APPLICATION OF THE WEATHER AND NANO-SATELLITE PROGRAM IN EDUCATION

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Abstract

Around twenty Universities and Colleges in Japan had started their own nano-satellite project since early 2000. The establishment of new education program using nano-satellite project should became ideal approach and accelerated in these year. However, it is still extremely difficult to start this project and promote it for the college who has no experience the space project. To change in this thinking, there is another ideal approach to start satellite project. That is to start from feasible technology and then aim for goal. This feasible technology should be an implementation of "Ground station" for the Weather-satellite and micro/nano-satellite. We had started the Weather-Satellite and Micro/Nano-Satellite Ground Station system design in National Institute of Technology (NIT), Kushiro College for the student graduation research since 2011 and had developed the NOAA Weather Satellite Grand Station for VHF and S-band systems. The Ground Station for the satellite can provide motivation for the mission design and configuration through the hand-on learning of real satellite data receiving and analysis and can be possible to utilize for the practical engineer training in the college.

Keywords: *Ground Station, Weather-satellite, NOAA, Micro/Nano-satellite, Space Project*

1. Introduction

In the year of 2009, MEXT (Ministry of Education, Culture, Sports, Science and Technology, JAPAN) had announced that nano-satellite research and development project should be promoted by concentrating the free innovation, power of originality of Universities and Colleges [1]. Around twenty Universities and Colleges in Japan had started their own nano-satellite project since early 2000. Space project in University and College as well as nano-satellite project is not only educational program but also venture creation for space related business chance originated by University.

The establishment of new educational program using nano-satellite program should become ideal approach and accelerated in these years. However, it is still extremely difficult to start this project and promote it for the college who has no experience the space project. To change in thinking, there is an ideal approach to start satellite project. That is to start from feasible technology and then aim for goal. This feasible technology should be an implementation of the "Satellite Ground Station" for the nano-satellite. This project will make a reality to provide a new hands-on learning in educational program for the students who has no design experience of nano-satellite.

We had started the Weather-satellite and nano-satellite Ground Station system design in our college for the student graduation research since 2011 and had developed the NOAA Weather-satellite Ground Station for VHF (See Figure1) and S-band systems [2]. We are now developing nano-satellite ground station systems as the student educational programs. In addition, the application of NOAA satellite weather image could open up a whole range of possibilities in the field of the student remote sensing observation.

College student does not have enough chance to have the experience that the system design and requirements for the development are coming from multifunctional technical knowledge which is organically connected to each other even engineer has individual specific knowledge. Thus, the Ground Station for the satellite can provide the motivation for the mission design and configuration through the hand-on learning of real satellite data receiving and analysis and can be possible to utilize for the practical engineer training in the college.

Nano-satellite project has a reality of complex engineering and technology. The Ground Station for satellite is a part of reality for this program. College student can touch the system reality in this project and this approach could be one of ideal "Technology Education".

Figure 1 NOAA VHF system developed by student

2. Micro/Nano-satellite program in University

(1) Development histories and future

Largest non-profitable organization for supporting practical space development activities in Universities and Colleges is "UNISEC (University Space Engineering Consortium)" in Japan. At least, 34 Universities and Colleges, and 44 Labs participate in UNISEC. UNISEC plays following roles [3].

[1] Human Resource Development; UNISEC provides oppotunities for students to discuss stimulate and improve themselves through space development activities.

[2] Technological Development; UNISEC challenges novel technological developments for future applications. UNISEC makes much of student's actions and creative ideas unbounded traditional ideas, which will lead to breakthrough and needs generation in small/micro/nano-satellite and rocket markets.

Figur 2 shows the micro/nano-satellite development history and future in University. In early 2000, micro/nano satellite program was a kind of educational program to learn complex specific engineering and project management. These activities are mostly depend on each university's ability, knowlege, and budget condition. The barrier of new entry in micro/nano-satellite program was the lack of easy access to domestic launch opportunities.

In 2009, JAXA (Japan Aerospace Exploration Agency) had developed multi-launch interface for micro/nano-satellite with their main mission satellite and had staterd actual launch service by H-2 rocket. In the next year of 2010, five maicro/nano-satellites, developed by 3 universities and 2 Insutitutes, were launched by H-2 rocket. In 2014, this year, seven micro/nano-satellites, developed by 4 universities, college, and 3 Insutitutes, were launched by H-2 rocket. Furthermore JAXA had announced that they would start actual launch service by using International Space Station/JEM.

These shair launch oppotunities would increase in new entry into the micro/nano-satellite project and encourage new entry into the space market.
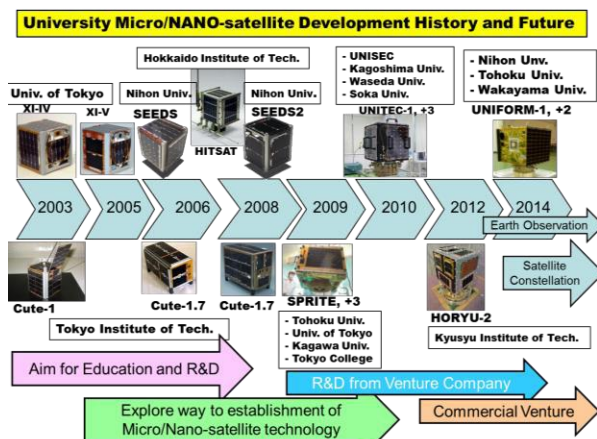

Figure 2 Development History and Future

(2) MEXT Strategy

MEXT had announced that nano-satellite research and development (R&D) project should be promoted by concentrating the free invention, power of originality of University and College in 2009. MEXT decided to support these activities for nano-satellite R&D with 2009FY supplementary budgets [1].

The aim of supplementary budgets is as follows.

[1] Nano-satellite R&D project, reinforcing efforts to achive earth observation systems by nano-satellite, should aim for the most advanved R&D project and expand to the potential of space utilization.

[2] Nano-satellie R&D project should concentrate the high-level technologies for the Smal and Mid-saized Enterprise, Ventures, and Universities.

As the result of review on the proposal from Universities, seven themes, proposed by six universitys and Institute, were selected as a candidate theme.

In these themes, graduate/under-grduate students and young researchers will play a center role in the micro/nano-satellite project. As the educational aspect, students can also practice system development and project management as well as technology aspect.

The Basic Plan for Space Policy is based upon government "New Growth Strategy of Japan". MEXT also continue this economic-revitalization policy in nano-satellite R&D project for the following future direction.

■ A new market development in space utilization shall be driven by micro/nano-satellite R&D programs.

