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HIROSHIMA JOGAKUIN UNIVERSITY

Information Engineering at Hiroshima Jyogakuin University

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広島女学院大学における「情報工学」の授業展開

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概要

広島女学院大学には高等学校における教科情報の教員免許取得のための情報コースが用意されている。そのカリキュラムの中に「情報工学」があり，本学の生活デザイン・情報学科の学生が履修している。また，来年度からは改組によって「情報工学」は「情報科学とテクノロジー」として開講され，新たに国際教養学科の学生が履修を開始する。本報告では，情報工学での授業展開での問題点を明らかにし，より文系色の強くなる新学科での授業展開に向けての改善方法を提案するものである。

Key words: 情報工学　Information Engineering，教科情報　Information Studies，
情報科学とテクノロジー　Information Science and Technology，文系　Liberal Arts，ロボクラフト　Robocraft，
ライントレースカー　Line Trace Car

1. Introduction

In 2001, our university revised the curriculum of the Faculty for Human Development in order to create an information science course, which includes a program for obtaining a high school teaching certification in information studies. The information science course encompasses a variety of classes, which are divided into six grouping of classes: Information Society and Information Ethics, Computer and Information Processing, Information Systems, Information and Communication Networks, Multimedia Representation and Technology, and Information and Business.

Information Engineering is one subject within Computer and Information Processing, and is provided as a required subject to the students trying to obtain a teaching certificate in information studies. However, the 2013 Information Engineering included only three or four students out of forty-five who intended to obtain the teaching certification, with the rest only interested in credits to graduate. In addition, at the Faculty for Human Development more than a few students taking Information Engineering dislike or are weak at mathematics and science.

Also, in April 2012, our university was reorganized into the Faculty of Liberal Arts and the Faculty of Human Life Studies, with corresponding new curricula. Because the information science course was placed within the Faculty of Liberal Arts, the number of students who are unfamiliar with technology is expected to increase.

This paper provides an overview of the Information Engineering in the old curriculum to clarify certain issues. Then, we propose how to develop the Information Science and Technology (the name of the corresponding subject in the new curriculum) in order to solve certain identified problems.

2. Syllabus and Classroom for Information Engineering

Table 1 shows the syllabus for Information Engineering.

Table 1 Syllabus for Information Engineering.

1. Introduction
2. Electronic machines in daily life and industrial applications
3. Measurement error and practical measurement
4. Basic machine elements and link mechanisms
5. Mechanism of simple motions and
   Practical training on the assembly of one robot of the Tamiya Robocraft series*)
   Students are required to complete one mechanical animal by the eighth lesson.
6. Practical training on the assembly of one robot of the Tamiya Robocraft series
7. Practical training on the assembly of one robot of the Tamiya Robocraft series
8. Practical training on the assembly of one robot of the Tamiya Robocraft series
9. Sensors and actuators
   Logic circuits and transistors
10. Practical training on soldering
    Line Trace Car MR-002**) assembly
    Students are required to complete the assembly by the twelfth lesson.
11. Line Trace Car MR-002 assembly
12. Line Trace Car MR-002 assembly
13. Optical sensors and light-emitting diodes (LEDs)
14. Experiments using electronic circuits
15. Computer control system
    Wrap-up of lessons

*) Students choose one from among the Robocraft series of Tamiya Inc.[1], namely, Mechanical Dog, Mechanical Rabbit, Mechanical Tiger, or Mechanical Pig.
**) Line Trace Car MR-002 is a product of EK JAPAN Co., Ltd.[2]

Figure 1 shows the relationship between Information Engineering and other subjects. In the figure, examples of both subjects offered by the information science course and those offered by the home economics course are shown. In fact, many students in the information science course take Information Management I, and Home Electrical and Mechanical Engineering, which are accepted as credits whether the students are in the home economics course or not. In Information Management I, an automatic rice cooker is studied as an example of an information processing system. In Home Electrical and Mechanical Engineering, one mechanism of electric appliances, such as a sensor, is studied. Additionally, according to the guidelines[3] for information studies, as revised by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2010, junior high school students are required to learn what kind of hardware is incorporated in electric appliances, and so both of these subjects are considered to be useful as part of an information science course.

