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# Educational Effects of the National Competition on Wood Working in Japan

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**Abstract-This study examines the educational effects of the national competition on wood working for junior high school students in Japan. The competition has been held since 2001, and many students have presented creative and high-quality designs. This study discusses the designs, finished products, and their presentations, focusing on two students who participated in the competition in 2015. We found that the students improved their ability to create a real product from their imagined idea. In addition, they gained "authentic understanding," which is defined as the continuous relation of various knowledge. Finally, they improved their understanding of contents studied in class and applied their knowledge to a problem-solving situation.**

**Keywords – Japan, National Competition, Wood Working, Junior high school, Creativeness, Problem-Solving**

## I. INTRODUCTION

In Japan, technology education is provided in each grade. In junior high school, a subject called "Technology & Home Economics" comprises the fields of "Technology" and "Home economics." This subject plays a particularly important role in technology education.

In elementary school, a subject called "Arts and Crafts" is included. Its objectives are listed in the national course of study as follows: "To enable children, by means of activities involving expression and appreciation, to savor the joy of creating while bringing their sensitivity into play. Also, at the same time, to foster the fundamental abilities underlying the creative activities that take the form of shaping and molding, thereby nurturing a rich feeling of aesthetic sensitivity" [1]. This subject mainly aims to nurture sensibility and imagination. In addition, "Arts and Crafts" includes learning activities such as "A. Expression" and "B. Appreciation." Its contents mostly comprise artistic expression. Therefore, The Japan Society of Technology Education, one of the most influential academic societies for technology education in Japan, does not regard "Arts and Crafts" as technology education [2].

In high school, a subject called "Information" is included. Its objectives are to cultivate an "ability to get things done for information literacy," "scientific comprehension of information," and "attitude of participation in an information society." These are learned through "information A, B, and C" [3]. The distribution of course content is as follows: 60 percent information A, 14 percent information B, and 16 percent information C [4]. Therefore, information is fully presented at ordinary schools. Moreover, the learning activities in "Information" courses include little art creation.

On the other hand, in junior high school "Technology" courses, all students study all the contents, which comprise "A. Technology of materials and their processing," "B. Technology of energy conversion," "C. Technology of nurturing living things," and "D. Technology of information processing" [5].

Thus, junior high school "Technology" course has a great responsibility in teaching technology education in Japan. The objectives of "Technology" are "To enable students to acquire fundamental and basic knowledge and skills related to materials and their processing, energy conversion, nurturing living things, and information

processing through practical and hands-on learning activities such as production, and to deepen understanding of the relationship between technology and both society and the environment, while also fostering the ability and attitude to evaluate and utilize technology properly." To accomplish these objectives, "Technology" teachers coach students in the following three areas [6].

1. Acquisition of basic knowledge and key concepts
2. The use of technology for working, constructing, and developing designs
3. The relationship between the technology and environment and society

Students' ability for developing a sustainable society is enhanced through "Technology" education.

Many programs exist on "Technology" in Japan to promote the students' ability. One of them, the national competition on wood working, occurs every year for junior high school students. In the competition, students use their knowledge and skills learned in "Technology" courses to design and create wood products. This competition aims to develop students' ability to assess technology. In addition, it fosters the students as human resources capable of contributing to society by working with others using technology [7]. The competition has occurred since 2001, and many students have applied their skills and knowledge to present creative and high-quality products. For the students, the experience of using their talents, together with their peers of the same generation, largely contributes to develop their problem-solving ability and creativity. The event and the products produced by the young competitor have been reported on several times [8, 9, 10, 11]. However, little has been said about the educational effects of the competition. To engage the educational effects of the competition, students are given instructions, suggestions on how to improve their work, and activities to prepare for competition in "Technology" classes.

This study focuses on two students who participated in the competition in January 2015 and examines the educational effects of the competition in terms of the design, the wood products, and their presentations.

## II. OUTLINE OF THE COMPETITION

The competition was held at the Shinkiba Tower in Tokyo on January 25, 2015. The 16 students had passed a prior examination concerning designs, wood products, reports, and process sheets to participate in the competition. On the day of the competition, they designed and created wood products in response to the challenge to create something that would hold "books and stationery and everything on my desk." Furthermore, they creatively presented their product to the judges. The judges, who comprised university teaching staff, school principals, and supervisors, evaluated the students' work, products, and presentations. Table 1 displays the outline of the competition.