■ Micro/Nano-satellite R&D program shall contribute the space diplomacy and oversea deployment.

(3) Micro/Nano-satellite development project

Through the final evaluation in the MEXT committee, the "UNIFORM (University International Formation Mission) Earth observation project", proposed by Wakayama University, was selected from the seven candidates as the MEXT R&D new project.

The UNIFORM project is organized by Wakayama University and following five Universities, and two Institutes participate in this project.

[1] University of Tokyo
[2] Tohoku University
[3] Hokkaido University
[4] Tokyo Science University
[5] Tokyo Metoropolitan University
[6] JAXA
[7] NESTRA [4]

The main aspect of this UNIFORM project is as follows [5].

[1] Micro/Nano-Satellite, the earth observation satellite "UNIFORM" will be design, developed and product by the alliance of the Universities.

[2] Human resource development will be managed through this project.

[3] To strengthen partnership with foreign University and Institution.

The main feature of the product (satellite) is as follows [6].

■ Size (50X50X50 cm), Weight (under 50 kg)
■ Shortening of the period of the design and development
■ Minimize the development cost
■ Reflect the latest research product flexibly
■ Mission payload: Micro-bolometer camera, visible light camera

The project period required from MEXT is for five years from 2010 to 2014. The project budget of each year is around $300 billion US dollar.

The year of 2014 is the final year of this project and the first satellite "UNIFORM-1" was launched on May 24, 2014. (See Figure 3) The main mission for the UNIFORM-1 is earth observation by using new developed infrared camera (Micro-bolometer). The series satellite UNIFORM-2, 3 are going to be developed on a continuing basis. The major characteristics of the UNFORM-1 are as follows [6].

■ Mass & Size: 50 kg, 50x50x50 cm
■ Communication: S-band (HK), X-band (Mission)
■ Power Generation: 100 w
■ Attitude Control: 3-axis magnetic torque rods

For the operation and data acquisition for UNIFORM-1, they have developed Ground Station Network in Hokkaido (Operated by Univ. of Tokyo), Fukui (Fukui Institute of Tech.), and Wakayama (Wakayama Univ.). (See Figure 4) UNIFORM-1 is operating in a circular, near-polar orbit (Sun-synchronous) of 600km above the earth. The key control station is Wakayama Univ. and 3m dish antenna is for S-band Telemetry/Command, 12m dish antenna is for X-band mission data. Figure 5 shows the Infrared and Visible Image above the Arctic which was taken by timer command for UNIFORM-1 on July 9, 2014 [7].

Figure 3 UNIFORM-1 developed by UNIFORM project
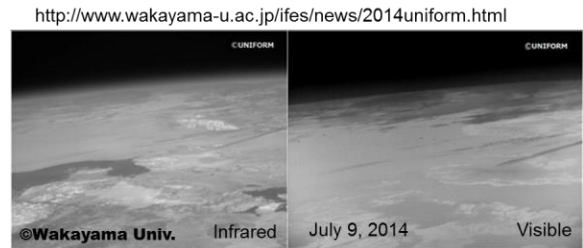

Figure 4 Ground Station Network for UNIFORM-1

Figure 5 Infrared/Visible Images above the Arctic

3. Ground Station as a Technology Education

(1) Technology Education

Micro/Nano-satellite and Ground Station project are complex engineering and technology. Students must learn the introduction of the "Satellite Communication Engineering" and "Orbital Dynamics" at first and deepen them through the Ground Station system design, development, implement, and real operation.

Tracking micro/nano-satellite, receiving satellite housekeeping/mission data, and then analysing satellite health condition, student can learn complex satellite design and systems using the Ground station facility.

(2) Why we select NOAA for the first challenge?

To establish the Ground Station at NIT, Kushiro College, we focused on NOAA (National Oceanic Atmospheric Administration in USA) weather satellite system for our first satellite receiving challenge.

NOAA's operational weather satellite system is composed of two types of satellite: geostationary operational environmental satellite (GOES) for short-range warning and "now casting" and polar-orbiting satellite (POSE) for long-term forecasting.

POSE satellites are able to collect global data on daily basis for a variety of land, ocean, and atmospheric applications. Data from POSE series supports a broadband range of environmental monitoring application including weather analysis and forecasting, climate research and prediction, global sea surface temperature measurements, atmospheric sounding of temperature and humidity, and many other applications.

POSE satellites are two polar-orbiting satellite systems constantly circling the Earth in an almost north-south orbit, passing close to both poles. The orbits are circular, with altitude between 830 and 870 km, and are sun-synchronous. One satellite crosses the equator at 7:30 a.m. local time, the other at 1:40 p.m. local time. We can see four satellite passes with enough elevation in daytime. A satellite pass directly over a Ground Station site will be within view of the site for about 15 minutes when the satellite is at about 830 km [8].

Data from all the satellite sensors is transmitted to ground. The Advanced Very High Resolution Radiometer (AVHRR) is the main sensor for the NOAA. The AVHRR is a six-channel imaging radiometer that detects energy in the visible and IR (Infrared Red) portions of the electromagnetic spectrum. The instrument measures reflected solar (visible and near-IR) energy and radiated thermal energy from land, sea,

clouds, and the intervening atmosphere. The instrument has an instantaneous field of view (IFOV) of 1.3 milliradians (mrad), providing a nominal spatial resolution of 1.131 km at nadir.

A second data transmission consists of only image data from two of AVHRR channels, called Automatic Picture Transmission (APT). For users who want to establish their own direct readout receiving station, low resolution image data (4 km) in the APT service, but can be received with inexpensive equipment [9].

We focused attention on this NOAA satellite APT receiving as a first mission for the Ground Station.

(3) System Design and Implementation for VHF

APD data is smoothed 4-km-resolution IR and visible image derived from the AVHRR instrument and transmitted within the footprint of NOAA polar-orbiting satellite. The APT data is transmitted continuously over a dedicated VHF link as an analog signal consisting of an amplitude-modulated (AM) 2400 Hz subcarrier frequency modulating (FM) the RF carrier at 137.1 MHz or 137.9125 MHz.

We had started the NOAA Ground Station system design for the student graduation research since 2011. NOAA APT VHF transmitting power is 5 watts FM/AM analog signal. Figure 6 shows the result of communication link analysis. From the link budget analysis, we understand that we have enough link margin and we do not need to design any specific Low Noise Amp (LNA) for the receiving system.

General ground-based FM broadcasting bandwidth is 20 kHz but APT downlink FM signal has 50 kHz wide bandwidth because of image data transmitting. We need to purchase the receiver which has the wide bandwidth FM receiving function.

