"Gestaltungunterricht" -the plastic education- on the cutting and rebuilding of cube for abecedarians of architecture

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Abstract: In this paper show a result of the molding education in the abecedarians of architecture. Particularly, as well as molding of a whole building, it is necessary to imagine the sectional drawing of the inside space of each room in a building such as the four walls, a ceiling and the a floor. In the *"Gestaltungunterricht"* necessary for architect, it is necessary not only to mold a whole solid like clay works but also to imagine the details and the sectional drawing of each part of a solid. This education is provided in a class called "foundational mathematics for design II" for the students of our university in the second semester of the first year. This *"Gestaltungunterricht"* is composed of four steps--design plan, design, production, and presentation. The form of the student's work varied, and there was it from a geometric shape to the form that expressed psychological description. I weighed other scores against the score of the work. As a result of this study, it seems that the students understood the shape of the sections of the cubes cut by them. And the score of work was associated with scholastic ability of the mathematics.

Key words: "Gestaltungunterricht", Plastic education, Cube, Abecedarians, Architecture

1. Introduction

When architects design buildings, as well as two-dimensional planning, the ability in three-dimensional modeling is necessary. Therefore *"Gestaltungunterricht"* -the plastic education- on building a solid is provided for the beginners of architecture as a first-year educational program. In this education necessary for architect, it is necessary not only to mold a whole solid like clay works but also to imagine the details and the sectional drawing of each part of a solid. This paper introduces plastic education aimed at acquiring the ability in molding by cutting and rebuilding of cubes. This education is provided in a class called "foundational mathematics for design II" for the students of our university in the second semester of the first year. This is composed of four steps--design plan, design, production, and presentation. Therefore, in this study is introduced the result by this education and is considered that it is comparison with scholastic ability of the mathematics. In addition, this study examines *"Gestaltungunterricht"* that went to improve ability to think about the section in the abecedarian of architecture.

2. The contents of the class

2.1 The class of foundational mathematics for design

The class of "foundational mathematics for design" is opened a course in as a class of the first grader. This class parts from I in II. The class of "foundational mathematics for design I" is in the first semester of the first year,

and the class of "foundational mathematics for design II" is in the second semester of the first year. The syllabus of each class are shown in the table 1. The students learn the basics of mathematics with the class of "foundational mathematics for design I" and learn architectural design education with the class of "foundational mathematics for design II". Both instructions are me.

"Gestaltungunterricht" is incorporated in "foundational mathematics for design II". The class of "foundational mathematics for design II" includes how to describe figures of isometric drawing, axonometric drawing or parallel perspective and the strength contest of the construction model with the paper other than *"Gestaltungunterricht"*. Mathematical knowledge is necessary for this class. However, if anything, as for this class, the plastic education plays a key role. In addition, isometric drawing and the axonometric drawing instruct how to describe transformation of the cube and the parallel perspective view instructs how to describe architectures. In addition, the strength contest of the construction model with the paper lets students produce a model such as the steel of wide flange shapes as the building material. The paper lets students you use Kent paper like *"Gestaltungunterricht"*.

The class of "foundational mathematics for design I" posts results of students on a test. The class of "foundational mathematics for design II" posts results of students by the evaluation of all works without conducting a test.

Table 1. The syllabus of the class of "foundational mathematics for design I and II"

foundational mathematics for design I		foundational mathematics for design II	
Times	Contents	Times	Contents
1	Why is mathematics necessary for architecture?	1	The guidance.
2	Let's know the unit to use to architecture.	2	The design plan of *"Gestaltungunterricht"*.
3	Let's know your human body dimensions.	3	The design of *"Gestaltungunterricht"*.
4	The numerical kind, the several characters.	4	The production of *"Gestaltungunterricht"*.
5	The common multiple and common divisor.	5	The presentation of *"Gestaltungunterricht"*.
6	The fractional calculation.	6	How to describe figures of isometric drawing.
7	The square root and index.	7	How to describe figures of axonometric drawing.
8	The approximate value and significant digit.	8	How to describe parallel perspective views.
9	The equation.	9	Exercise 1 of parallel perspective views.
10	The function and graph.	10	Exercise 2 of parallel perspective views.
11	The logarithm graph	11	Trial manufacture 1 of the construction model with the paper.
12	The trigonometric ratio and function	12	Trial manufacture 2 of the construction model with the paper.
13	The several sets of signs and calculation methods	13	Production 1 of the construction model with the paper.
14	Test	14	Production 2 of the construction model with the paper.
15	The commentary and return of the test.	15	Strength contest of the construction model with the paper.

