

Development of Auxiliary Implements for Fixation of Wood Piece in Hand Sawing Learning Implemented in School for Disabled Students

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This is a technological problem-solving project-based learning for students in technology education teacher preparation course to apply their knowledge comprehensively and upgrade their skills efficiently in making things (*monodsukuri*). The main task is to develop an auxiliary implements for the fixation of wood piece stably to help disabled students learn sawing operation by fully using their two hands. Magnetic holders were adopted in auxiliary implements as the side-stoppers and end-stopper, so that the wood piece can be easily and immediately fixed or released just by changing over switch to ON or OFF. The validity of the developed auxiliary implements was verified by putting it to trial for students in the Secondary Special Support School attached to Faculty of Education, Kumamoto University. Based on the responses to the questionnaire survey, the positive evaluation was obtained from their comments. "It is a very helpful tool for disabled students to overcome difficulties in wood sawing learning." "Training by using such functional tool is especially an effective way to stimulate students improving their literacy and mastering basic knowledge through active learning." Doubtlessly to say, the usefulness of this tool can also be extended to the ordinary elementary school students and unskilled junior high school students. From the standpoint of finding high quality practical hands-on activities for technology education teacher preparation, this project was successful in collaboration with the school attached to our faculty. The development of the tool to meet the specific educational needs provided a student-centered learning through experiencing the whole *monodsukuri* processes of motivation, designing, making and evaluation. This approach is an authentic application for pre-service teachers to develop and improve their capability in technological problem-solving.

Key words : technology education teacher preparation, technological problem-solving, making things (*monodsukuri*), woodworking teaching tools, auxiliary implements

1. Introduction

Technology Education teacher preparation is accentuated on upgrading their capabilities in technological problem-solving, because technology and society are always in a state of change. Good teachers must have technological abilities to develop new teaching materials and tools to help them present interesting and relevant information to students. Needless to say, hands-on activity, especially *monodsukuri* (making things) is the most efficient way to reach the goal of technology education teacher development. To offer the most comprehensive technology experience available, a project-based learning was carried out in collaboration with the Secondary Special Support School attached to Faculty of Education, Kumamoto University in the challenge of overcoming difficulties in working learning for disabled students there.

As well known, special support education is aim at realizing education meeting the needs from the students with

disabilities so as to develop their capabilities to the fullest extent and cultivate their ability to participate in various aspects of society as possible in the future. To match the individual educational needs from disabled students in the Secondary Special Support School attached to our faculty, a questionnaire survey was conducted to search a definite real-world problem-solving project available either to special support education and technology education teacher preparation. Based on the results obtained from the questionnaire survey, it was perceived that the necessity of improving the learning environment of gardening and woodworking, which requires the integration of real problems and the needs of technology skills. The impact of invention and innovation is the key to evaluate one's technological competence which is hard to be acquired without experience the path through clarifying objectives, brainstorming ideas, elaborating design concepts, drawing schematic diagrams, discussing and optimizing the structure,

obtaining enough tools, materials and supplies, making a trial product and evaluating the performance.

Continuing with the previous development of tools for gardening learning¹⁾, this study focuses on developing the auxiliary implements for supporting disabled students in the stable fixation of wood piece in hand sawing learning.

2. Development of auxiliary implements for fixation of wood piece in hand sawing learning

Based on the investigation on woodworking study in the Secondary Special Support School attached to Faculty of Education, Kumamoto University, the state of tools frequently used in making activities, and the demands for the tools with necessary functions were figured out.

Figure 1 shows how an end-stopper and two side-stoppers help disabled students to hold the wood piece during sawing. The side stopper was adjustable by turning the knob to tighten or to loosen the wood piece to be cut off. The difficulty was found in judging when to stop the knob turning for disabled students, especially in loosening operation. However, the end-stopper was screwed at a certain position immovably. So the nuisance for teachers is to screw the end stopper for students after changing of the cutoff length of wood piece every time, as it is too difficult for disabled students to remove and screw the end-stopper at the proper position by themselves.

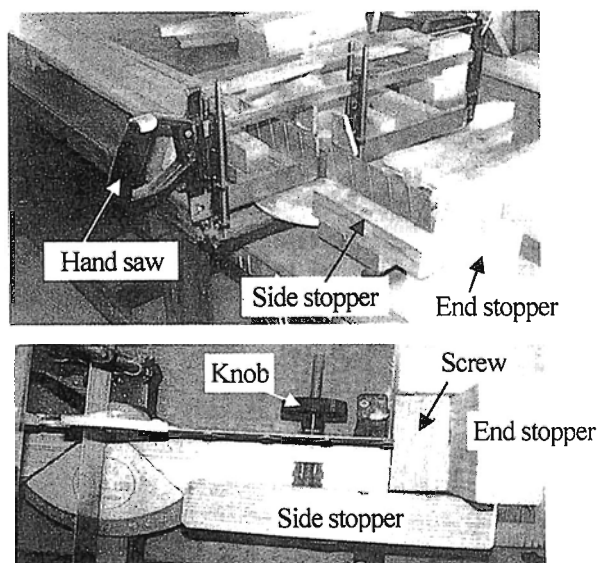


Figure 1 Fixation of wood piece in hand sawing

To improve the environment of woodworking learning for disabled students, the development of auxiliary implements for the fixation of wood piece easily and flexibly in sawing operation has been carried out. It was a problem-solving

