

## **Research to Current Subject in Figure Education from upper Elementary School in Japan - Effectiveness on “Kiri-E” with Origami**

### **1. Introduction**

At present, from the elementary school in Japan to the middle school / senior high school curriculum of figure education, each unit is divided. There is a situation where they are not able to cooperate well. Also, the teachers do not teach in relation to teaching materials other than the educational content of textbooks, and there are many situations where it does not lead to actual activities of children and students. It is considered not to be a subjective activity of children and students; after all, it is considered not to live in subsequent learning.

Through activities using "Kiri-E cut picture", children and students learned subjectively and examined ongoing learning of each unit this time. We can find family crests in Japan. There are many beautiful and refined designs in Japan, such as representing the country, organization, family and individuals. This report introduces traditional Japanese family crests from hundreds of years ago. They are still used today and symmetry plays a role in the design.

### **2. Family crests in Japan**

Typical examples of “KAMON” (Family crests) are the followings.

- (1) "AOI": Asarum --- TOKUGAWA family
- (2) "KIKYOU": (Chinese) bellflower, balloon flower --- AKECHI family
- (3) "ROKUMONSEN": Six Coins --- SANADA family
- (4) "MARU NI JYUJI": Circle and Cross --- SHIMAZU

### **3. MON-Giri: "Kiri-E" with ORIGAMI**

Edo period followed the Warring States period, was a peaceful period. KAMON was used in paper cut-out art Kiri-E for symbols of Samurai families and as trademarks or marks of great merchants. This Kiri-E art is used artfully not to cut through the whole body of the design, but to make a shallow or deep cut on a folded sheet of paper twice, thrice or half-dozen times. Then the designs of unimaginable beautiful patterns can get spread-cut. Tracing the traditional designs of MON-Giri is only cutting the lines correctly with scissors. It will be understood the developing shape completely in one glance at the design of MON-Giri, but then sometimes there are unexpected results.

It is the most charming point. This point is valuable when studying symmetric relationships and spatial recognition in mathematics lessons, so we can use MON-Giri for supplementary materials or lessons in school.

#### 4. Results of classes at university students

On December 2016, I had the opportunity to conduct class using this Kiri-E for students of Faculty of Education in Gifu University. I taught 71 students who are aiming for elementary school teachers in the future and conducted classes on figure problems using the questions of national academic ability and learning situation survey in 2009. They do not major in mathematics and science. The questions of this survey were based on the theme of MON-Giri with ORIGAMI. I also conducted questionnaires on their awareness of mathematics at the time of high school and after entering university. In the fall of 2016, the same students were taking the "Mathematical verification test" (quasi-second grade as same level as the examination of 10th grader), and the results were also compared.

##### 4-1. Questionnaires

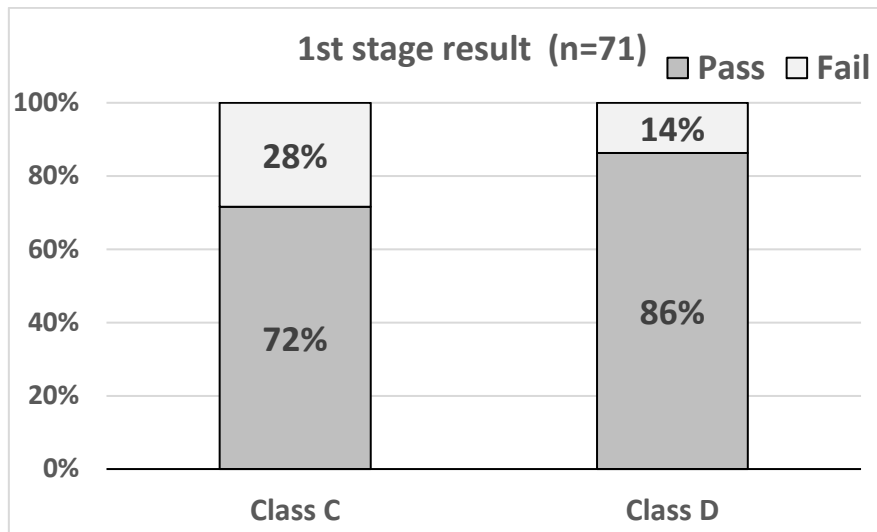
As shown in Fig.1, they did not necessarily like mathematics at variance with their high scholastic ability in high school. After entering university, the same result is obtained.