## Ⅲ. EXAMPLE OF PRACTICAL ACTIVITIES

This chapter particularly observes two students who participated in the competition and introduced the designs, works, products, presentations, and their relationship with their teacher. These represent instances of problem solving.

Table 1. Outline of the program implementation

[The rules for the competition]
1. The time limit is 4 hours. As you work, keep in mind the time needed for each step. Especially, do not ignore the finishing process.
2. The materials are two Japanese cypress boards (t15×W200×L900) and a plyboard of basswood (t4×W450×L450). Except for these, clasp for jointing is allowed.
3. The finished product must measure 160 centimeters or less, which is calculated by adding together width–length–height.
4. The work process should include using a marking gauge with a square scale, cutting with a saw, parts processing with a plane, assembling with a hammer, and finishing with sandpaper.

[The presentation]
・Appeal of the practical use, design, and work procedure
・Per-capita allocation of time is 2 minutes

[The examination]
The completion rate, originality, design process, skill, attitude in the work process, and presentation. In addition, skills are assessed in terms of using a marking gauge with a square scale, cutting with a saw, parts processing with a plane, assembling with a hammer, and finishing with sandpaper.

*A. DESIGN*

In the competition, the challenge was to "Produce a product for books, stationary, and everything on my desk". The students designed the product features to solve problems they encountered in daily life. Table 2 lists the features that the two students devised. The students outlined the designs in the work process to solve their problems.

Student A found that textbooks, notebooks, box of tissues, trash box and iPad were placed different point in his room. Therefore, he had to go for these in each point when he wanted to use. He thought that this action was inefficient. In addition, He found that a few books fell using normal book-stand. So, He devised three functions to solve problems. Figs.1 display the designs outlined by the student A.

Student B found that his desk was always cluttered with reference books and notebooks. He thought the cause

Table 2. The function devised by two students

| Student | Function |
|---|---|
| A | ·Textbooks and clear file folders do not fall, can be taken in and out easily<br>·Box of tissues and trash box can be put in for compact storage.<br>·iPad can be taken in and out easily, can be used hands-free |
| B | ·Both large and small books can be stored<br>·The storage space changes based on the number of books<br>·The practical use is space saving |