project to train pre-service teacher in technology education through the whole process of making things including designing, building, and performance evaluation. A great sense of accomplishment and skill upgrading by interactive learning processes and valuable academic experiences can be achieved through such creative and integrated technology activities relating to the use of appropriate material, to broad array of materials and products.

The key concepts in developing the auxiliary implements used for fixation of the wood piece in hand sawing learning are summarized as follows:

- some unique and new technology to be adopted in;
- an adjustable fixation system adapting to various dimension and cutoff length of wood piece;
- convenient operation suitable for learners;
- a useful tool in heightening learners' autonomy;
- a meaningful experience in improving learners' literacy, interests, aptitudes and measuring skills, etc.

Taking it into account that the range of hand saw is 200 mm in width and 105 mm in height, the developed auxiliary implements was designed to be available for cutting the commercial dimension lumber in cross section of 4 inch by 10 inch (89 mm x 190 mm) or smaller.

Figure 2 shows the diagram of auxiliary implements for the fixation of wood piece in hand sawing learning. Two steel plates were installed on two parallel wooden crosspieces. A scale fixed on to the steel guide way functions as a simple measure for determining the length of wood piece to be cut off. Magnetic holders MB-PG, made by the Kanetec Corp., were used as the side-stopper and end-stopper to fix the wood piece firmly. Although the adsorption power of the magnetic holder is 1500 N, rubber skid sheets were attached on both sides of magnetic holders (Figure 3) to prevent slippage by increasing the friction resistance along the contact boundaries between stopper and wood piece for safety in hand sawing. Magnetic holder can be fixed and released easily just by changing over the switch to ON or OFF position, which enables teachers free from screwing up the end-stopper frequently when the cutoff length of wood piece changes.

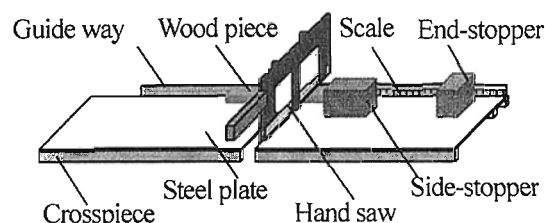


Figure 2 Diagram of auxiliary implements for fixation of wood piece in hand sawing

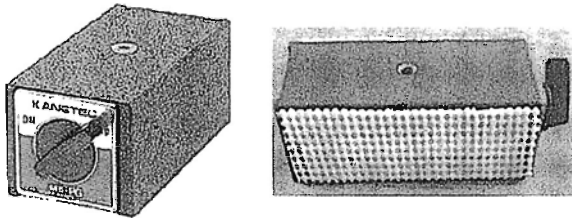


Figure 3 Rubber skid sheets attached on both sides of magnetic holders to prevent slippage during sawing

3. Results and discussion

To verify the effectiveness of the developed auxiliary implements for fixation of the wood piece in hand sawing learning, a trial use was performed by the students in the Secondary Special Support School attached to our faculty.

The magnetic holder used as the stopper for fixing the wood piece aroused students' great curiosity. They enjoyed setting it actively, and challenged to adjust the proper position of the end-stopper carefully according to the cutoff length of wood piece by themselves (Figure 4).

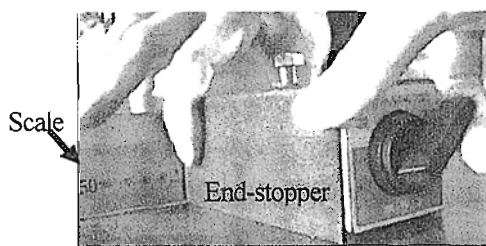


Figure 4 Setting the end-stopper carefully according to the cutoff length of the wood piece

Even though it took time for them to set the stopper at an appropriate position, it is meaningful training in special support education. The observation reveals that the introduction of the auxiliary implements improved the environment for students with an active learning instead of working just by rote. They have gotten to understand the importance of dimension through ensuring the cutoff length of wood piece for sawing. These activities led them to be able to organize all of the operations step by step independently.

