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A Study of Developing the Practical work Integrated the Course of Study in Upper Grades

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ABSTRACT

Recently, the tendency for young people losing interest in science has accelerated. This tendency is remarkable for not only Japan but also some countries of Asia. It is thought that this tendency was brought from the decrease of the chance to watch the actual manufacturing activities, and the decrease of the real experience which children makes something in their childhood. In order to bring up the capable engineers on such a social background, making a product practice which promotes the understanding of the application of theory for manufacturing products is important in addition to study by the text book. In this study, some practical work materials for the lower grades in the college were developed. Integration of the developed materials and the course of study becomes an effective teaching method of the of subjects on a special field. Arranging this practical work on the learning process makes a high effect of the integrated practical work on the curriculum.

Keywords: Engineering Education

I. Introduction

One of the reasons that young people keeps away from making a product or losing interest in science is an insufficient physical experience of mechanical things since children's primary education. With what kind of toy, how to play? That childhood play but it causes a significant impact on school age academic performance. As a result of declining birthrates and spreading Information Technology the children's environment has greatly changed, from the 1990s. Due to low birthrates the playing of children in groups has sharply declined. It has increasingly become common for children to play alone with toys at home. Furthermore even those toys have greatly changed since the 1990s. Children play with toys that comprise of very few mechanical parts with a simple structure such as an electric mini car(mini 4 wheel drive). These toys are disassembled and they comprise of very few mechanical parts such as gears, they mainly comprise of electric circuit boards and motors. And also a significant number of children are playing with video games before the school age[1, 2].

On the other side, In Japan due to pressure-free education in compulsory education the science and mathematics academic performance of students has fallen remarkably. Lack of basic knowledge of technical education, the high rate of advancement to the next higher level of education and low birthrate, moderate number of students with a weak desire for learning is enrolling in colleges and universities. In the mechanical engineering lessons of colleges and universities compared to the existing such as control, information and simulation technologies the required content of study is increasing steadily than before. In addition, in universities and colleges not only research, development and capability training but also capacity development of comprehensive manufacturing is required. The development and improvement of the education methods to enable the learning of mechanical technology in a limited period of time has become an important issue3).

Then the author propose to integrate the contents of the practical work and lecture of the specialty subject, and introduce an example that develops the educational

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materials for making a product that can promote the understanding of students.

II. Problems of generally making a product in practical work

There have been many reports about general making of a product for practical work for lower grades as an introductory education. However, there are several problems about these reports and these problems are explained below.

1) The student requires the skillfulness of the machine tool.

The process of making a product by students cannot at least avoid assembling of a number of parts. The manufacturing of these parts requires machinework of metals. These parts need to use machine tools, and also some skills for operating the machine tools by student even lower grades is required. Also, students can not do high precision processing, complex shape, and special materials such as hardened steel, rubber, and ceramics etc.. At last, in some cases the students can not complete the product that they proposed and designed.

2) A lot of time is required for machining of parts. The training time is limited, but students take much time making the product after school. Training factory management, such as safety control of student's working hours are difficult. The selection of training education materials needs to take student's manufacturing time into consideration.

3) Special facilities in manufacturing is required.

The product that needs special machine tools such as LASER machine, and special tools can not be used in manufacturing in many universities and technical colleges.

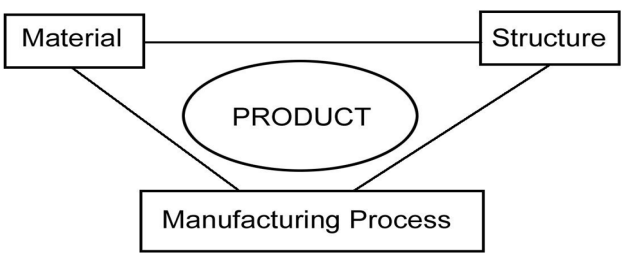


Fig. 1 The relation of a product(quality), structure, material, and a manufacturing process. The concept which student should learn first as foundations of craftsmanship

4) Quantitative evaluation of products is required.