2.2 What is *"Gestaltungunterricht"*?

Originally *"Gestaltungunterricht"* is molding education provided in *"Bauhaus"*. *"Bauhaus"* is a German plastic university. *"Bauhaus"* was established in Germany Weimar in 1919. *"Bauhaus"* is the general school which there educated about art and the architecture including industrial arts, a photograph, and the design. In addition, *"Bauhaus"* may point at art of the rationalism to descend it and functionalism-like art. It was only 14 years before being closed a school in 1933 by the Nazis that *"Bauhaus"* is existed as a school. However, the tendency to expression had a big influence on modernism architecture [1].

2.3 *"Gestaltungunterricht"* of this study

The print to distribute to students of this problem is shown in figure 1. This education is provided to let you grasp a three-dimensional cross-section for abecedarian of the architecture. This *"Gestaltungunterricht"* is composed of four classes: design plan, design, production, and presentation. At first, the students divide a 120-millimeter cube into more than ten parts. This is because it is the numerical values those 120-millimeters are easy to be divisible with an integer as for the one which chose one side as 120-millimeters of the cube. For example, it becomes 120/6 = 20, 120/5 = 24, 120/4 = 30, 120/3 = 40 and 120/2 = 60. Then, the students verify that the distributed parts become the original cube. And they build the divided parts into their favorite form. In addition, the students produce a rebuilding model on an A4-size Kent paper. But they students must not use adhesive tape to produce the rebuilding models. They must build their work using paste and space to starch. Because the adhesive tape is disturbed the image of their work. For example, the adhesive tape changes a color and it changes the luster. The student who completed a work draws a portfolio. Finally they submit the models and the portfolios which they produced. They draw a title, full name, university register number, concept, sketching of the fabricated solid model, photograph when they had an original cube and the others on the portfolio. As for this *"Gestaltungunterricht"*, it is thought that students can develop power to think about form at the same time as they understand the section of architecture.