One feature of the developed auxiliary implements is to expose disabled students to unique technologies so that they would experience how to apply and master the useful tools. To meet the special needs for disabled students in woodworking learning, the new auxiliary implements not only enables the setting of the magnetic stoppers just by one-touch conveniently but also satisfies the diversity of the wood piece in different dimensions and cutoff lengths. This

flexible and reliable system could fix the wood pieces with different sizes exactly and firmly by using one end-stopper and two side-stoppers as shown in figure 5, which secures the safety for disabled students in sawing learning definitely.

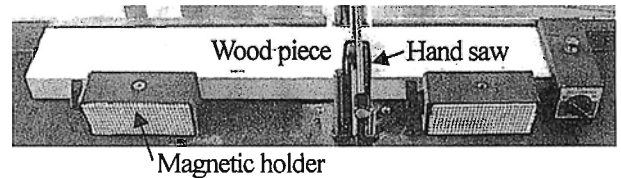


Figure 5 Fixation of the wood piece stably for hand sawing

As a helpful tool with variable fixation system of wood piece to support disabled students in woodworking learning, the additional function of dimensional measurement plays a great role in motivating them to be autonomy and to take part in learning fully and actively.

The evaluation of the developed auxiliary implements was also carried out by executing a questionnaire survey among teachers in the Secondary Special Support School attached to Faculty of Education, Kumamoto University. The survey contents are as shown as follows:

1) Do you think the developed auxiliary implement for fixation the wood piece in hand sawing learning is useful for your students?

2) Do you think the developed auxiliary implements is efficient in woodworking learning?

3) Would you please describe the resulted educational advantages in details?

4) Do you think it is possible to motivate students by using such auxiliary implements? If your answer is yes, please let us know the changing of students' attitudes in details?

5) What do you think about the capabilities for disabled students to acquire through working learning by using some auxiliary implements?

Based on the feedback of the questionnaire survey from the respondents, a positive assessment of the developed auxiliary implements was obtained from teachers in Secondary Special Support School attached to our faculty, and as summed up as follows:

The introduction of the auxiliary implemrnts for fixation the wood piece enables the leaners shaked themselves free from working by rute, which led them to callenge the whole hand sawing process independently, i.e., setting the stopper properly to ensure the accurate cutoff length and adapt to the changes of wood piece's dimmensions accordingly.

The students' attention has been engaged by the unique auxiliary implements so that a significant effectiveness has

been perceived in stimulating and enhancing student's interest in working learning.

The educational effectiveness in special support education was evident from the remarkable improvement in students' attitude to full participation of the leaning activities. They competed with each other and encouraged each other which livened up the enjoyable learning environment.

From the standpoint of providing a meaningful preparation for technology education teacher, this fundamental approach of making things fostered the pre-service teachers understanding of material science and structural engineering, upgraded their drawing, designing and processing skills, and developed their capabilities in technological problem-solving.

4. Conclusions

This joint research on technology teacher education and special support education deals with a development of auxiliary implements for woodworking learning.

Generally, special support schools aim at giving students education suited to their individual needs, as the learners there are mentally retarded, or physically disabled, or health impaired. To realize the equal opportunity education, the key is to develop the potential of individuality and extend capabilities of each student which can be guaranteed participation in activities at school, then get ready for participation into society independently in the future. Therefore, different from sedentary learning, working learning is more focused on improving the skills and capabilities of disabled students for their future social participation independently through special support education.

On the other hand, to reinforce the capabilities of pre-service teacher in technological problem-solving, a project-based learning through experiences of making things was carried out in technology teacher preparation course. It is a whole process training of designing, decision making, processing, modification, trouble shooting and performance evaluation.

This study herein is an achievement of collaboration with the school attached to our faculty that are beneficial to mutual needs in technology teacher education and special support education. To improve the woodworking learning environment for disabled students, the development of an auxiliary implements has been conducted for the fixation of wood piece in hand sawing learning. The generality and functionality of this developed auxiliary implements enables

the fixation and the releasing of the wood piece easily and immediately just by one-touch handling. The essential feature is the using of magnetic holders as the side-stoppers and end-stopper which can tighten or loosen the wood piece flexibly irrespective of the dimension and cutoff length of the wood piece.

The effectiveness of this development was verified by put it to trial in the Secondary Special Support School attached to the Faculty of Education, Kumamoto University. Based on the feedback of the questionnaire survey from the teachers in Secondary Special Support School attached to our faculty, the usefulness and effectiveness of the developed auxiliary implements in special support education has been evaluated. Especially, the equipped scale along the guide way played an important role in encouraging disabled students to take part in working learning actively and independently.

This project-based learning provided opportunities for pre-service teacher to challenge with exciting hands-on activities that cover a variety of areas in technological problem-solving. Such experiences help shape the student's attitude about activities process learning which engaged and motivated students to heighten their confidence in the future career they will explore.

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References

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