For the receiving antenna location and antenna selection, we measured actual antenna skyline at the top of building. (See figure 7) We could secure the clear skyline and we attempted to receive APT data by turn-style antenna which has omni-direction at first. The omni directional antenna is easy to implement but collect grand-based communication noise even satellite pass through the zenith.
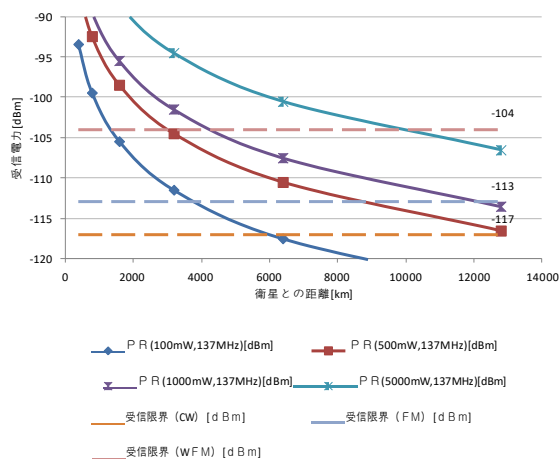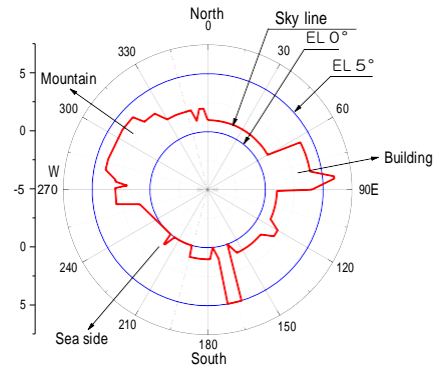

Figure 7 Skyline at the antenna location

Figure 8 turn-style antenna and Yagi beam antenna

Then we requested to modify the 144 MHz Yagi beam antenna which is amateur radio use to 137 MHz NOAA dedicated antenna which has five elements and two stack. (See figure 8) To control the beam antenna, the azimuth/elevation rotator and controller should be implemented with antenna system additionally.

To operate the NOAA Ground Station, we can see and display each POSE satellite orbit as a prediction data on world map showing on PC display using satellite orbital determination software which is openly available on the web [10]. Figure 9 and 10 shows NOAA satellite trajectory prediction on world map which is implemented in the NOAA Ground Station PC.
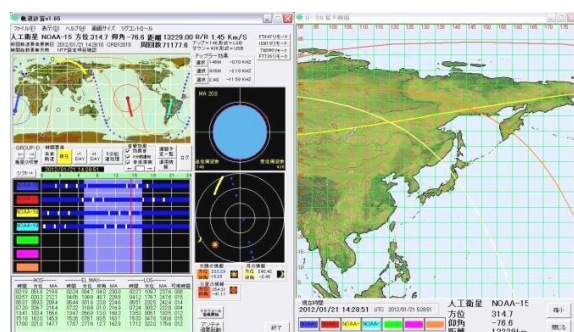

Figure 9 Trajectory Predictions on world Map

Figure 6 Communication link budget analysis

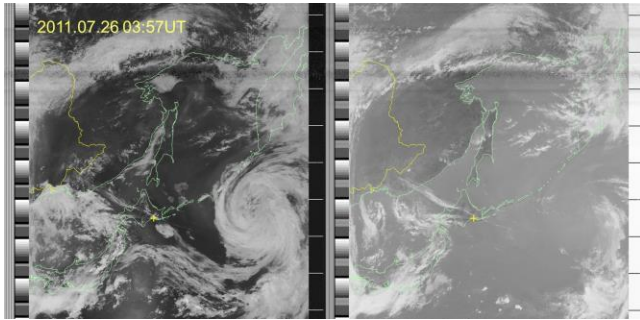Figure 10 NOAA Data Receiving by Student
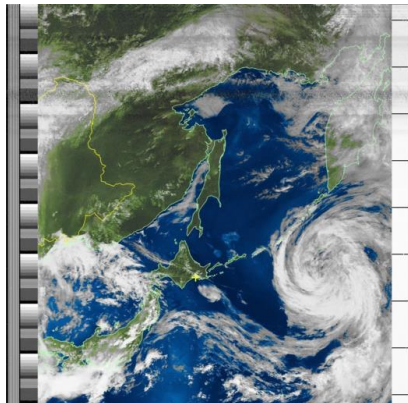
Figure 11 Receiving Raw Image from NOAA

Figure 12 Enhancement process image

As the result of the system design and system implement, we could perform and demonstrate the NOAA APT receiving successfully. Figure 11 shows receiving raw image from NOAA, which was passing over the Japan islands and downlinked real time observation image. The left side picture is visible image and the right side picture is Infrared Red (IR) image in Figure 11. Figure 12 shows the clear image, cloud, sea, and land, which were enhanced from raw image in Figure 11. We can see typhoon cloud in the ocean. These APT decoding and image processing software is "WXtoImg" which is openly available on the U.S. web-site [11].

Our first challenge was completed successfully. Now we understand that we can take clear earth observation image from NOAA with poise. This means that we can expand this to other possibilities.

As the developmental application, the space communication experimentation using this Satellite Ground Station for NOAA APT data receiving was newly adopted one of item for the regular student Electrical Communication Experimentation course since 2013
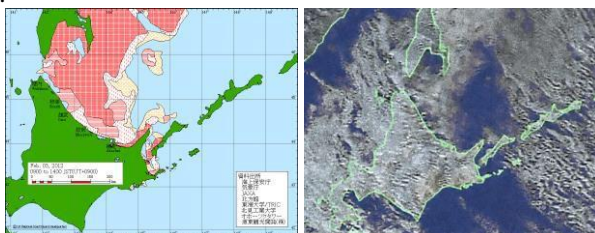
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Figure 13 Sea ice condition chart and NOAA image

Most significant thing we found was we could see floating sea ice condition directly and real time in Okhotsk Sea, Hokkaido. The chart in Figure 13 shows sea ice condition on Feb. 3, 2012 which was released by Ice Information Center, Coast Guard, Hokkaido, Japan. But this information has one day delay. Although we can see it by real time, more high resolution image should be required as the next steps.

(4) NOAA S-band Receiving System Development

NOAA has two types of direct mission broadcasting. One is Automatic Picture Transmission (APT) and the other is real-time HRPT (High Resolution Picture Transmission). HRPT transmissions contain data from all instruments aboard the NOAA polar-orbiting satellites. The data stream includes information from the all sensor information processor, and from the AVHRR, providing five of six channels at 1.131 km resolution. HRPT is S-band real time link, carrier frequency is 1698 or 1707 MHz, and transmitting power is 6.35 W. NOAA main mission band is S-band/HRPT [9].