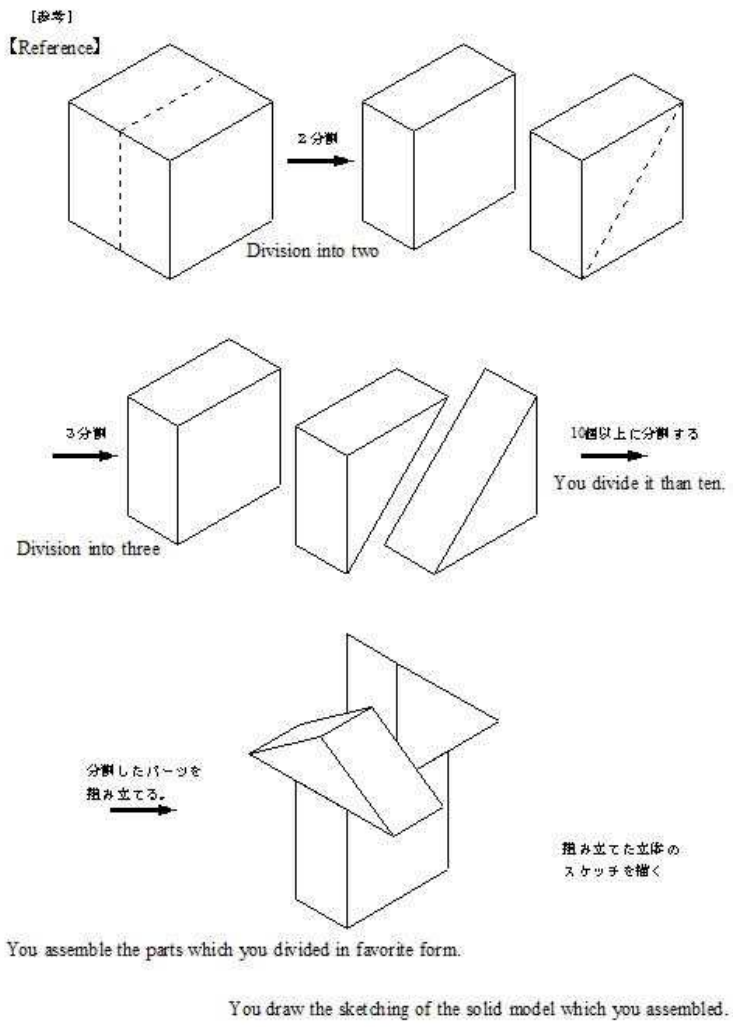

Figure 1. The print to distribute to students of this problem

3. Examples of a submitted work

Figure 10 from figure 2 shows examples of a submitted excellent work (model and portfolio) in a few years. And table 2 shows a Japanese title and English translation of the title, the number that was divided and the score at each work. In addition, the work of figure 9 (Work-H) is damaged by an East Japan great earthquake disaster a little. The submitted work was 60 works in a few years. The average of each divided number in 60 works was 43.8. The work which was divided most number was 112. The work distributed with fewest numbers was six (figure 11). Because this work was not divided than ten, it was unacceptable. And the average of score in 60 works was 76.7 points. The score of the most excellent work were 90 points. In addition, the score was acquired by three judges (university teacher) including me. And the results were one hundred at a perfect score. Like work-A and work-F, or like work-C and work-H, there was the same title in the work. But a concept of work was differed, and the model form was not same, too. The work had many things reflecting the image of a certain form like work-A, work-C, work-E, work-G and work-H. On the other hand, like work-D and work-I, the form to express psychological description existed. In this way, the work had much static form. However, like work-D and work-F, the dynamic form existed. But there was little dynamic form. If anything, there was much form of the geometric shape such as work B. In addition, as for unacceptable figure 11, the form is interesting. However, there was little divided number and it did not return to a cube [2]. In addition, each of the cut parts is a cube, a quadrangular prism, and a triangular prism, but the number of the parts with the curved surfaces is relatively small.

Table 2. The title of works

number	Japanese title	English translation of the title	The number that was divided	grade
A	Forest　フォレスト	Forest	24	87
B	「JOY」	Joy	24	82
C	歯車	Gear	35	83
D	Crest of a wave	Crest of a wave	80	90
E	Flower	Flower	33	85
F	ボックス	Box	50	87
G	森	Forest	59	87
H	歯車	Gear	64	88
I	未来	Future	93	88