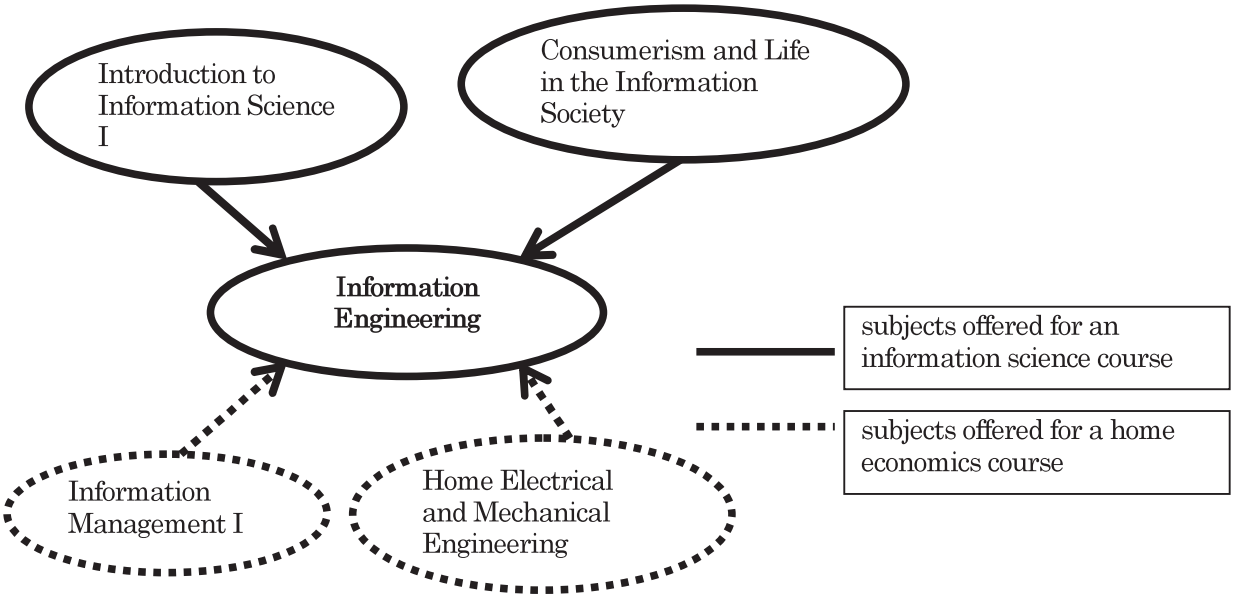

Figure 1 Relationship between Information Engineering and other subjects.

Figure 2 shows Environmental Laboratory III, where students attend Information Engineering lessons. Visible in the classroom are model figures for drawing and torsos for dressmaking. Although the room is equipped for drawing and dressmaking, it is appropriate for Information Engineering lessons, as the classroom is furnished with wide tables, a sink, and plenty of electrical outlets embedded in the floor.

Figure 2 Environmental Laboratory III where students take Information Engineering lessons. Model figures for drawing and torsos for dressmaking are kept in the classroom.

3. Practical Training Development of Information Engineering

The effect on Information Engineering lectures of introducing practical training in the School of Engineering at Kinki University was previously reported by Sachiko Deguchi[4]. In the current section, practical training in Information Engineering in 2013 at Hiroshima Jyogakuin University is described. The first practical training session is the construction of a simple system including a link mechanism by using craft paper, wires, and pins, as shown in Figure 3. We used Tatsuo Komine's method[5] to construct a link mechanism for rocking two legs of a paper toy by manual rotation of a wire. All students could complete this task.

Figure 3 Paper toy whose legs rock by a link mechanism.
It is made by using Tatsuo Komine's method[5].

The next practical training (from the fifth lesson to the eighth) is the assembly of a Robocraft robot, which walks with four legs by converting motor rotation motion into rocking motion of legs. The purpose of the assembly of a Robocraft in practical training is as follows:

i. It is useful to beginners for warming up before the next assembly, the Line Trace Car. There are a variety of machine elements (e.g., tapping screws, bolts, nuts, gears, and cranks) in the assembly kit.

ii. Students can easily know whether their assembly of the Robocraft has succeeded or failed by switching it on: it will either move or not.

iii. A real robot toy is helpful for students to validate knowledge of a link mechanism.

Approximately 80 percent of students succeeded in constructing a Robocraft. The rest of the students initially would not admit their mistakes and instead blamed the motor. In fact, the robot did not work because of incorrect wiring or fit of the components. Such students could realize their own mistakes after taking their robot apart and re-assembling it, and then seeing it walking.