When we had started NOAA satellite Ground Station system design for VHF, we already had a plan to implement S-band system in very early phase and requested the budget [2]. The requirement for the NOAA S-band receiving system was finally accepted in 2013 Fiscal Year.

The implementation of the new NOAA S-band receiving system has been completed by the spring of 2014. (See Figure 14) Then, the system performance of auto data acquisition, image processing, and data storage should be evaluated until secure operation should be confirmed.

4. Application of the NOAA weather image

The performance of new NOAA S-band receiving system has been evaluated by receiving weather image until the system should be confirmed stable data receiving and processing.

During the winter, we can see the dynamic sea ice moving in Okhotsk Sea. Figure 16 and 18 are S-band image and show the sea ice conditions. In comparison with VHF image shown in Figure 15 and 17 as same pass, we can find dynamic sea ice moving, huge vortex, fringe, assuming caused by some interference wave in the S-band image

To evaluate the system performance, S-band images should make comparison with VHF images for some time in the future.
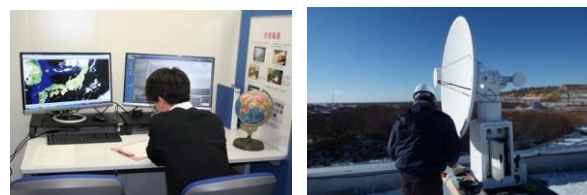

Figure 14 Image processing PC and S-band antenna
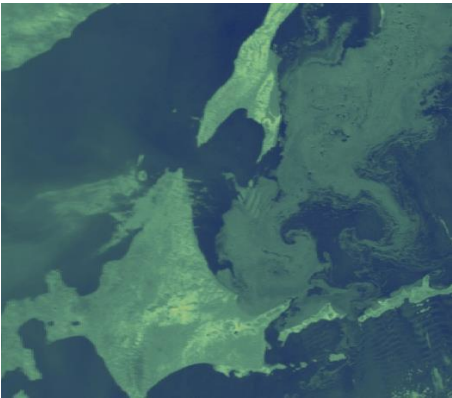
Figure 15 NOAA18 VHF (Feb. 26, 2014)
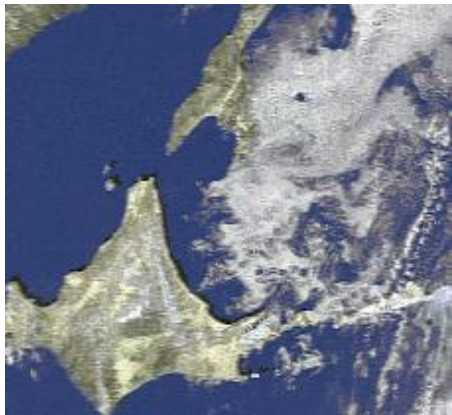

Figure 16 NOAA18 S-band (Feb. 26, 2014)
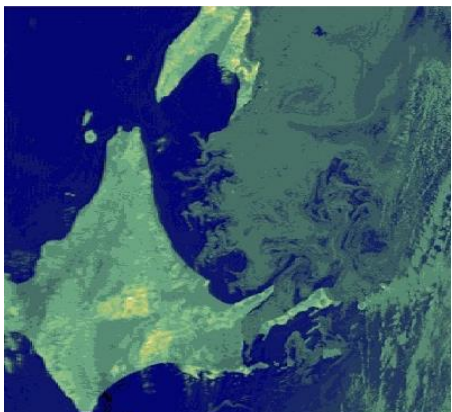

Figure 17 NOAA19 VHF (March 19, 2014)

Figure 18 NOAA19 S-band (March 19, 2014)

5. Conclusions

The Ground Station for the satellite can provide the motivation for the mission design and configuration through the hand-on learning of real satellite data receiving and analysis and can be possible to utilize for the practical engineer training in the college.

Micro/Nano-satellite project has a reality of complex engineering and technology. The Ground Station for satellite is a part of reality for this program. College student can touch the system reality in this project and this approach could be one of ideal "Technology Education". Based on this ideal approach, we established NOAA satellite Ground Station. We also recognized that the application of NOAA satellite weather image could open up a whole range of possibility in the field of the student remote sensing observation. We also understand that the satellite program or other space programs will open a lot of doors for the College educational programs.

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ACTIVE LEARNING VIA MECHANICAL ENGINEERING-BASED EXTRACURRICULAR ACTIVITIES

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Abstract

Currently, the institution of higher education in Japan has proposed a more efficient learning environment, in particular for engineering students. With the rapid decline in Japan's birth rate, the Japanese College of Technology is looking at enhancing and maximising their human resource development. We have created an environment to allow active learning for highly motivated students as part of their extracurricular activities. This paper describes how the college conducts a trial by promoting active learning as part of its extracurricular activities in the mechanical engineering department.

The project is named "Mech. Cafe - Mecafe", and this is meant to encourage students to take part in mechanical projects voluntarily. In this Mecafe, the students will participate in technical and engineering competition events such as "Student Formula Car Project", "Flow Visualization Contest", or some in-house events which include "Handmade Powder Metallurgy Workshop" and "EV Car Design Project". As today's students are pressed for time, it would be difficult for them to participate in such events. Therefore, it is important to create a conducive environment for them to take up these projects, as this will in turn help them to become more creative and motivated in their work.

We have seen some positive results from this trial. The Project-Based Learning (PBL) in extracurricular activities will keep our teaching environment competitive without making major changes to our educational curriculum. However, we found that our teachers face challenges during the trial. For instance, the "Student Formula Car Project" involves some metal work processes such as welding, cutting and assembling work. As a result, the teachers need to take responsibility for these safety issues even if the students had volunteered to take part in these activities. It is noted that such existing safety issues had significantly undermine the acceptance of our proposal on the extracurricular activities in our college.

Introduction

It is well known that the labour force of Japan will decrease rapidly by the problem of a decrease in the birth-rate. The Japanese population is down 0.21% in 2013. New baby is born in every 31 seconds while the other Japanese dies every 25 seconds. It is predicted that the number of death is keep increasing, and people aged 65 years or older will account for a 30% of the total population in 2040. In order to maintain the scale of Japanese industry, it is important to perform engineering education for young generation because technical level in the labour force has a major impact in productivity and level of research and development in industry. Our institution, Japanese college of technology, was established in 1962 to educate engineers who can sustain the economical growth as demands from Japanese industries. In recent years, demands from industries are changing radically as the globalization of industrial activities rapidly proceeds. Now we must review our roles in future, confirm our new task for the next generations and cultivate innovative human resources for Japanese industries.