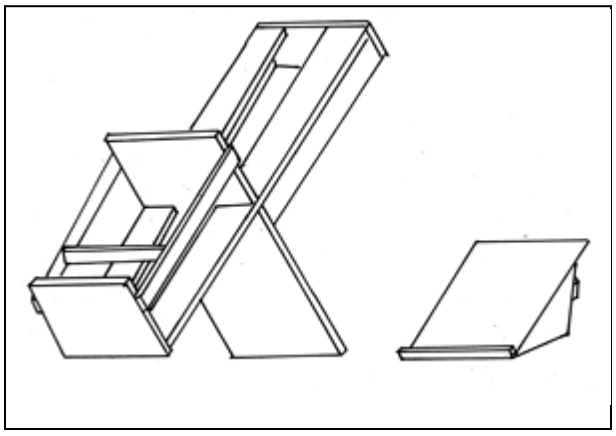

Fig. 1 The design by Student A

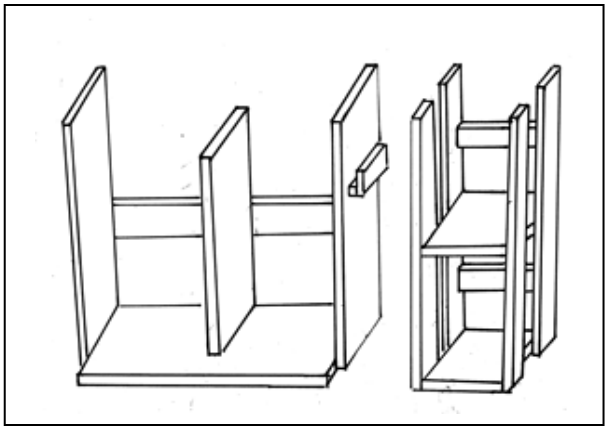

Fig. 2 The design by Student B

Table 3. The process sheet by the student

| PROCESS | MAIN WORK | TOOLS | POINTS OF ATTENTION |
|---|---|---|---|
| Marking | ·Mark line on materials | Carpenter's square | I must take a precise measurement. So, I write the marking-off lines with discretion. |
| Cutting | ·Saw across<br>·Saw Vertical | Saw | · I fix a material down with a clamp. |
| Processing | ·Plane butt end<br>·Mark a point of hole<br>·Make a prepared hole | Carpenter's square<br>Plane<br>Chisel<br>Hammer<br>Borer | · I plane butt end as priority.<br>· I plane while checking being perpendicular of butt end.<br>·I put wood not using under material when drilling |
| Assembling | ·Drive a nail<br>·Spread a woodworking bond<br>·Rabbet joint parts | Hammer<br>Square | 1. I assemble the part used for storing box of tissues.<br>2. I assemble the front parts. Next, I join side plate and partition plate with this.<br>3. I assemble the part used for storing iPad. |
| Finishing | ·Rub with sandpaper<br>·Chamfer the corners<br>·Erase the marking-off line | Plane<br>Sandpaper | · I rub the corner of front plate with sandpaper.<br>· I don't chamfer the corners too much. |

