On Appropriateness of Exercises for Education of Basic Design in Relation to Science and Mathematics

Takeshi Kinoshita & Katori Zushi
Faculty of Engineering,YamaguchiUniversity, 2-16-1, Tokiwadai, Ube-shi, Yamaguchi, 755-8611, Japan
E-mail: kino1020@yamaguchi-u.ac.jp

We have investigated how effectively the training of basic design that we created can facilitate students' interest in the areas of science and mathematics. In addition, we investigated whether contents setting of exercises were appropriate. In Japan, the current program of art classes has little connection with science and mathematics. We concentrated that education of basic design has connection with natural observation, figure and color in science and mathematics. We had model classes for 9 students from an elementary school and 10 students from a junior high school. Main contents on the exercises of basic design are as follows: (1) to sketch a banana and draw figure by outline. (2) to compose of the shape of banana and a geometric shape. (3) to paint with a color in achromatic color and chromatic color by two same figures. The next regulations were put up, as regulations related to science and mathematics: (1) exactitude of geometric shapes. (2) reality on sketch of a banana. (3) sameness on brightness to segment of two figures. We examined to appropriateness in exercises for education of basic design by investigation of regulation to every works.

Key words*: Design, Education, Evaluation, Figure, Color*

1. Introduction

Basic design is an interdisciplinary field in which findings in chemistry, mathematics, psychology, and physics [1]. For example, combination of well-defined shapes and structures is an indispensable part of basic design requiring a rudimentary knowledge about geometry in mathematics. We are proposing that education of basic design can contribute to educations of science and mathematics in elementary school and junior high school. In general, it has also been pointed out for these several years that students in elementary and high school avoid science and mathematics education in Japan. We believe that one of the reasons is the lack of explicit link to the real world. In other words, matters in the current curriculum are too abstract for students to grasp how they are used in daily life. It seems that a genuine design education in elementary school does not exist. It has been pointed out that the current curriculum concentrates too much on art. Again, the link between the curriculum and the real world is not transparent. There are some possibilities that students can learn science and mathematics through drawing, dividing and painting geometric shapes in basic design.

In the present paper, one exercise was introduced. It is a new material to enhance the design-science linkage. The purpose of the present paper is as follows: (1) to look the appropriateness of the exercises for elementary school and junior high school students, (2) to find evaluation items which can achieve, or can not achieve. Our new methods and materials for design-science linkage include observation and sketch of natural object.

2. Methods

2.1 Material

The first author has taught design courses at university for several years. We have developed the teaching materials and tasks for the experimental class on his teaching experience. In this study, we used one task. This task is the newly proposed material to introduce a tighter link between design-science and design-mathematics. This

task is in particular focuses on the link toward science. In the beginning, Sketch a shape of observations on a banana. It seems that sketch has a direct relation to imagination [3]. Secondly, draw two same compositions of a banana shape and a geometric shape (pick one shape from a circle, a triangle and a square). Paint the left side composition in achromatic colors with a wide variety of brightness. Paint the right side composition in chromatic colors matched the brightness with the left side brightness. The duplication of colors must be avoided.

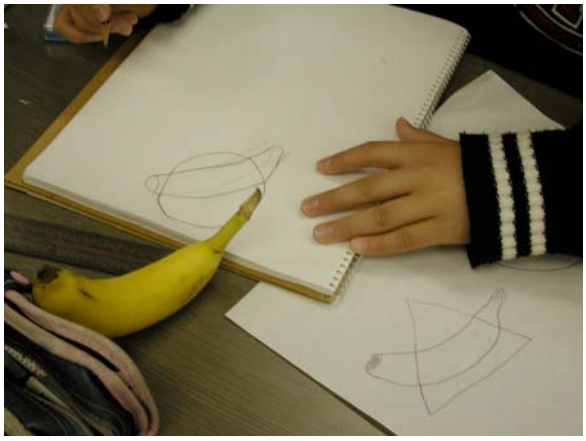
Figure 1: Sample of students' work for task

2.2 Experimental class

9 students from a Kamiube elementary school (10 or 11 years old) and 10 students from an Ube Junior college high school (14 or 15 years old) participated in our experimental class. They were all volunteers and joined to our experimental class outside of their schoolwork. Experimental classes for elementary school students were done at Yamaguchi University. The time schedule was as follows: lecture is 10 minutes, work is 160 minutes, review is 20 minutes and interview is 30 minutes in December 7, 2003.