Active learning is effective educational technique to make student creative and innovative. It also cultivates self-realization of the students. Since it has been suitable for our educational task, Japanese college of technology has implemented project/problem-based learning as we have many practical training curriculums which are represented by scientific experiments, workshop training and practical manufacturing skills. Mizokami (2007) classified the types of active learning in practical training as follows;

Problem exploring type: which students plan a learning theme themselves and investigate it.

Conclusion of the investigation is presented as output type articles which depend on what they learned about the theme.

Problem solving type: which a teacher plans a learning theme or task roughly and students investigate or achieve it. Conclusion of the investigation is presented as outcomes type articles which depend on how they achieve the theme.

Mizokami also mentioned that learning processes in practical training are "information gathering", "interview, questionnaire investigation and experiment", "production", "group discussion", and "presentation", etc. Education system in Japanese college of technology can easily implement such learning processes in classes as teachers are conducting detailed teaching in small classes which are allowing close attention to students.

However, scholastic ability of our students has declined gradually in recent years. It seems that some students hard to get motivation for learning. The significant gap exists between postures of such students and requests from teachers although the students have entered into our college after they had admitted our admission policy. So teachers must spend more time for supplementary class. Now we have realized that it is important to promote motivation in engineering activities to perform practical training effectively, especially for *problem exploring type* active learning. However, educational budgets, manpower and spare time for additional supplementary class are completely restricted due to our characteristic educational system which is congested curriculum schedule.

Takahashi (2005) noted a hypothesis that the origin of the decline of greediness for learning in Japanese schools arose by dilution of communitarian class culture, which gives to students an environment of "*exposure to other views*" and "*need for approval from classmate or teacher*" efficiently. He said that such environment is connecting to formation of learning motivation in students. Then he suggested that extracurricular activity should be considered to examine the decline of greediness for learning. Investigation of Mizokami (2009) may proof this hypothesis as he found that students who spent much time positively for extracurricular activities show the characteristic as follows;
 (1) They have capability to carry out study in extra-class, and positively design for life.
 (2) They consider rich human relations and club activities to be the importance of student life.

So it can be found that well-balanced extracurricular activities with classroom studies are important to get positive motivation in self-learning and self-development.

On the other hand, extracurricular activities in the educational institution can cultivate not only mental and physical health but also self-realization which sustains motivation in student life. Actually, it is presented that the establishment of educational supporting community to encourage student's extracurricular activities performed in Kanazawa Institute of Technology significantly not only promotes the satisfaction in students life but also the number of the entrance examination applicants of the department (Demura, Tani and Hattori, 2006; Hattori, Matsuishi and Tani, 2006). This fact indicates that the environment of *problem exploring type* active learning with "*extra-class support*" should be maintained to enhance more advanced human resource development in the university.

Enrichment from "*exposure to other views*", "*extra-class support*" and "*curricular support*" is found to a device, which develops the further quality of active learning in Japanese universities (Mizokami, 2007). Tokito and Kubota (2013) found that the extracurricular experience effects student's self-development, and noted that it is necessary to set environment to build communities for participants, to give students central roles, and to set a common goal for both students and teachers. In these viewpoints, we suggest that our college need to perform more active learning program to give student more motivation for leaning positively. The proposal should be suggested as *extra-class support* with considering of our less educational budgets and manpower.

In this paper, active learning environment as an extracurricular program, which is voluntarily proposed by students who want to make active action in mechanical engineering, is presented. We have tackled with establishment of the learning environment as extracurricular activities. The attempted project is named "*Mech. Cafe - Mecafe*", which is taken as the science cafe. Students plan to participate or apply to some technical and engineering competition events, such as "*Student Formula Car Project*", "*Flow Visualization Contest*", "*Preventing the Fastening Failure of Bolts*", or some in-house events which is prepared by our school, such as "*Handmade Powder Metallurgy Workshop for junior high school students*" and "*EV Car Design Project*", etc. A few results of their trial which aims to attend the events are presented.

Materials and Methods

The purpose of *Mecafe* project, which we have attempted to establish the environment and community to propose active leaning as extracurricular activity, is as follows;
 (1) To maintain the environment where students can perform engineering activity in extra-class.
 (2) To produce a community that can share a student's motivation for the other student or teacher.
 (3) To use the output from the activity for the publicity work of our department.

Firstly, a student proposes the contents of activity. Several teachers become an adviser. Advisers select the proposal which has feasibility and give a student permission of execution. Then the student organizes the other students who agree with the activity. Thus the *problem exploring type* active learning was attempted as extracurricular activity by the supporting of teacher's advice.

The budgets of the activity were distributed from the exhibition expense of campus festival event. An in-

house grant given through competition in our college, which name is "student challenge project", has also been allotted. These amounts of a budgetary ceiling are 100,000 yen, respectively.

The environment for the activity has been prepared by our department as computer design exercise room and common rooms which are provided by advisor. Typical 3D CAD software and 3D printer are available in these rooms, and members of the projects can use these rooms under the permission of advisors. The progress of each project is reported in the meeting held once per week. In order to share the proposal and work of each student, "Cybozu live" which is web based groupware was used. 3 to 5 students took part in one project.

Results and Discussion

Flow Visualization Contest: The Japan Society of Mechanical Engineers (JSME) performs this event every year. In this event, the students of university/college participate per a group or laboratory, and perform the presentation which tells the fun of fluid engineering to the general public. Our group developed the portable flow visualization equipment as shown in figure 1, and participated in the event. The exterior of equipment is made from plastic corrugated paper. The smoke generated with smoke generetor is passed by the channel, and is lit up by the LED light. Since smoke passes along the tandem type nozzle, a flow serves as a line and can be sighted as shown in figure 2. The nozzle and the bell mouse for minimizing disturbance were created with 3D printer. Thus, since it was an easy material and work, the student was able to create characteristic equipment at a low price with safely work. Activity time was about 300 hours and the price of expense was about 30,000 yen including smoke generator. In the contest, although they did not result in the award, many particioants admired the competitive performance of the equipment (Figure 3). They continuing the activity trough the year for next competition.

Preventing the Fastening Failure of Bolts: The competition was performed by The Association for the Advancement of Manufacturing & Technology. The idea, which can sight it immediately when a failure of a bolt to fasten arises, has been invited only for students in college of technology in Kansai Area. There were 156 applications and our group won the highest award and prize of 200,000 yen. In the activity, students processed new structure of the bolt, and they checked their idea so that it might become the structure which a failure to fasten does not occur. Based on the test result, they drew up the intelligible proposal document, and explained the unique idea. Activity time was about 30 hours and the price of expense was about 1,000 yen.