The third practical training (from the tenth lesson to the twelfth) is the assembly of a Line Trace Car. In the practical training, students are divided into groups of four to six people. Within each group, they are required to clarify the division of the roles and to confirm each other's work as a group. This group work can bring a feeling of responsibility and make students work carefully. In class, students were given a brief explanation of the Line Trace Car in the following order.

i. The role of two motors, each separately contacting directly either a right rear wheel or a left rear wheel. The Line Trace Car runs in a straight line when both motors are rotating but the car turns to the left when its left motor stops and the right motor continues.

ii. How to identify a black line and a white background by using a light emitting diode (LED) and a photo transistor.

The Line Trace Car can return to a black line by an IC device if it runs off the black line. The Line Trace Car is controlled by the current on/off states of the motors and is a good tool for students as an example related to the binary number system.

Students could gradually master their manual skill through practice. However, all groups had trouble with the Line Trace Car after assembling it. Each group is tested by determining whether its car can go around a fixed loop course at least three times. The Line Trace Car is designed to discriminate between black and white in the lighting environment of the classroom by setting the values of semi-fixed resistors. Therefore, in order to make a car trace the loop course, students first need to put the car on the course and then adjust the semi-fixed resistors in accordance with a series of procedures given in the manual. In spite of a teacher's warning in advance that they should adjust their car, all groups came to the course for a trial run and only switched on their Line Trace Car. Of course, their cars wandered from the course and students were stranded in front of the fixed loop course board laid out on a teacher's desk as if they had not understood what had happened to their Line Trace Car. The first trial success rate was 0%, which was the worst ever.

In this respect, it is thought by the authors that this situation arises from students' habit of using computers and software without referring to manuals. In addition, students prefer searching for information on the Internet to reading manuals on paper. These trends are growing stronger year by year. On reflection about the situation that students took no notice of the need to adjust their car, students should have been explained the physical meaning of adjustment of resistors before the trial run rather than after it.

In future, we intend to provide a check sheet, which is one tool of quality control (QC), so that students can perform self-checking for the adjustment of their car.

Eventually, each group could make their car go around the course three times after adjusting resistors. Students were required to write reports on the paper toy, the Robocraft, and the practical Line Trace Car.

4. Discussion

In the next academic year, the junior students majoring in information science at the Faculty of Liberal Arts will start studying the subject Information Science and Technology, renamed from Information Engineering after the curriculum revision in 2012. In the meanwhile, as the result of the reorganization of our university, the percentage of students who have an end-user-oriented temperament is higher than those who are technologically oriented. Fortunately, the new name, Information Science and Technology, should make students feel that this is a familiar subject; since almost all students majoring in information science have taken Introduction to Information Science, they can easily consider it as a subject developed from the earlier course. The Japanese term for "information engineering" carries a strong connotation as a subject requiring science and engineering, and so mathematics. Therefore, students are used to asking teachers for help if they lack sufficient knowledge of mathematics and physics.

As shown in Figure 4, two subjects, namely, Introduction to Physics and Information Science Fieldwork, have been added in the new curriculum.

To understand the technology which is used in the Line Trace Car, it goes without saying that physics is essential. Although Introduction to Physics is a liberal arts subject, it is useful for learning Information Science and Technology. Furthermore, we plan tours of factories such as a food factory and a broadcast station in the Information Science Fieldwork. Through fieldwork, students can see examples of information and communication technology (ICT) closely related to people's daily lives. They

can feel that ICT is close to them and the experience will develop their curiosity about technology.

In addition to the check sheet mentioned in the previous section, a practice notebook is helpful for improving understanding in the Information Science and Technology. It is easy for students to take pictures in practical training by using their smart phones and also they can confirm their results by pasting pictures into a notebook, using it just like a picture album. A notebook is better than a portable computer in terms of cost. In addition, we would like students to learn to make good use of not only digital information but also their own handwritten notes taken on site.