In Figure 2, we presented how things are going in class. Meanwhile one task group came to our University only in the last week. As for junior high school students, experimental class was done at their school. The time schedule is basically the same as elementary school. The teaching staffs include the authors and 3 or 6 teaching assistants recruited from Yamaguchi University. The numbers of recruited member differ according to the number of participated students. Teaching assistants helped students when they were working on the tasks, for example, how to draw geometric shapes, and how to paint, and so on.

One crucial difference of our experimental class from art classes in an ordinary elementary school curriculum is the review session in which all students' work were put in front of the classroom and reviewed by the first author.



(a) Observation and sketch of natural object.

(b) Paint the color the composition

Figure 2: The working process of the task

2.3 Evaluation of works

The first author evaluated each of evaluation items in all student works. Ranking of the works was determined in terms of the achievement of the task. Evaluation of the

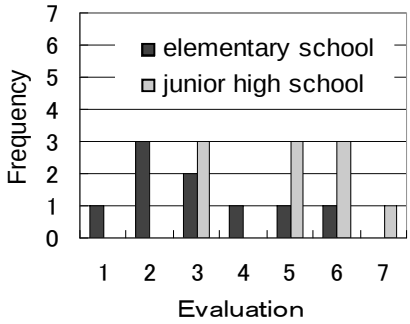
works was told to all students in the class. The subjects of evaluation items were (1) reality of natural shape (banana's outline), (2) exactitude of geometric shapes, (3) dissimilarity of brightness, (4) dissimilarity of hue, (5) uneven of paint (6) overall evaluation. Every student works were set out in three lines on a wall in the practice room, and changed to position in order to evaluation (Figure 3). This is not a usual procedure in an ordinary art class due to the nature of the curriculum: ranking can't be given to students' art works. However, what we have done in our experimental class is not "art" but "design" with a specific scope and achievement goals. Thus, a score between 1 and 7 was given to each works.

Figure 3: Setting out of students' works for task by instructor

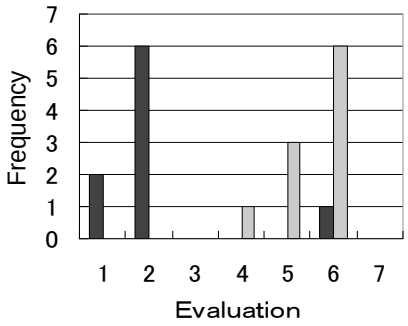
3. Results and Discussion

We summarized distribution every evaluation item (Figure 4), and we investigated it in a graph of an elementary school in detail. Dissimilarity of hue grows well generally, and it is a high score most in an evaluation item. Exactitude of geometric shapes concentrates on the evaluation that most are bad. Therefore, it is the hard item. We compared evaluation of students from a junior high school with evaluation of students from an elementary school (Figure 5).

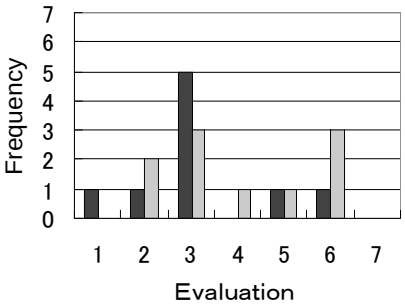
Students from a junior high school get high evaluation than students from an elementary school. Therefore, the work is easy to wrestle for students from a junior high school. Adversely it is difficult to wrestle for students from an elementary school.