1 Did you like mathematics in junior high school and high school days?			2 Do you like math after entering university?		
① Like	8	11.3%	① Like	2	2.8%
② Somewhat like	27	38.0%	② Somewhat like	12	16.9%
③ Somewhat dislike	19	26.8%	③ Somewhat dislike	38	53.5%
④ Dislike	17	23.9%	④ Dislike	19	26.8%

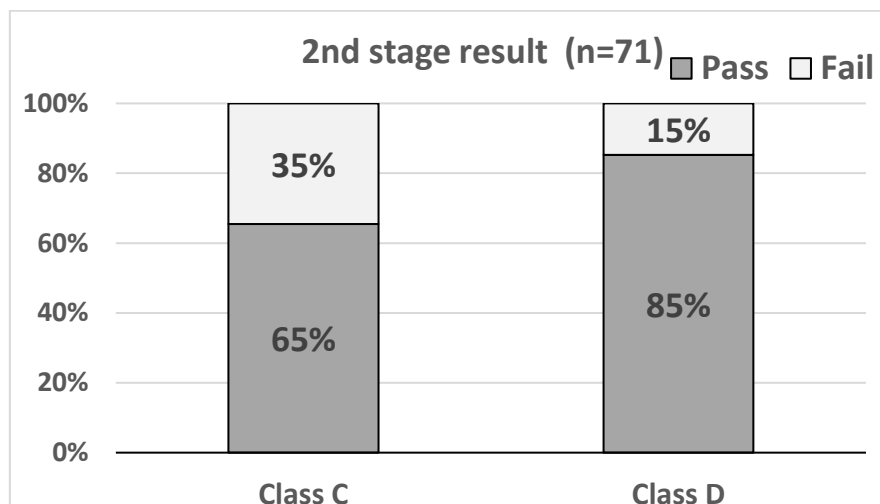
Fig. 1: Did you like mathematics in junior high and high school? (N=71)

##### 4-2. Mathematical verification test

This proficiency test consists of two stages types: the first stage is a calculation skill test and the second stage is a mathematical skill test. The results of these test are compared with the data of the student of class C majoring other than mathematics and science and the data of the student of class D majoring mathematics and science. The passing grade of this practical mathematical skill test is about 70% in the first stage and about 60% in the second stage. The comparison between class C and D is as follows (Graph 1&2).



Graph 1 Calculation skill test



Graph 2 Mathematical skill test


Although it is a test with 10th grader's level, the students in class D majoring in mathematics and science have relatively good results. But it turns out that the result of the students in class C is not very good.

### 5. Class with national academic ability in 2009

The questions of this survey were based on the theme of MON-Giri with Kiri-E. This national survey is targeting 9th grader in Japan. It was questions focusing on the symmetry of figures, with the theme for cutting play with ORIGAMI.

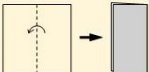
In these classes, the students were also allowed to fold origami and cut with scissors. They were working with great interest. The following Fig. 2 is an example of how to play and question number 3.

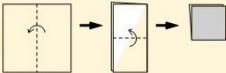
1 Kiri-E Crest cutting play" that has been popular since the Edo period. Folding the square paper several times, cutting and opening the paper will produce a beautiful pattern of cutouts.

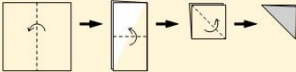


how to play

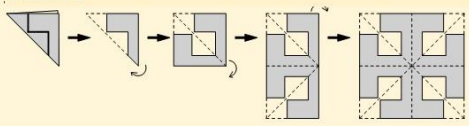
Fold the square paper as shown below

1 time 


2 times 

3 times 

As shown in the figure below, fold the paper three times, cut the paper with thick line, open it and you will get a pattern like the one shown.




(3) In the figure below, fold the paper three times, choose the pattern that you can cut.



Fold the paper three times , there are 4 symmetrical axes.

correct answer



The correct answer rate is 54.3%

Fig. 2: How to play & Question number 3

## 6. For the Future - Curriculum of figure problems in Japan -

The curriculum of figure education in Japan is divided and there is no continuity. Also, at the time of high school, there is no direct curriculum at present. It is necessary to further devise learning through activities. Children / students learn by themselves, and further study is needed for the continuing learning of each unit. We need ingenuity of learning through activities. Results of the practical mathematical skill test say that the students who are not very good at mathematics will become teachers of elementary school and teach math. Furthermore, I would like to study about learning with activities and study about teacher training.

## References

- Public Interest Foundation Japan Mathematical Examination Association. (176th) *Practical Mathematical Skill Test Level 2 Grade*.
- National Institute for Educational Policy Research. (2009). *National academic ability and learning situation survey with 9th grader Students Mathematics B*, pp.1-2 Commentary material, pp.64-67 Survey result by question, pp.6.