Student Formula Car Project: Student formula car convention is a content of Society of Automotive Engineers (SAE) of Japan which regulation is same as American Formula SAE®. The aim of the convention is to activate engineering education by offering the
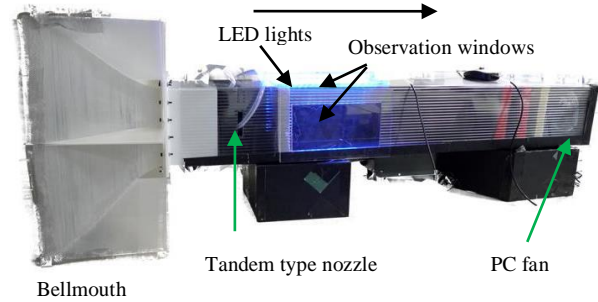

Figure 1 Photograph of the portable flow visualization equipment
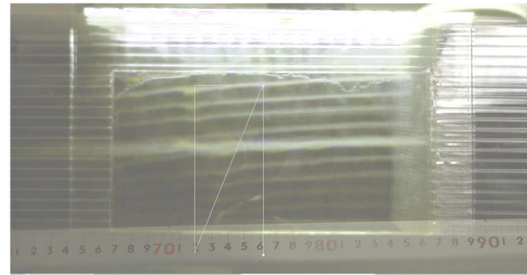

Figure 2 Flow lines generated by tandem type nozzle
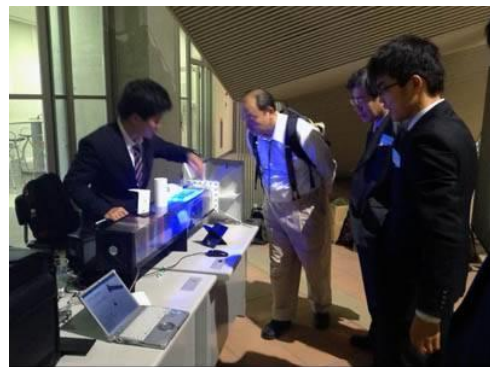
Figure 3 Presentation in the contest

opportunity of craftsmanship. By the student himself constructing a formula car team, developing and manufacturing the small racing car of a formula style in about one year, students learn the essence of craftsmanship and realize severity and joy of engineering. In an athletic meet, students compete for the collective strength in manufacturing of formula car, such as marketing, planning of manufacturing, concept of car design, and cost competitiveness, rather than compete for the running performance of the developed formula car. In order to participate in the convention, students visited the activity of the neighbouring universities first. The adviser gave them the racing cart which is the most fundamental formula car, and promotes self-learning of the member.

However, the activity in student formula car project includes some metal working processes such as welding, cutting, etc., assembling work, firing engine and running test. As long as the age of our students is not coming of age, the advisor must have responsibility in safety issues even though the activity is voluntarily proposed from the students. The advisor finally has to suggest making a contract with the parents of the

students in safety issues to evade lawsuit for injuries which may happen in the activities. Moreover, sufficient money is required in order to manufacture the formula car which can be run safely. This project is difficult for attaining only in extra-curricular activity in our department. Probably, it will be hard to participate in a competition until permission of total support is supplied from our college. However, even though it is hard for students without much time with few budgets, to make their effort to participate in the events, to make an environment for such projects is very effective to get some students creative and motivated themselves. Now, the students are just going to design of their own formula car by finishing an understanding of a regulation in the competition. They are also striving for self-study as shown in figure 4 as they are doing disassembly and assembly work of an engine.
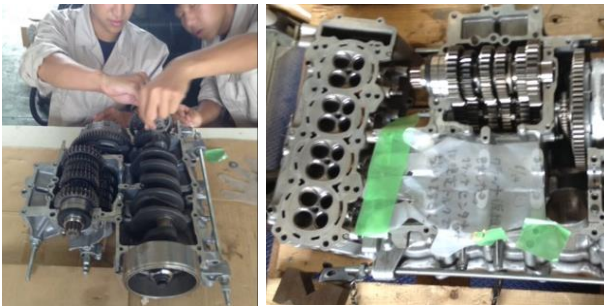

Figure 4 Example of activity as a trial to produce formula car

Handmade Powder Metallurgy Workshop for junior high school students: The author suggested the simplified powder metallurgy method in order to conduct the workshop practice which aims to give young students interest in metalworking technology or material science in the common crassroom without any special devices (Taniguchi, Ozaki, Kodama and Nakajima, 2012). Since the suggested method is a theme of undergraduate research in advisor's laboratory, teaching assistant can learn about knowledge of metallurgy by the student in laboratory. The member of *mecafe* who attended as a teaching assistant can realize difficulty of teaching engineering to the participants through helping the workshop. Thus we consider that it is how to promote a motivation that students help the open class or workshop as a teaching assistant.

Campus festival event: In the exhibition of our department in a campus festival, members of *Mecafe* work as leading position in order to tell participants the fun of mechanical engineering. In other words, members offer their labour for the exhibition, in exchange for the budgetary measures for their activities in *Mecafe*. Articles on exhibition were a racing cart, 3D printer, flow visualization equipment, an engine cut model, etc., and the workshop which makes a paper craft bridge was also held. Since many kids come to the exhibition, it is necessary to explain the knowledge of mechanical engineering briefly. The member created the poster panel and performed the presentation, and students other than a *Mecafe* member also participated

voluntarily and helped the exhibition. We think that such a presentation becomes an important opportunity to increase students' communications skills, and brings up the students who can tackle with graduation research actively. Figure 5 shows the photograph of the campus festival events.

Figure 5 Photograph of exhibition scenery in campus festival

EV Car Design Project: This is the project to develop an EV car in extracurricular activity. Not only the student of a department of mechanical engineering but the student of the department of electrical engineering has joined to the project. The activity fund was supplied from the "student challenge project" which the school proposed. The member have got the used buggy and replaced its engine into motor. Since permission of work from the college has been obtained - unlike the case of a formula car team - , the members can be able to receive the support from technical staff in producing the car. Figure 6 shows the photograph of body frame after removing engine of the buggy. They have designed EV car by using this frame.