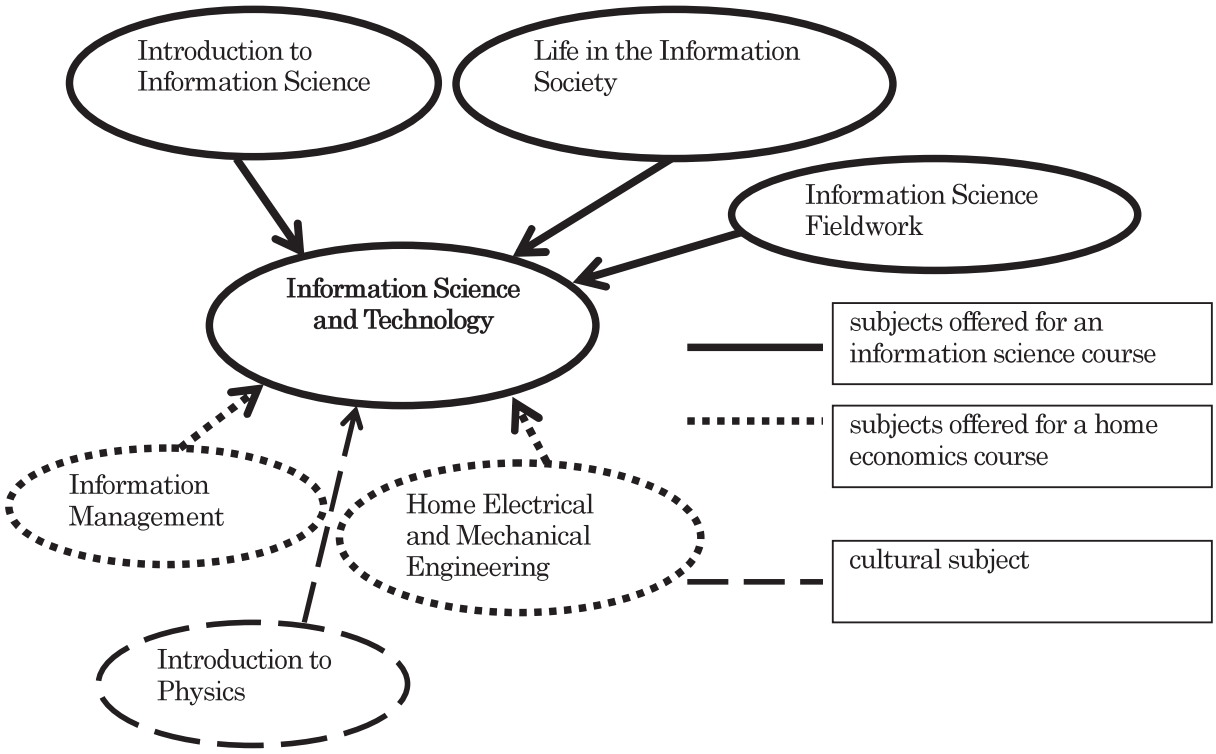

Figure 4 Relationship between Information Science and Technology, which changed from Information Engineering after the curriculum revision in 2012, and other subjects. Life in the Information Society, revised from Consumerism and Life in the Information Society, and Information Science Fieldwork will start in 2014.

5. Summary

Before the reorganization of our university, there were usually approximately 30 students majoring in information science, which is 20% of the students in the Department of Life Design and Information Science. After the reorganization, however, there are only approximately 10 students majoring in information science, which is 6% of the students in the Department of Liberal Arts. This number may reflect the phenomenon that Japanese younger people are turning away from the sciences. Therefore, it is necessary to take the above situation into account for the development of Information Science and Technology.

The present report makes recommendations for the next steps, which are summarized as the following three key points.

i. Students need to take Introduction to Physics and Information Science Fieldwork for a deeper understanding of Information Science and Technology.

ii. The term "daily lives of students" is an important element for the sake of curiosity about technology.

iii. A check sheet and a practice notebook written by hand are expected to be useful tools in practical training.

With the aim of sparking student interest in the technology which will change their future lives, we intend to offer the

Information Science and Technology. Accordingly, students can deeply understand how and why information technology is applied in information processing.

References

1) http://www.tamiya.com/japan/products/Robocraft/
2) http://www.elekit.co.jp/product/4d522d303032
3) http://www.mext.go.jp/component/a_menu/education/micro_detail/__icsFiles/afieldfile/2012/01/26/1282000_11.pdf
4) Sachiko Deguchi, IEICE Technical Report, ET, 105(298), 17-22, 2005
5) 小峯龍男, ELEKIT MOVITシリーズではじめるロボット工作キット入門塾, 技術評論社, 2005