Fig.1 shows the necessary requirements as a desirable comprehensive teaching material in engineering education. In compressive manufacturing training, it requires to understand that raw materials, structure, process depend on product feature and quality. The concept that students understand first in practical work is function and quality of a product and it is depends on it's material, structure and manufacturing process.

The target of comprehensive manufacturing training in general practical work is the production of parts with many kinds of production methods. The students can understand the relationship of the product in Fig. 1, that means materials structure and a manufacturing process that gives the quality of product by manufacturing the product which consists of many parts. The difference of the product's function and quality is not evaluated in most reports. The student's product must be evaluated numerically based on engineering. The developed teaching materials of making product can not practice at several college at lower grades from these problems[4, 5].

III. The necessity for integrated material of practical work

In this chapter, the necessity of developing from the so far existing general practical work to integrated manufacturing is described. The author indicates the problems in most of the reports of the so far existing manufacturing training in lower grades.

First of all, in the materials for making a product in practical work there is need to attract attention and interest of students, and there is need to promote the student's production will. As a result of emphasizing this point, there are problems such as:

1) There are cases in which the contents which students experience in practical work and the curriculum in the upper grades do not relate.

2) Although they are practical work for mechanical engineering courses, most of the knowledge of making a product involves a relation of knowledge of material engineering or there are cases in which production can

be made with only knowledge of control engineering.

Secondly, even with reports of coordination between practical work, experiments and lectures as a placement for lecture complement, practical works, experiments and lectures are advanced at the same time and carrying out an arrangement of confirming with after lecture practical works or experiments. As a result, without giving consideration to education contents in upper grades the practical work in lower grades is completed with the production that does not include engineering analysis

Then, the author proposes the necessity of an integrated training in order to improve these problems. On considering learning efficiency, there is need for a relationship with as much as possible special subjects in the upper grades. However within a limited period of time compensate for student's shortage of basic knowledge and lack of experience and there is need to make them understand advanced educational contents.

Therefore, ignore the array of learning contents from the easy to the difficult, and accept many learning content at special subjects of course of study on practical work in the lower grade. The learning contents even if the lower grade student have not studied can promote to stimulate and understanding of the concepts by considering the three points.

1) Present learning content such that student can understand directly by seeing and listening.

2) Without using mathematical formulas use a simple chart.

(3) Present technical terms.

Students in the lower grades cannot deeply understand high level learning contents but getting a feeling of the contents to be studied in the future can give them an expectation of the study in the upper grades.

IV. Proposal of the development method for educational materials for practical work

Students pass through the following three stages of order before acquiring knowledge.

1) Realization of the problem: Students know the learning target.

Traditionally, out of the various experiences from their childhood and boyhood plays students have been getting a learning target. The unit learning in compulsory education as a result of first presenting the topic for the teaching unit students had realized the problem concerning what to study. It is important as a motivation for learning of specialty subjects.

2) Understanding of learning items: Understanding systematically the learning target.

Traditionally, students used to get learning items through various learning forms such as reading and attending lectures. In compulsory education students understand while repeating the learning units. In other words, in technical education it is important to understand these learning items and at this stage it had played an important role in colleges and universities. But in recent years students by only attending lectures the understanding has become insufficient.

3) Fixation of knowledge: Execute and practice the understood items and put them into application.