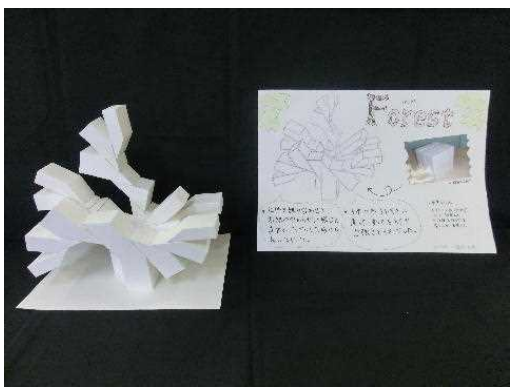

Figure 2. Work-A

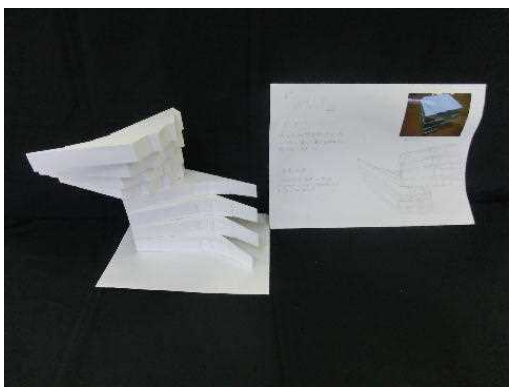

Figure 3. Work-B

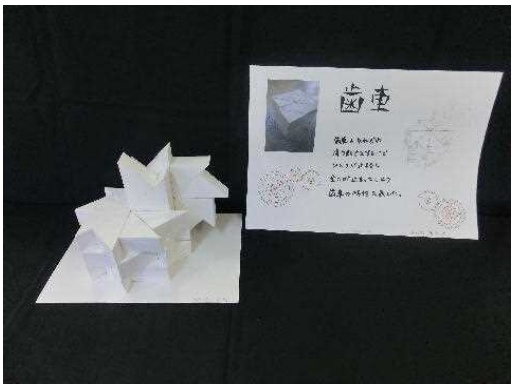

Figure 4. Work-C

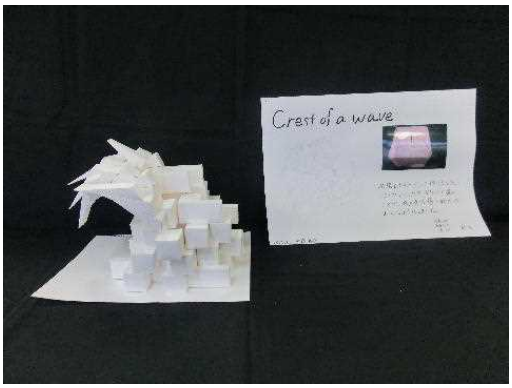

Figure 5. Work-D

Figure 6. Work-E

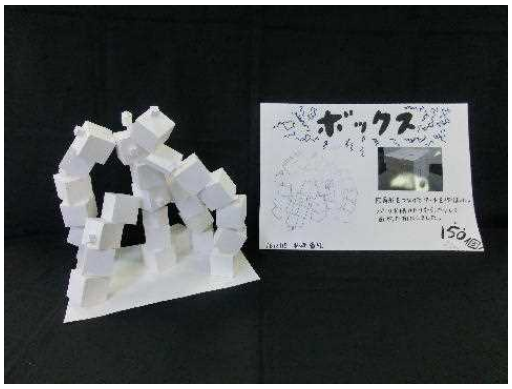

Figure 7. Work-F

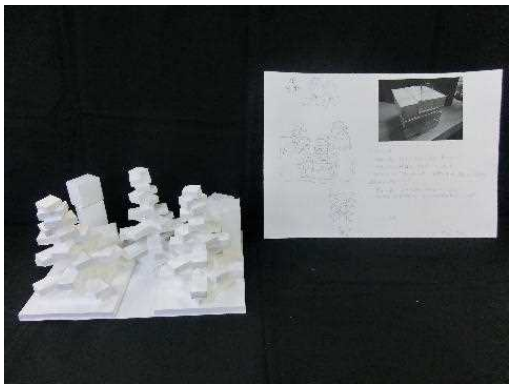

Figure 8. Work-G

Figure 9. Work-H

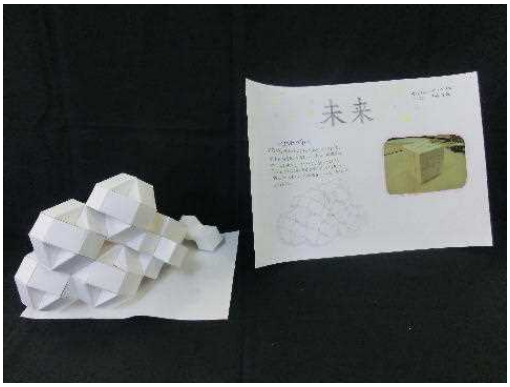

Figure 10. Work-I

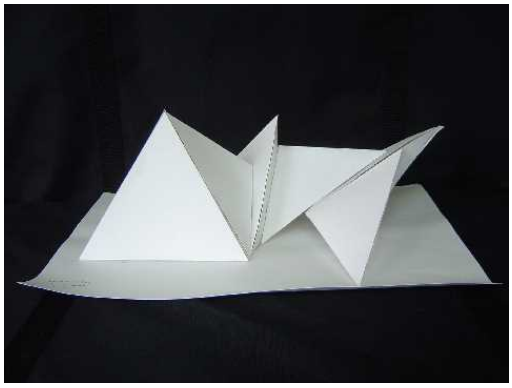

Figure 11. Unacceptable work

4. Result and consideration

The submitted work was divided into a static work and a dynamic work. As for the submitted work, there were many works which were more static than dynamic works. Most of static works were imitation of the existing form such as "Flower (Work-E)", "Forest (Work-A or G)" and "Gear (Work-C or H)". However, dynamic works expressed a mental tangle such as "Future (Work-I)" and "Box (Work-F)". In this way, the form of the work was each, and it was difficult to classify by the KJ method it [3].

Therefore, in this study, I investigated it whether the work of what kind of student was good results. At first I investigated relationship between the score of the student's work and the number that they divided a cube into. Figure 12 shows the relation. Because the coefficient of correlation was 0.141, the relations of both can judge that a relationship was light. However, students whom results had good divided a cube into more parts. It is thought that this is because a variation of the form spreads by dividing a lot of cube.

Then I investigated relationship between the score of the student's work and the score of "foundational mathematics for design I" conducted in the first semester of the first year. Figure 13 shows the relation. The coefficient of correlation of both was 0.740. In addition, the average of all students in "foundational mathematics for design I" was 75.8 points. This average score had lower 0.9 points than the average of the score of the student's work. Therefore, it was judged that the relations of both with the score of the student's work and the score of "foundational mathematics for design I" were straight line relationship. When a student divides a cube, this is thought to be because the student uses a lot of mathematical elements. The mathematical element is not only numerical computation, and the figure or form processing capacity will be included, too. As for this *"Gestaltungunterricht"*, it is thought that students can develop power to think about figure or form at the same time as they understand the section of architecture. The teacher should instruct a mathematical element to let students understand the section of architecture.

