper bridge as PBL. A Paper bridge is a bridge made of paper. Table1 is about basic information of the workshop.

Table 1. Basic information of the workshop

Visit place	JKUAT
The number of members	6people(5Japanese + 1Kenyan)
The number of participants	20people(5Kenyan × 4groups)
Target	Undergraduate students in JKUAT who have basic knowledge about mechanics

Making and designing a paper bridge includes essence of structural mechanics which is important component of civil engineering. And it is considered to have high learning effect. Some of Japanese members major in bridge. So we chose bridge as subject in this workshop. Target is Undergraduate students in JKUAT who have basic knowledge about mechanics. The students who don't major in structural mechanics can attend this workshop too. In order to enhance their motivation to learning, we divided 20 people into 4groups and have them compete with each group. Each Japanese student joined each group as an adviser. Evaluation points are whether they design intentionally in accordance with given conditions and whether they consider experiment well as stated below.

The flow of workshop are as follows.

[1] Lecture
Japanese students taught basic structural mechanics and how to design a bridge.
[2] Design
Each group designed cross section, whole dimensions, stiffeners and so on.
[3] Making a paper bridge
Using cardboards (thickness is 1mm) with glue gun, cutter and so on, they made their paper bridges.
[4] Experiment
They observed destruction property by putting loads on their bridge and considered the differences from their design.
[5] Presentation
They had a presentation about their design, experiment and consideration. And all students evaluate the presentations of each group and the ranking of each group was decided.

Fig. 1. Paper bridge

Fig. 2. Experiment

3.2 Test

In order to verify the learning effect of this workshop, we carried out tests two times before and after the workshop. Shift of score is one of the index to evaluate the learning effect. Test problems were made by using Japanese national civil service examination as a reference. Problems which require basic and wide range of knowledge are selected. There are 11 problems, and max is 11 points. Table2 shows a correspondence of problem number to kind of problem.

Table 2. A correspondence of problem number to kind of problem

Problem number	Kind of problem	Problem number	Kind of problem
1	Pure tension	7	Buckling
2	Bending moment	8	Pure tension
3	Second moment of area	9	Bending moment
4	Deflection of a beam	10	Second moment of area
5	Deflection of a beam	11	Section modulus
6	Buckling		

4 RESULTS & DISCUSSION

4.1 Test results

Table3 shows lowest point, highest point and average of first and second test. Fig.3 shows correct answer ratio for each problem. We carried out a questionnaire about study hours, and Fig.4 shows a relationship between study hours and an increase of score.

Table 3. Test Result

	Lowest Point	Highest Point	Average
First Test	1	6	3.35
Second Test	5	11	8.35

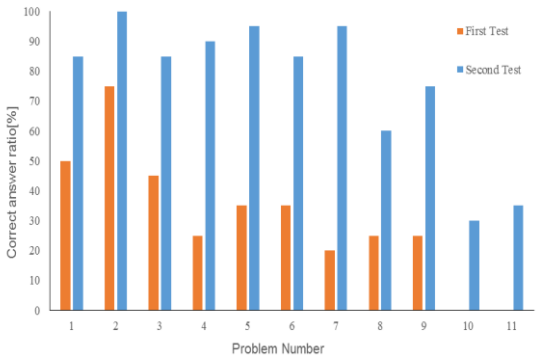


Fig. 3 . Correct answer ratio for each problem

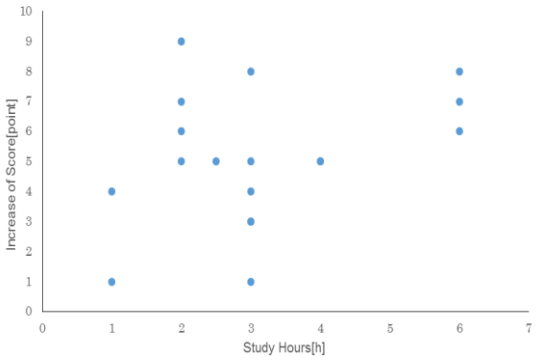
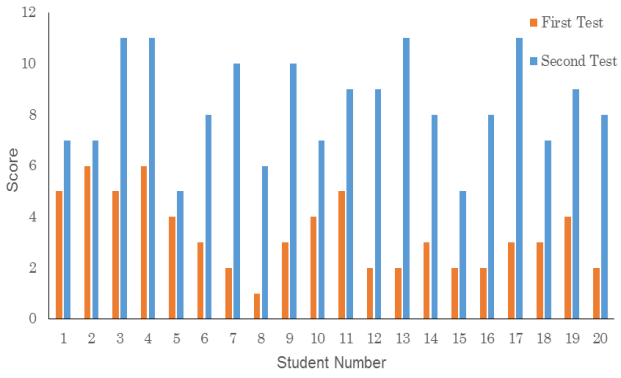


Fig. 4. Relation between the study hours and the increase of score



Student Number	Department
1-4	Civil Engineering
5-9	Agricultural Engineering
10-15	Soil, Water and Environmental Engineering
16-19	Biomechanical and Processing Engineering
20	Architecture

Fig. 5. Score of each JKUAT students and correspondence of the student number to the department

According to the Fig.3, correct answer ratio increases obviously, and the table3 says that average rises by 5points. From the Fig.4, the relation have positive correlation (correlation coefficient≒0.35). According to Fig.5, students majoring civil engineering scored high points relatively in the first test. However, in the second test, a distribution of score look alike. This

means that the level of this workshop would be just right for the students.

From the above, this workshop would have learning effect.

4.2 Comments and attitude of applicants

We got comments from JKUAT students about this workshop. Table4 shows some examples of the comments.

Table 4. Comments from JKUAT students

1	Great workshop. It reveals real situations which require application of engineering skills learnt during the course work.
2	In this workshop we made bridge bearing approximately 20kg. A small goat weigh approximately 20kg. So we can make bridges goats can cross. We are already engineers!
3	The bridge project is a promising project. It should be spread to other nations to increase the knowledge of bridge construction..
4	Great workshop. It should happen more often.
5	The first exam makes one attentive to the lecture. The second exam is good as it confirms one has understood. The practical is good it ensure one doesn't forget things they have been taught.

Judging from these comments, this workshop has not a little component of educating civil engineers. This results accord with our purpose of training civil engineers.

And I felt that the motivation to the workshop of JKUAT students was so high. At all process of design, assembling a paper bridge, experiment and presentation, group discussion necessarily occurred. Therefore, they worked on the tasks initiatively.

5 CONCLUSIONS

-We confirmed good learning effect of PBL. Furthermore, there are added value of increasing motivation and learning practical skill.

-This is first step, so our research is about only Kenya. However, we it is necessary to move the other developing countries

-Technical issues still remains. Japanese members don't have so much knowledge about civil engineering, and it was difficult to answer questions from JKUAT students exactly. It is necessary to study hard. Besides, this time we used test score as an index to evaluate learning effect. However, increasing the test score does not necessarily means training civil engineers. This verification with other new index is needed as prospects for the future. It's better to use an indicator which can assess the effect of disciplining civil engineers quantitatively.

6 REFERENCES

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