ENGINEERING EDUCATION THROUGH OFFICE HOURS FOR MANUFACTURING
(MONODUKURI OFFICE HOUR)

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Abstract

To improve students’ skills at manufacturing, introductory manufacturing education has been introduced for all departments at Akita National College of Technology since 2006. Survey results conducted for first and second grade students indicated that more than 50% of students thought that manufacturing education was quite useful for their departments and wanted to manufacture on their own in the future. However, about 50% of second grade students have lost interest in manufacturing. Therefore, we have introduced Monodukuri office hours (office hours for manufacturing) as an after-school activity. Results show that Monodukuri office hours have gradually increased students’ interest in manufacturing.

Keywords: manufacturing skill, introductory manufacturing education, Monodukuri office hours

Introduction

To improve students’ manufacturing skills, introductory manufacturing education was introduced for all departments’ first grade students at Akita National College of Technology (Akita NCT) in 2006. Currently, according to syllabi of colleges of technology in the Tohoku region, two college education programs have introduced similar manufacturing programs to those of Akita NCT. Sendai National College of Technology – Natori offers a similar class in its Department of Material and Environmental Engineering. Ichinoseki National College of Technology has manufacturing laboratory practice in all departments. Results of a survey administered to first and second grade students indicated that about 50% of second grade students have lost interest in manufacturing. Therefore, in an attempt to improve student interest in manufacturing, we have introduced Monodukuri office hours (office hours dedicated to manufacturing) as an after-school activity. Results show that student interest in manufacturing has been increasing steadily.

Nationwide, reports have described that manufacturing education consists of different classes of the school year (Honmura et al., 2008) and reports on education have addressed lower grade education and graduation research projects (Yoshida et al., 2008). Nevertheless, no example of education combining manufacturing and office hours has been reported yet in the relevant literature.

This study clarifies the effects of Monodukuri office hours on education, conducted as an attempt to improve student interest in manufacturing.

Manufacturing education in workshops

At Akita NCT, manufacturing education is offered in first grade for all departments. Mechanical engineering, electrical engineering, chemical engineering, and civil and environmental engineering are respectively denoted herein as 1M, 1E, 1C, and 1B.

After safety education and guidance, the contents of education in workshops include manufacturing spinning tops using a lathe (lathe), manufacturing pen holders using milling machines (milling machine), making a picture stand by hand-finishing work (hand-finishing work), and making small boxes using sheet metal work (sheet metal work). Figure 1 presents the appearance of manufacturing processes in a workshop.

Fig. 1 Manufacturing processes in a workshop.
Manufacturing education has been done at the Practice Workshop and the Manufacturing Technology Practice Center. The teaching staff comprises five technical staff members of the Technology Education Support Center and one teaching staff member selected from each department.

**Survey results for manufacturing education**

In August 2009, a questionnaire survey related to manufacturing education was administered to first and second grade students who attended manufacturing education when they were first-grade students. Questionnaires were administered respectively to 1M, 1C, 1B, 2E, 2C, and 2B. About 40 respondents’ answers were obtained from each class. The obtained results are presented in Figs. 3–7.

Results of surveys are summarized as follows. In Fig. 3, responses to a question about the relation between manufacturing and each department specialty are shown. For each first grade class, about 95% (M Dept.), 70% (C Dept.) and 85% (B Dept.) of students think manufacturing education is useful for their specialty, but these results decrease to about 50% for second grade students. From this figure, for first grade students, we can readily recognize that not only mechanical...
department students but also other department students regarded manufacturing education as quite useful for
their department and for becoming professional engineers. However, that percentage decreased in
second grade, probably because students at that stage have mastered basic experiments and practical training
in each department, and there are fewer opportunities to
demonstrate manufacturing technology.

Particularly, the results of 2C and 2B in Fig. 3
indicate that about 50% and 70% students do not regard
manufacturing as useful for their specialization. This is
regarded as a serious problem. Figures 4–7 show
comments and opinions related to the future of
manufacturing after attending manufacturing education.
From Figs. 4 and 5, more than 75% of first grade
students want to manufacture items on their own, and
about 70% of them want to manufacture even more than
second grade students do. However, when they become
second grade students, the percentage has shrunk,
perhaps because the second grade students’ interests are
directed to subjects in which they have specialized. In
addition, because there are fewer specialized subjects,
differences in first grade did not arise among
departments. Figure 6 shows that about 50% of all first
and second grade students want to use the Workshop
and the Manufacturing Technology Practice Center
outside of class time, as an after school activity. From
Fig. 7, we can easily notice that the students desire a so-
called support system, judging from a high rate of
answer A or B in the questionnaire in Fig. 7. Figure 7
shows the total number of people giving various
responses.

Outline of Monodukuri Office Hours

Survey results show that about 65% (M Dept.), 60%
(C Dept.), and 50% (B Dept.) of students want to use
the Workshop and the Manufacturing Technology
Practice Center outside of class time. However, about
50% of second grade students have lost interest in
manufacturing by that time. Therefore, we have
introduced Monodukuri office hours (office hours for
manufacturing) from 5–6 pm every Wednesday as an
attempt to improve student interest in manufacturing.
This approach designates so-called office hours during
which students can receive guidance or actual machine
tool manufacturing consultation.