Figure 6 Photograph of body frame of EV car

In the active learning environment which we have prepared for the students who want to make active actions in mechanical engineering voluntarily effectively work as community to give the students motivation in school life although we do not have much budgets of department and manpower of teachers. It is considered that we successfully prepared the environment of *problem exploring type* active learning

and students have build themselves community of "*exposure to other views*" and "*need for approval from classmate or teacher*". For example, almost all proposals from students have been carried out and we could use the results of student's activities as the articles on exhibition, and the results bring us positive motivation in self-learning and self-development of the students as some activities have got prize in the competition or got budgets as the proposal won in the competition of our college. For the moment, we do not investigate how the activity leads to an improvement of scholastic ability of our students because the activities are still on a small scale. So we should improve the environment and promote self-learning in the extracurricular activity more. One of the efforts was performed as a boot meeting for the first grade student has been planned by the member, and new members have joined to our activities. Thus, proposed activity is voluntarily managed by students. We need to find how this activity influenced the improvement of the posture of students for learning in college of technology.

Conclusions

We have attempted conduction of active learning as extracurricular activity. The project named "*Mecafe*" has been established as an "*extra-class support*" from department of mechanical engineering in our college. In the *Mecafe*, the students plan to participate to some technical and engineering competition events or some in-house events such as exhibition in campus festival. These promotions as Project-Based Learning, PBL in extracurricular activities bring us the environment of *problem exploring type* active learning and it will keep our teaching environment competitive without big changes of our educational curriculum and teacher's effort. However, we have also found some risks in teacher's roles in the proposed activities because as long as the age of our students is not coming of age the advisor must have responsibility in safety issues. For example, the student formula car project team could not get permission for their activity in the judgment of our college because safety risk exists in metal working process to develop a formula car due to our poor experience in craftsmanship. It is concluded that such existing safety risks in extracurricular activities in our school restricts our proposal.

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A PBL MODULE "LAB-PRACTCE IN ELECTRONIC CIRCUITS" IN THE ELECTRICAL AND ELECTRONIC DEPARTMENT OF KITAKYUSHU NATIONAL COLLEGE OF TECHNOLOGY: STRATEGY AND TASK DESIGN

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Abstract

A problem based learning (PBL) module, "Lab-practice in Electronic Circuits", is held for the fourth year students of the electrical and electronic department in our college. In this module, groups of three or four students build robots to complete given tasks. A ready-made robot kit (LEGO MINDSTORMS NXT) is employed and the students try to build mechanical parts and original electrical/electronic circuits to improve the performance of their designed LEGO MINDSTORMS. As electrical technical tasks have been chosen so far, we set the robotic competition including mechanical tasks for the class of 2013. So, their robots are tasked to escape from chaser robots and to climb a wall/hill using a mechanical anchor catapult and a motor-driven winch system. Since this is their first robot building experience, two opportunities (i.e. robotic competitions) to build robots are provided to compensate for their lack of experience in fabrication.

At the first competition, they built robots only using original components of the LEGO NXT. Based on the results and experience obtained from the first attempt, the students fabricate t h e i r next robots with their own original mechanical and electrical parts for the second task mentioned above. The electrical motor control unit is attached to the NXT using HiTechnic prototype board which provides an easy-to-use platform for connecting other electric devices to the NXT. Although LEGO MINDSTORMS NXT is often used in only the introductory education of engineering, it has been confirmed that combinations of a ready-made LEGO robot kit and original mechanical and electrical parts, are very effective to increase the technical level of robot. The Electrical and Electronic Engineering department students could fabricate a wide variety of mechanical catapults and winch systems without a mechanical engineering background. It is shown that this type of PBL module is effective to combine the fields of engineering education. From this module, the students learned the importance of combining different engineering fields to solve the problem.

Keywords: *problem-based learning (PBL), LEGO MINDSTORMS NXT, robotic competition, combination of the fields of engineering*

Introduction

The field of electric and electronic engineering covers a wide range of manufacturing industry. Therefore, students in the electric and electronic engineering department acquire basic science and electric and electronic engineering skills through lecture and laboratory-based courses. Areas of courses include fundamental electrical circuits, electromagnetism, electronic circuits, electronics covering semiconductor devices, computer and information technology, control system engineering, electrical power engineering. Recently, it has been required to improve class lessons and curriculums in institutions of higher education by adopting students' active learning. A problem/project based learning is one of good instruction methods to promote students' active learning. Our curriculum has also provided a problem based learning (PBL) module named "Lab-practice in Electronic Circuits" for 4th year student since 2011. In this module, through the development of original robot, the students learn programming, electronics, circuit development, group collaboration, presentation skill as well as problem solving skill. This paper describes the module design and methodology and problems come out for three years.

Subject design and strategies

"Lab-Practice in Electronic Circuits" is the only PBL subject of one credit for the 4th year students in our department. The total class hours of this PBL module is limited to be 2 hours × 15= 30 hours, because our curriculum has to cover the fields of the electrical and electronic engineering mentioned above. Figure 1 shows the scheme of this PBL module. The module is divided

to two periods in which robotic competitions and result presentations are held respectively.

In this module, a combination of a ready-made robot kit (LEGO MINDSTORMS NXT) and original electronic circuits is employed to compensate the lack of total class hours. Although the employed robot kit is often used in only introductory education of engineering due to its simplicity, more technical flexibility can be added using HiTechnic prototype board to provide higher level technical tasks. Moreover, since the group members are shuffled after the first competition. the students have to try the second one with new members and again build the partnership in the new group. Thus, each student in the new group enables to share their experiences and strategies obtained in the previous groups. Through participating in the two robotic competitions, the students learn especially the collaboration work, presentation skill as well as problem solving skill. Table 1 shows a list of tasks imposed on students. Since the total class hours of this module is limited, the tasks have been adjusted according to the difficulty and load of the second competition. Although details concerning second competitions are explained later, the technical level (i.e. electrical and mechanical difficulty) of the robot has increased year by year.

The first half period

In the first half period, students learned the basis of LEGO MINDSTORMS NXT robot system including the mechanical system, principles of sensor units, electronics as well as programming. The students were randomly divided into groups of three or four members.
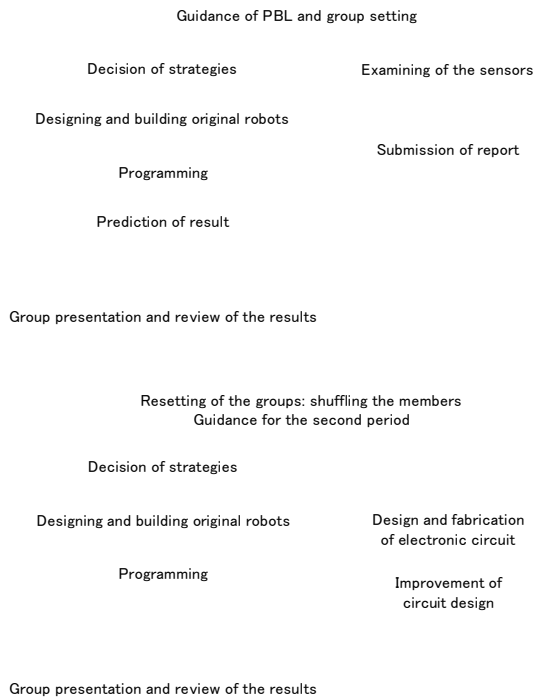
Guidance of PBL and group setting

Decision of strategies   Examining of the sensors

Designing and building original robots

Submission of report

Programming

Prediction of result

Group presentation and review of the results

Resetting of the groups: shuffling the members
Guidance for the second period

Decision of strategies

Designing and building original robots   Design and fabrication of electronic circuit

Programming   Improvement of circuit design

Group presentation and review of the results

Figure 1 The scheme of "Lab-practice in Electronic Circuits".