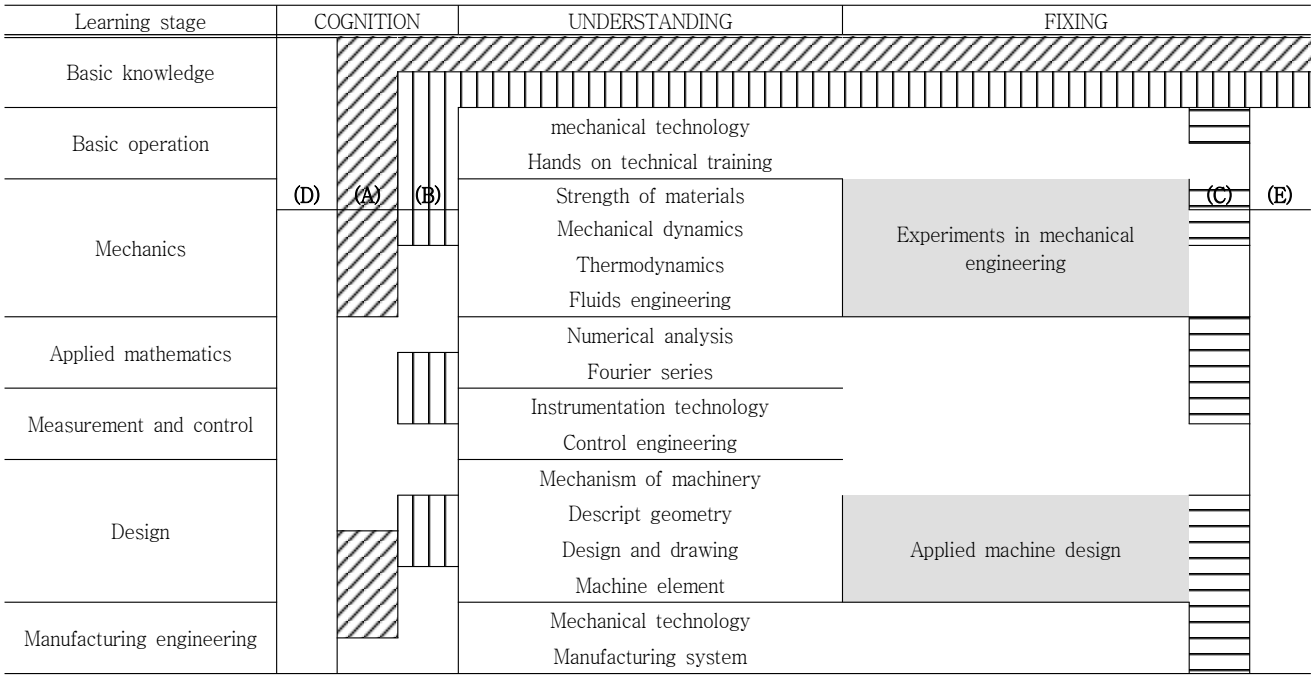
Traditionally, experience by students such as actual use of the machine, assembly and dismantling was providing fixation of knowledge. Recently, this experience is only lacking in graduation research.

The author shows the development methods for learning materials by raising several examples. At the time of developing learning materials, distribute the learning materials you are trying to develop into the previous three stages of the learning process and it is important to make clear of the relation with the specialty subjects.

In table1 the author shows an example of a manufacturing training he developed in mechanical engineering. First of all, inside the table(D) is an example of an already existing subject.

Currently, it is a layout for introductory education implemented as basic mechanical education in most colleges and universities. In his school it is offered as fundamental mechanical system engineering. The teachers of specialty subjects are lecturing the basics of their research regions in away easy to understand. Traditionally, this content used to be sufficiently completed by personal experience of each individual before admission. Students of recent years due to scarcity of mechanical technological

Table 1 Location of developed material on learning process



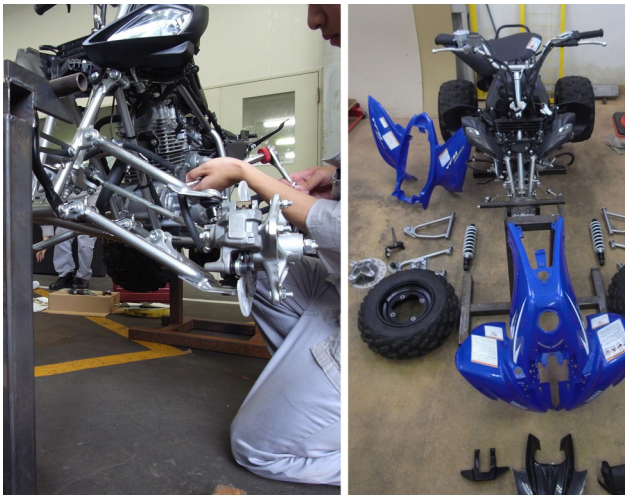
(A) Dismantling and Assembly using All Terrain Vehicle(Fig. 2(a))
(B) Making violin(Fig. 2(b))
(C) Making the digital model of violin(Fig. 2(c))
(D) Fundamental mechanical system engineering
(E) Graduation research are covered with many knowledge on subject and all learning stages.