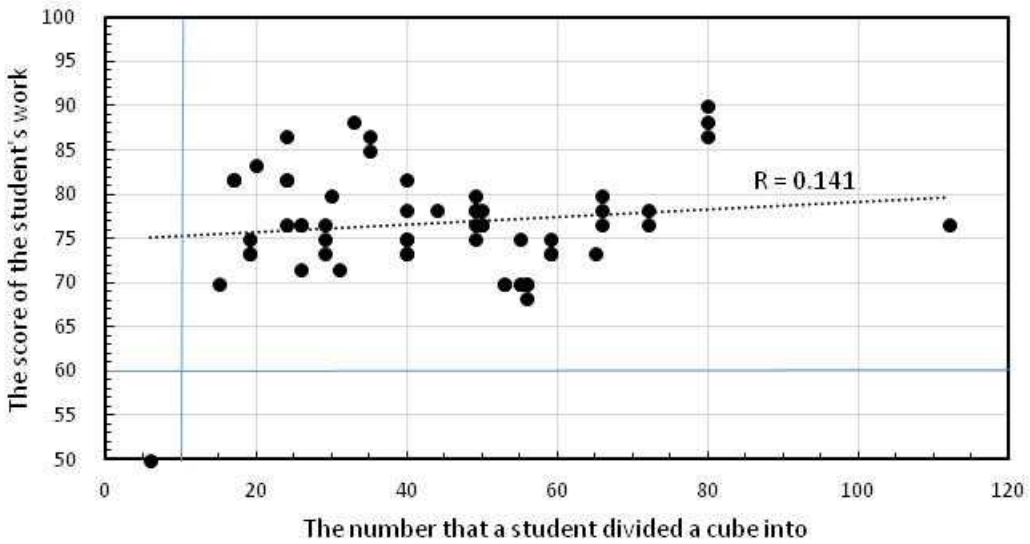

Figure 12. Relationship between the score of the student's work and the number that they divided a cube into

Particularly, about the student who score of "foundational mathematics for design I" is low and the score of the wok is high, a teacher should instruct the mathematical element well. The student may design the better architecture by doing so it. Of course, about the student who the score of "foundational mathematics for design I" is high and the score of the work is low, a teacher should carry out instruction to raise the imagination of the student. The student may design a better architecture by doing so it. This *"Gestaltungunterricht"* is conducted of in first graders for abecedarian of architecture in university. In this way, from to conduct this education method, the teacher can choose the instruction method of architecture design according to the score of the student. And, for the students of the abecedarian of architecture, it may be possible for better education of architecture to instruct it as a game not such an exercise or training in first graders.

Furthermore, I investigated relationship between the score of the student's work and the score of the parallel perspective view which I conducted afterwards. Figure 14 shows the relation. In addition, I marked the score of the parallel perspective view with one of me. The average of this score was 78.8 points. This average score rose 2.1 points than score of *"Gestaltungunterricht"*. In this way, the relations of both were correlative. The coefficient of correlation of both was 0.802. Because the parallel perspective view draws the space from the section in architecture, ability to think about a section is necessary for it. Particularly, for the student to be *"Kenchikushi"* - the national professional qualification or licensing of an architect- and a qualification of interior planner, a section and parallel perspective view is necessary. This is because a problem to ask this ability is made questions for by a qualifying examination. Therefore the students would show ability to think about the section that they cultivated by *"Gestaltungunterricht"*. And, it is thought that the will of the student improved by receiving this education because the average of score rose. Based upon the foregoing, *"Gestaltungunterricht"* can determine an effective instruction method for an abecedarian of architecture.

