Introduction of Design Project to Enhance Student Motivation in Engineering Education

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Abstract

Kanazawa Technical College (KTC) is a 5-year educational institution that focuses on experiential learning. The subject that the student studies at KTC has both general and technical classes. As students advance, general classes fade out, and they take more technical classes until their schedules look like those of college students. Because manufacturing skills are scarce, students in lower classes cannot yet fabricate a complex work. Basic studies needed for students to acquire the skills lower students' motivation, at times. Then, a papercraft project was introduced that could be executed even by low-skill students. As a result of the activity in this design project, students thought more deeply and their motivation rose. In addition, students were able to improve their planning and management abilities.

1. Introduction

Kanazawa Technical College (KTC) is an intensive 5-year educational institution that focuses on experiential learning. In their first year, students take general subjects, hands-on courses, and technical classes related to their major. The general subjects are those typically found in any high school around Japan, and these are given a strong emphasis in the early years. As the students advance, these topics fade out, and students take more technical classes until their schedules look like those of college students. Throughout all five years, there is a consistent proportion of hands-on classes in which students practice what they are learning from both their general and technical classes to create real things.

The Electrical and Electronic Engineering Department follows a hands-on curriculum in which students create projects ranging from LEGO robots to electric go-karts in order to learn the skills necessary for an electrical engineer. In the fifth year of study, students perform a capstone project that spans the entire year. Many of the projects are hands-on activities for system manufacturing, robot manufacturing, and program creation. Because manufacturing skills are scarce, students in lower classes cannot yet fabricate a complex work. However, the basic training provided in lower classes is necessary and indispensable to the process of acquiring manufacturing skills and experience. In addition, it is necessary to train students to acquire management skills that can encompass the entire manufacturing process.

To solve this problem, a new design project was introduced. In fiscal year 2013, the plan and the management of a papercraft course for schoolchildren were executed. Expertise is not required for the papercraft. To please schoolchildren, students designed a papercraft school bus using an illustration popular with children. Students taught a handicraft course to local schoolchildren using the designed papercraft.

In this paper, we first describe the educational system in Japan. Next, the curriculum of KTC is described. Finally, the papercraft project introduced to students of lower-level classes is explained.

2. Japanese educational system and education at KTC

2.1. Japanese educational system

First, the context of KTC within the Japanese educational system is explained. Figure 1 shows a diagram of the Japanese educational system. [1] [2] Education is compulsory from elementary school through junior high school. Many students who finish the compulsory education go on to high school. KTC is a college of technology, which is a special kind of school in Japan that is different from technical colleges in other parts of the world. A college of technology provides graduates with an associate's degree upon graduation, but that degree also includes three years of high school. Thus, when students complete junior high school, they choose to enter either a high school or a college of technology. Literally translated from the Japanese, a college of technology is a "specialty high school," and, as such, it offers a 5-year intensive study curriculum that integrates the general education of a high school with the specialized technical training of a vocational school. These schools are accredited as institutions of higher education by Japan's Ministry of Education. KTC guarantees 100% job placement for all of its graduates. However, not all students choose to enter the workforce immediately. Thirty percent of our graduates transfer to a university in their 2nd or 3rd year, depending on their chosen field of study.

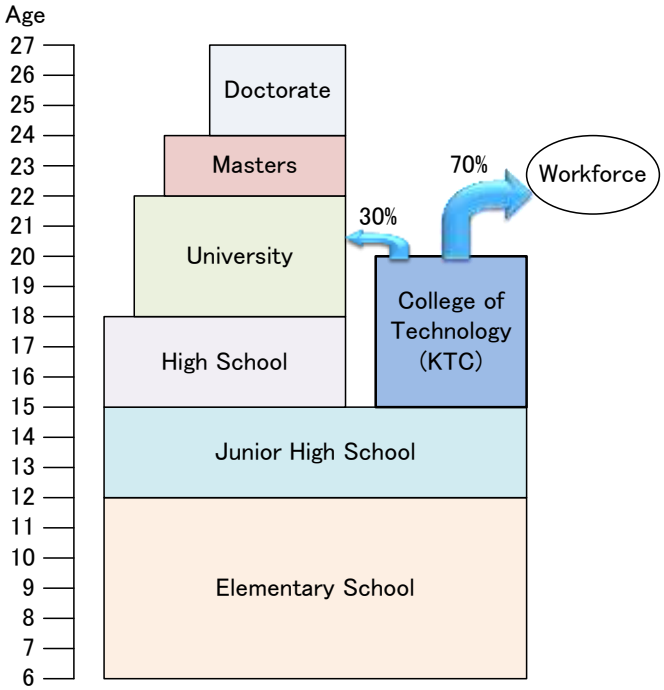

Figure 1. Japanese educational system.