Manufacturing Technology Practice Center

The manufacturing education described above was
performed mainly in the workshop during class time.
However, Monodukuri office hours are held at the
Manufacturing Technology Practice Center outside
school hours. The Manufacturing Technology Practice
Center has various machine tools as presented in Fig.
8, for instance, two manual-type small lathes, three
bench drilling machines and a manual-type small
milling machine. As cutting tools, there are three bench-type band saws, a middle-type band saw, a shirring machine, and a high-speed precision cutting machine. Furthermore, there are a work table for finishing work, a bending machine for sheet metal, a vacuum experimental apparatus, and constant temperature laboratory equipment. Using these machine tools, students can attempt more varied machining and manufacturing work than ever before.

Details of Monodukuri Office Hours

The Monodukuri office hours were performed at the Manufacturing Technology Practice Center. Teaching staff include four robocon supervisors (teacher) selected from each department. Not only teachers of M Dept. and E Dept., but also the teachers of C Dept. and B Dept. have joined as instructors for Monodukuri office hours, and students of each department are familiar with using the Manufacturing Technology Practice Center. Moreover, we are able to correspond not only with manufacturing by machine tools and electronics workshops, but also with pottery using an electric furnace, and so on. To have use of the Manufacturing Technology Practice Center during Monodukuri office hours, we have been dealing with machining work by lathe and milling machine as well as puncture repair of bicycles and consultations about the repair of personal computers, which are not treated in the manufacturing education in the workshop. As public relations activities,

Table 1  Actual use result of Monodukuri office hours (Apr. 2010–Mar. 2012)

<table>
<thead>
<tr>
<th>Contents of consultation</th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair of a personal computer</td>
<td>4</td>
</tr>
<tr>
<td>Repair of a bicycle</td>
<td>13</td>
</tr>
<tr>
<td>Puncture repair of a bicycle</td>
<td>13</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
</tr>
</tbody>
</table>
we put up a poster of Monodukuri office hours in each classroom (Fig. 9).

Table 1 shows actual use results of Monodukuri office hours. As shown in this table, many students use Monodukuri office hours for repairing bicycles (used for commuting to school). To date, the actual use of Monodukuri office hours has amounted to more than 30 instances, even though opening hours are late for many students.

During Monodukuri office hours, teaching staff only give advice and help students. Students must fundamentally prepare the materials in advance. Repair and maintenance work must be done on their own.

As an example of Monodukuri office hours, a student came to the Manufacturing Technology Practice Center to repair a broken carrier of the bicycle. Figure 10(a) shows the bicycle carrier with the break. The teaching staff member (teacher) consulted about it with technical staff of Technology Education Support Center. According to the advice of the teaching staff, it was to be repaired completely with welding work. Initially, the student thought of repairing it on his own. However, because he joined the IC class, he was not taught how to do welding work. Therefore, the welding work was done by technical staff (Fig. 10(b)). As in this case, work and technical guidance for students are done by professional technical staff instead of teaching staff.

Figures 10(c) and 10(d) portray students repairing the back-light of a notebook PC and repairing a bicycle puncture independently.

Although the actual instances of Monodukuri office hour use are not many (34 times in two years), this effort is an attempt to improve student interest in manufacturing, especially for students who have difficulty operate machines, students who are not interested in making things themselves, etc. Based on these results, we inferred that students’ interests in manufacturing have increased gradually.

Recently, student members of the robot contest club, who designed and manufactured robots for competition, and the motor vehicle club, who designed and manufactured solar cell vehicles and fuel cell vehicles, have come not only from M Dept. and E Dept., but also from C Dept and even B Dept. Moreover, in open lectures teaching students how to design and make model airplanes and trying to fly them held at the Mechanical Engineering Dept. of Akita NCT. In Aug. 2009, there were some C Dept. and B Dept. students serving as teaching assistant students. Until that time, such students were almost all M and E Dept. students. These results clarify that the effect of introductory manufacturing education and Monodukuri office hours on the students’ interest in manufacturing has increased.

Conclusion

Examples of applications of current cases of Monodukuri office hours were introduced in this paper, and the outline and details of Monodukuri office hours were explained.

Initially, to improve student interest in manufacturing, we introduced Monodukuri office hours (office hours for manufacturing education) in after-school activities. Results show that student awareness was improved, and that student interest in manufacturing has been increasing steadily.

Not only for M Dept. students, but for all students, manufacturing education using machine tools has become the foundation of basic manufacturing. Students can experience difficulties and enjoy their time through manufacturing education. They can become engineers with multifaceted ideas related to their department specialties.

We hope that, through manufacturing education and Monodukuri office hours, many students will become familiar with manufacturing, and will take advantage of that knowledge graduate research projects and their work after graduating from our school.

References