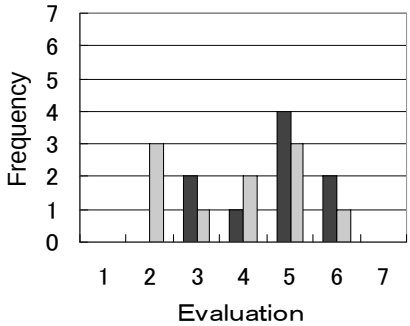
(1) Reality of natural shape



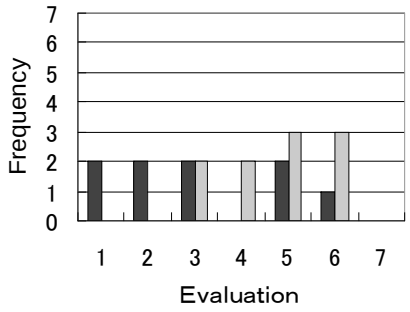
(2) Exactitude of geometric shapes



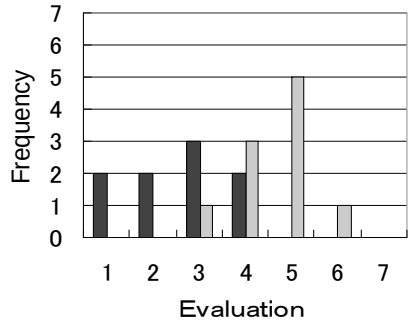
(3) Dissimilarity of brightness



(4) Dissimilarity of hue



(5) Uneven of paint



(6) Overall evaluation

Figure 4: Distribution every evaluation items

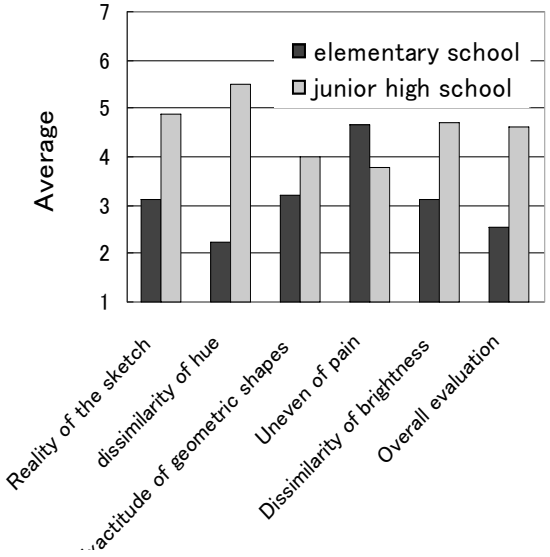


Figure 5: Comparison of students from an elementary school and students from a junior high school

4. Conclusion

We proposed the new exercises for curriculum for elementary school and junior high school to highlight the linkage between design and science, and the linkage between design and mathematics. In order to examine and evaluate the effectiveness of our exercises in encouraging students to lean science and mathematics, we conducted experimental class by the use of the exercises. We found that our exercises, which include observing and drawing natural shapes and geometric shapes, was appropriate for junior high school students. Further experiments will be conducted for elementary school by new exercises.

Acknowledgement

We are grateful to volunteer students and the staff at Kamiube elementary school and Ube Junior college high school for their enthusiasm and cooperation. We also wish to thank Kumiko Shinohara, Graduate School of Science and Engineering Yamaguchi University, for her advice. This work is supported by Grant-in-aid for science, provided by JSPS, grant number: 15020245 and 16700209.

Reference

[1] Mitsui. H., (1996). Bi no kouseigaku. *Chuko Shinsho*, (in Japanese)

[2] Nagai Y. & Noguchi H., (2002). Relations between creativity and thinking types of design students observed in sketch drawings. *The science of design*, 48, 6, 39-46

[3] Kinoshita, T., Miike, H., Ichikawa, M., Kitahara, M., & Osa, A. (2003). The role of basic design training in science education. *Journal of the Asian Design International Conference*, 1, 145.