The college of technology system was founded in 1962 during a time of strong economic growth in Japan. Industry, at the time, had a strong demand for new hires with a set of technical skills that could be put to work immediately without requiring the 3 months to 1 year of training that is typical for college graduates. [3] KTC, established in 1962, is one of the oldest private colleges of technology.

2.2. Curriculum at KTC

The structure of the 5-year curriculum at KTC is shown in Figure 2. Beginning in their first year, students take general subjects, hands-on courses, and technical classes related to their major. The general subjects are those typically found in any high school in Japan, and they are given a strong emphasis in the early years. As students progress through the curriculum, these topics fade out, and the students take more technical classes until their schedules look like those of college students. Throughout all 5 years, there are

hands-on classes in which the students practice what they are learning in both general and technical classes to create real products. These classes bring together general and technical concepts and allow students to see how the concepts are applied in practice.

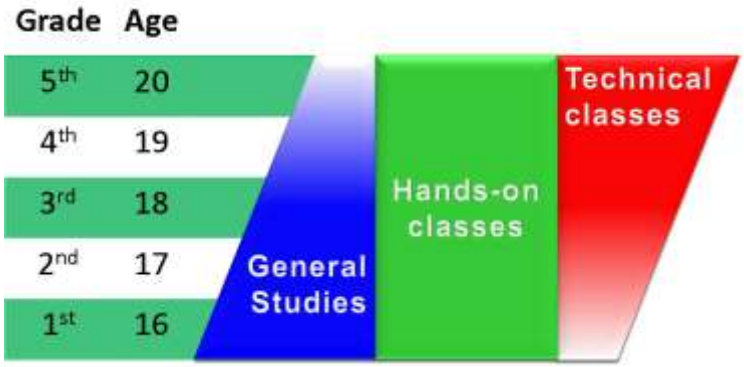

Figure 2. The structure of the 5-year curriculum at KTC.

The Electrical and Electronic Engineering Department follows a hands-on curriculum in which students create projects ranging from LEGO robots to electric go-karts to learn the skills necessary for an electrical engineer, including soldering, circuitry, and C programming. In their fifth year, students choose one project from the many available to them. Many of these projects come from industry and/or can be entered in a national or international competition. In fiscal year 2010, the students performed robot therapy, [4] [5] using a pet-type robot [6] and a remote-controlled robot [7] [8] in senior citizen facilities. To please the senior citizens, the students created various programs for the robots.

3. New design project

3.1 Plan of papercraft course

Because students' skills are advanced by the time of the capstone project, an advanced theme can be selected. Therefore, students' motivation is high. However, because their skill level is low, student in lower classes can select only a basic theme. The motivation of students in these lower classes tends to be lower.

To improve student motivation, a new design project with the following features was introduced:

- Even students of lower classes with low-level skills can perform.
- Project planning and management can be practiced.
- An outside evaluation is introduced.

To satisfy these demands, students examined the management of the papercraft course for schoolchildren. In the papercraft course, even students in lower-level classes with limited skills can perform it. Students who participated in the project planned the papercraft course that the schoolchildren were able to enjoy. The features of the papercraft course that students planned include:

- A familiar school bus is made for the schoolchildren.
- A illustration popular among schoolchildren is drawn on the side of the bus.
- Special skills are not necessary for producing the project, and the production work can be easily accomplished.
- Music is used to keep the work interesting.

To assemble the model, students beforehand completed the parts that were too difficult for the schoolchildren. "Kobito Dukan," a character popular with schoolchildren in Japan, was included in the

cut-in illustration of the bus. The author and the publisher gave consent, and this picture was used. Figure 4 is an assembled model. When the upper part of the bus is opened, a mechanism causes music to play.

Figure 3. Papercraft model at the previous state of assembly.

Figure 4. Assembled papercraft model.

3.2 Performance in the papercraft course

Students presented the papercraft course intended for schoolchildren on January 26, 2014. Participants in the course were 12 schoolchildren from 7 to 11 years of age. Figure 5 shows some scenes from the course. Each student staff supported the work of one or two schoolchildren. Because students completed the project for a purpose beyond academics, they thought more deeply than usual and developed presentations that were popular among the schoolchildren. Therefore, the students seemed to experience feelings of great achievement. Their motivation improved and was maintained through continued participation in a project presented outside the school.

Figure 5. Scenes of the course.

4. Summary

In this paper, we described the educational system in Japan and the curriculum of KTC. In addition, the papercraft project introduced for students of lower-level classes was explained. To entertain the schoolchildren, the students managed a papercraft course. It was found that the students thought more deeply and showed increased motivation when participating in an activity outside the school.

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