experience before technical education, it is necessary as an introduction to specialty subjects and motivation for learning. Therefore it can be placed as the recognition for the learning purpose. The main purpose is to expose them to regions of specialty at an early stage.

Three examples that were laid out for the development of manufacturing training the author developed in mechanical engineering are shown. First of all (A) is a lay out of a learning process for assembling and dismantling the four wheel all-terrain vehicle in the lower grades training. Diagram 2 shows the situation of the training. This training relates machine's fundamental operation, mechanical dynamics, design and working method. Furthermore, specifically as a specialty subject it can relate the machine working method, material dynamics, mechanical dynamics, thermodynamics, fluid dynamics, mechanisms, mechanical drawing, mechanical elements and machine working methods.

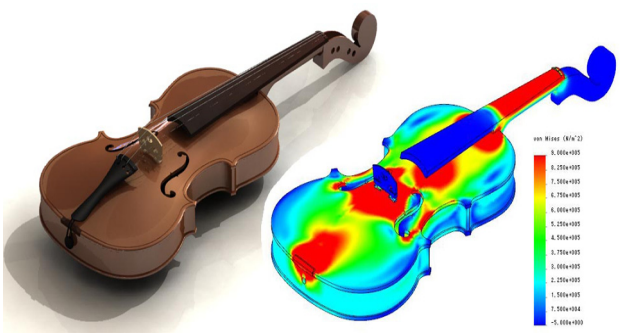
Next the author laid out the learning process for the production training of the violin in(B). (Diagram 3 shows the photograph that relates to the production). At the same time it relates to most of specialty subjects. The characteristic of this teaching material is that as a result of being a wooden processing the processing time is reduced and high level of completion is achieved. Furthermore, with frequency analysis of the tone quality of the violin, the training product can be evaluated and you can be able to get a feeling of specialty subjects such as the Fourier series. In this second example from the basic educational point of view, realization, understanding and fixation a characteristic that entirely covers all the learning process. And again the digital model production for the violin that uses the 3D-CAD for the violin in (C) is carried by FEM analysis of the violin.(Diagram 4 shows the analysis result). Not only as a drawing for a 3D-CAD applied task but by carrying out the engineering analysis method “the FEM analysis” there is an advantage of analyzing the fault at the time of manufacturing the violin.

As characteristics for these development cases the following items are mentioned. According to students by making things that they have interest in a learning target they



(a) The practical work using ATV

(b) Making violin



(c) The FEM analysis using the digital model violin

can draw high motivation towards mechanical engineering and get a realization of specialty subjects. Than in the lower grades training by giving them a feel of the contents of most specialty subjects it promotes their understanding of specialty subjects. Fixation had been done in the traditional engineering experiments but in recent years integrations of knowledge such as PBL are needed.

V. Conclution

In the development of training materials in lower grades the importance of integration with lectures in high grades was proposed. Showing with a development example a development method was proposed. A summary of the main points of the development method are as follow;

1) In development of training materials there is no necessity of covering all the stages of the learning process with a single training material.

2) For purposes of problem awareness and fixation of the learning process there is a need to develop training materials in the lower grades.

3) In order for students to recognize the general academic system for mechanical engineering it is desirable to include most of the study items in training materials.

4) At the time of carrying out a development or an improvement for integration of general training and specialty education it is important to make clear of which stage of the learning process the training content is improving.

5) By developing suitable training materials for every stage of the learning process an integrated training with high results can be obtained.

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