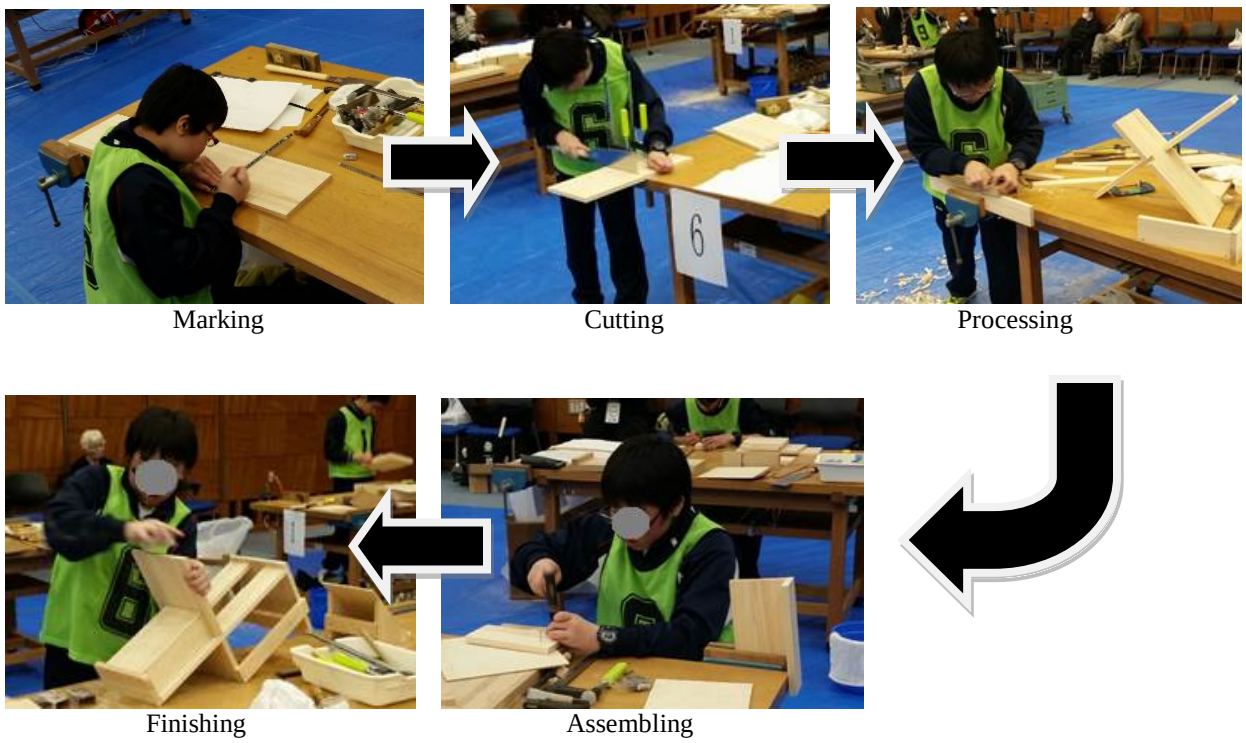


Fig.3 Activities of the student

that his rack could not store both large and small books. In addition, he felt that his desk had a space shortage for learning. So, he devised three functions to solve problems. Fig.2 display the designs outlined by the student B. In the design phase, the teacher asked the students a question instead of giving them an order. This approach difference is important to simulate student creativity. First, the students made rough sketches of their proposed products. Next, while the teacher looked at each rough sketch, he asked the students about the relationship between the problems in lives and features of their product designs. The teacher noted that the students discovered many ideas. Which caused them to revise the rough sketch many times. Finally, the students outlined the design for their product by adapting the rough sketches to conform to the rules of the competition.

*B. WORK*

The wood products were created using a carpenter's square, a saw, a plane, a chisel, and a hammer, based on the students' process sheets. Table 3 display the process sheet by the student. In the process sheets, the students described main work, a tool and a machine to use, and the points of attention for each step. In the assembling process, they used figures and a detailed description to summarize their work procedure. Furthermore, the students developed the wood-cutting graphs. In the wood-cutting graphs, they described the name of the components, finished dimensions, and the lines for cutting and finishing. In addition, the lines for cutting were marked to distinguish the cutting and finishing. The students worked using the process sheets and the wood-cutting graph for problem solving. Fig.3 display the activities of the student. They completed their products within the time limit. Fig.4 and 5 display finished products by the students.

Regarding the work, the teacher asked the students about effectiveness of the procedure for this work to introduce the use of a process sheet. The students thought about how to use the skills and knowledge learned in "Technology" classes most efficiently to make the process sheet. Once it was made, the students practiced working on their product based on the process sheets. To determine whether or not the students were actually more efficient and effective doing the work by following the process sheet, the teacher measured their work time till completion.

*C. PRESENTATION*

The students gave a creative two-minute presentation of their product to the judges. They delivered a talk regarding the problems in their life, the features they had designed to solve the problems, and future prospects with demonstrations using a prop and a placard.

Student A called his product "Large X." It has a compact size and can be used to store textbooks, notebooks, a trash box, and a box of tissues at a slant. Moreover, it is accompanied by an iPad stand that allows the iPad to be used hands-free. He designed the product for the user's maximum convenience.

Student B called his work the "Effortless rack." It could store textbooks and notebooks that were normally scattered on his desk. The product comprised big and small racks. The big rack had the small rack either built-in or external to it depending on the number of items being stored. The student designed the product to change according to the storage capacity desired by the user.

In the presentation, the teacher did not comment much. As the teacher valued what the students had to say about the production in their own words.

Fig. 4 Finished product by Student A

Fig. 5 Finished product by Student B

Table 4. Presentation by Student A

| |
|---|
| The title of the product is "Large X." It performs various functions and stores many items according to the user's needs. The items of my choice are textbooks, notebooks, a trash box, a box of tissues, and an iPad. First, regarding the storage space of books, a normal book cabinet has a basal plate parallel to the ground. In this case, the books fall if there are not enough of them. Thus, I put the basal plate at a slant with a little ingenuity. As a result, the books do not fall. Similarly, tissues can be plucked out in a breeze by putting the box of tissues at a slant. Additionally, unused tissues and trash on the desk can be dumped at once by putting the trash box like this. Finally, the iPad is easy to operate because the stand places it at a visible angle. Furthermore, it is easy to take the iPad in and out of the stand. These functions are just a few examples among many. This product can be used in various ways. I want to achieve great things by studying with "Large X." |

Table 5. Presentation by Student B

| |
|---|
| The title of the product is the "Effortless rack." It looks like a common rack on the surface, but it can change form depending on the number of books. It can be a small rack to store small books. The small rack is built into the big one if there are a few books; consequently, this product saves space. On the other hand, if the books are large and heavy, the small rack changes to an external rack. Therefore, the product has a large capacity for storage space. I came up with the idea for this product because my desk is always cluttered with reference books and notebooks. Although currently there are only a few books, I anticipate having a lot more later. Therefore, I would use this product with the small rack built in for now, and in the future, I will make the small rack an external rack. Through this competition, I see the need for devising products to solve daily life problems. When I grow up, I would like to be a creative problem solver. |

## IV. DISCUSSION

This chapter discusses the educational effects by examining the students' activities in the competition.