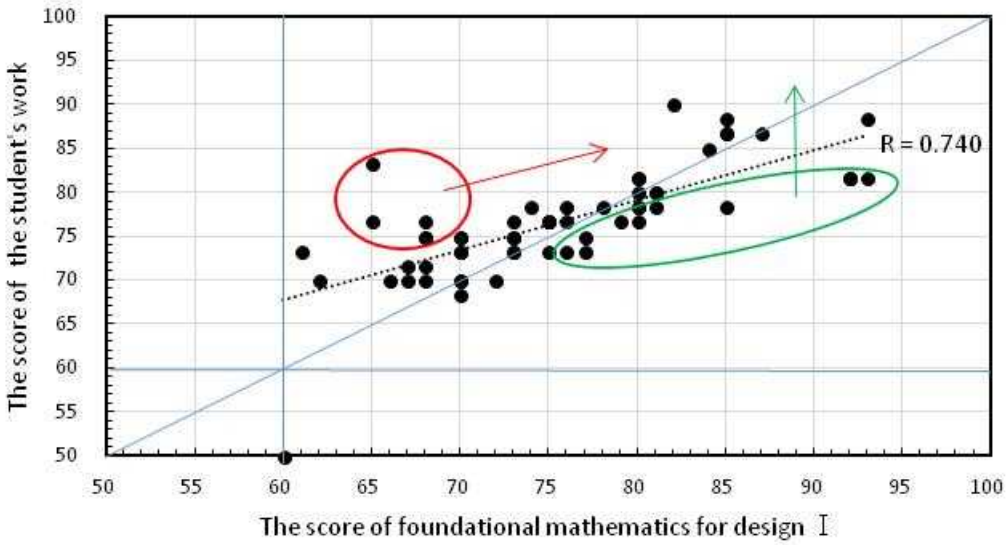

Figure 13. Relationship between the score of the student's work
and the score of foundational mathematics for design I

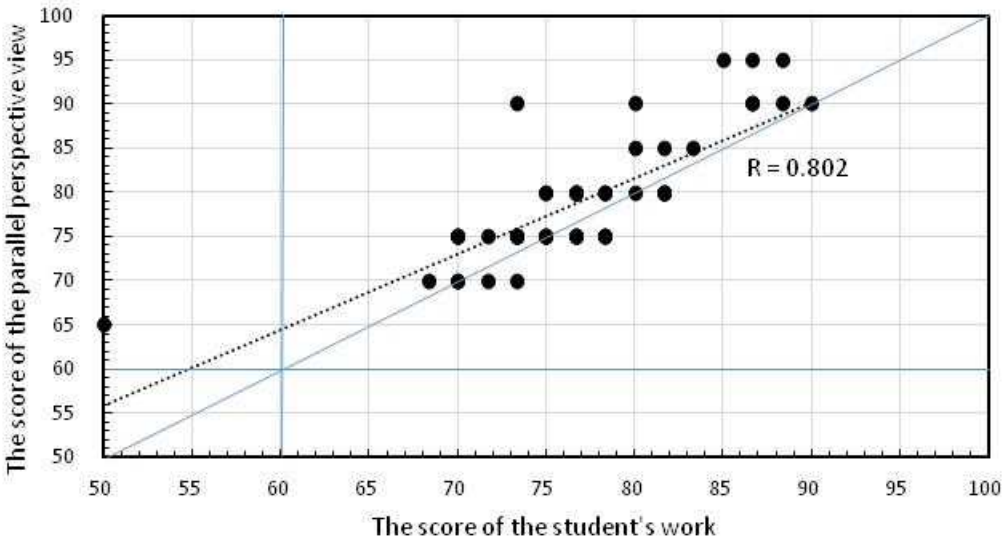

Figure 14. Relationship between the score of the student's work and the score of the parallel perspective view

5. Conclusions

This study examines *"Gestaltungunterricht"* –plastic education- that went to improve ability to think about the section in the abecedarian of architecture. As a result of this study, this paper makes the following things clear.

1. It seems that the students understood the shape of the sections of the cubes cut by them.

2. Many of the produced rebuilding models had static form, and some of them had dynamic form. And there was it from a geometric shape to the form that expressed psychological description.

3. The score of the student's work was correlative with score of the mathematics and the score of the parallel perspective view.

Based upon the foregoing, *"Gestaltungunterricht"* can determine an effective instruction method for an abecedarian of architecture.

I must weigh it against the scores of the architecture design work when the students became an upper-class student in future. I may examine an evaluation of the whole department's education by doing so it.

6. Examples Citations

[1] Whitford, F. (1994) *Bauhaus (World of Art)*, Reed Business Information Inc, Surrey UK.

[2] Matsumura, K. (2008) *"Seirokumentai no setsudan to saikouchiku niyoru zokeikyoiku" - "Gestaltungunterricht" –plastic education- for cutting and rebuilding of cube-*, Bulletin of the society for science on form, Society for Science on Form 23(1), pp.79-80, Tokyo, Japan

[3] Kawakita, J. (1996) *"Hassoho"-The idea method-*, Chukoshinsho, Tokyo, Japan.