First, the students thought regarding the problems they faced in studying at their desk. They considered that their books were not organized due to differences in the book sizes. In addition, their personal belongings that they used with high frequency were not easily accessible on their desk. To solve these problems, the students outlined the designs of products they imagined. Shigematsu defined the design in creation as the process of pursuing things while making a prediction regarding solving problem [12]. Additionally, he defined design as a process of devising that changes something from the imagination into a work of creativity. The students imagined new product features to solve their real problems, and drew from these thoughts to create their rough sketches. After discussing the rough sketches with the teacher and outlining the design, the teacher asked them about the relationship of the design features and the purpose and its importance in fueling their imaginations. These questions led the students to improve their designs. It was considered that this combination of dialogue and action and the rough sketches and design outlines evoked students to more creatively imagine their process and product.

Next, the students outlined the process sheets. They described the necessary tools, main work, and points of attention in each step. In the description, they took advantage of the knowledge they had learned in "Technology" courses to explain each step. Nakato described the importance of "authentic understanding" in the creativeness process [13]. He defined authentic understanding as the continuous relation of various knowledge. Authentic understanding involves linking theoretical knowledge with real-world situations and putting it to practical use. For gaining authentic understanding, it is necessary to have an independent mind for learning. The students had a strong motivation to create their wood products using problem solving. Using the process sheets encouraged the competitors to incorporate their technology knowledge as they worked out the most effective proves to use in the competition. The teacher agreed that the process sheets enhanced their effectiveness so that the students could generalize what they already knew for use in other context by developing outline using the process sheets. We judged that their theoretical knowledge amounted to the continuous relation of various knowledge based on the process sheets they filled out. Therefore, they gained an authentic understanding.

Finally, the students completed their work through problem solving using the skills and knowledge they had learned previously. Thereafter, they gave presentations on the products they had designed to show how they had solved a life problem and might achieve innovative changes in the future. In regard to evaluating children's creations, Onda described that an idea's useful originality for oneself should be appreciated in the incubation of the idea and the work [14]. In addition, Maslow classified creativeness into "creativeness of exceptional ability" and "self-actualizing creativeness" [15]. Based on this doctrine, Onda discussed that the actions of creativeness of exceptional ability have new value for society; in contrast, actions of self-actualizing creativeness have value for oneself. Additionally, both sides have continuity, and deepening self-actualizing creativeness leads to creativeness of exceptional ability. Thus, Onda argued that activities that promote self-actualizing creativeness are important in education. As the teacher valued and promoted both types of creativity in his students and regarded self-actualization creativeness to develop exceptional ability being important for their future. It is clear that it is an advantage to have a teacher who leads students from such a place of personal consciousness. Therefore, the students' designs and presentations in the competition emerged as evidence that independent-minded problem solving is a creative act with new value. Based on the above-mentioned consideration, we believed that these activities enhanced the students' physical imagination, authentic understanding and self-actualizing creativeness. The competition gave students the opportunity to advance their various abilities.

## V. CONCLUSION

The students designed products and gained authentic understanding from the independent-minded activity. Furthermore, they completed their products using self-actualizing creativeness. Through this experience, they enhanced their understanding of the contents of junior high school "Technology" courses and applied their knowledge to a problem-solving situation. One former participant even enrolled in an authorial seminar to become a "Technology" teacher. Therefore, we presume that the competition contributed to the student's vision of a future self and authority for self-actualization.

Onda described the conditions for encouraging creativeness as students' having a receptive attitude, receiving reassurance, and having a positive relationship with their teacher [16]. In the future, we will examine the emotional relationship between the teacher and the student in the competition.

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