After the instructions of the PBL and the problem (competition task) were completed, they started to examine sensors and the NXT system by themselves. Basing on the investigation of references, measurement of sensor signals, disassembling sensor units, and their already learned knowledge, each student writes a report to explain how the sensor system works. Although each member of a group reports a unit individually, the reports are evaluated by all group members and are revised with a red pen that is employed to emphasize the missing point that should be improved. By considering the results of real measurements and the revisions of report, they can recognize what they know, what they do not know, and they have to learn. Then, they started to build their original robots and the programs for the competition. In 2013, without both examining sensors and writing the report, the students learned the NXT system and programming in the process of building their robots for the first competition.

Figure 2 shows the competition field. The field consists of three gates that have a pair of photo sensors to detect the light emission from a robot. So the competition is named "Three gates". When the level of light robot emitting reaches a threshold one, the gate is considered to be opened. To win the competition, a robot has to open the all gates and return to the original position quickly without any troubles. Although the competition is same every year, the degree of difficulty

Table 1　The list of tasks imposed on students in 2011 to2013.

Task		2011	2012	2013
Sample robot building in the first guidance		✔	/	/
1st robotic competition	Title	Three gates		
Task				
Examining sensors and report submission		✔	✔	/
Revision of report		✔	✔	
Result prediction		/	✔	✔
Group presentation and review of the results		✔	✔	✔
Revision of presentation slides		✔	✔	✔
2nd robotic competition	Title	Close encounters of the third kind	Vampire hunter	Escape from titans
Key technology		Sounder by PIC and piezo buzzer	Electro-magnetic flux pulse generator by RLC discharge	Winch by hobby motor and mechanical anchor catapult
Task				
Design and fabrication of electronic circuit		✔	✔	✔
Revision of circuit diagram		✔	✔	✔
Group presentation and review of the results		✔	✔	✔
Revision of presentation slides		✔	✔	/

Figure 2 The first competition field

Figure 3 Rough sketches of typical NXT robots.

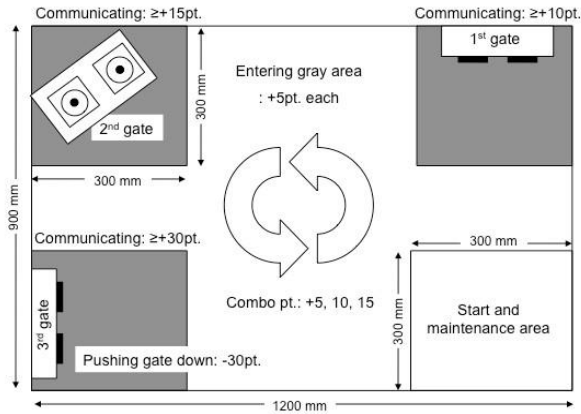
Figure 4 Image of second competition in 2012

Figure 5 Image of second competition in 2013

of the competition is changed by gate positions and adding some barriers, and so forth.

After the first competition, the all groups make presentations about their results: strategies, achievement of purposes, strong points and features of their robots and so on. There was also lively discussion on each presentation every year. Right after each group's presentation and discussion, facilitators (i.e. lecturers) reviewed their presentation and give advices for improvement of their presentation. Basing on the discussion and the comparisons of their presentation to other groups' ones, each member revises individually their presentation slides with a red pen. Through these processes of revisions, they can recognize the importance of impressive presentation and meaningful report as well. The group presentations are again made after the second competition

The second half period

In the second half period, a making of original electronic circuits and the designing of robot are tasked to the students. As the contents and rules of the competition and technologies used are changed every year, a specification of robot of the year changes too. Self-made electronic circuits are attached to NXT robots using HiTechnic prototype board which provides an easy-to-use platform for connecting other electronic devices to the NXT. Figure 3 shows rough sketches of robot of each year. The competition of each year is described below.

In 2011, photo sensors were replaced with microphones, though the competition field was same as the first. So students had to design and fabricate original sounder circuits and build robots equipped the sounder units. With building their circuits, the students also examined the electrical properties of these components a frequency response of piezo buzzer). The competition was from a famous scene in the movie "Close Encounters of the Third Kind". When a robot communicated microphones as gatekeepers with certain famous melody, the gates answered the melody by colorful light.

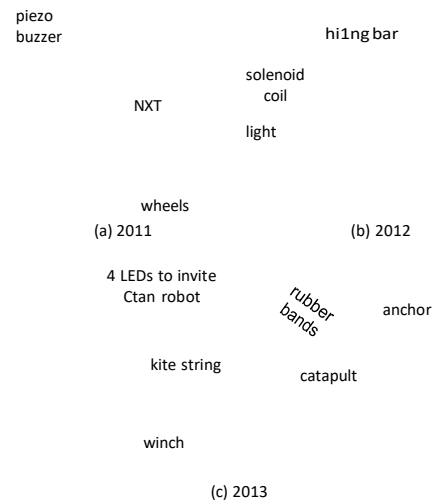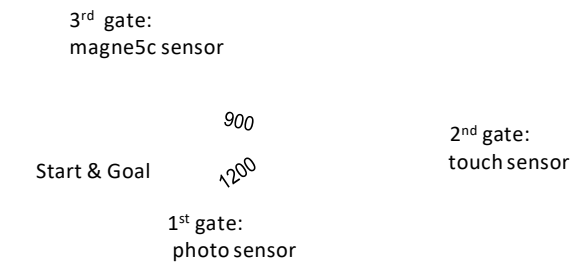In 2012 and 2013, the competitions were from popular TV animation programs. Figure 4 shows an

image of the second competition in 2012. Although the field is same as the first one, sensors of the gates were replaced with photo, touch and magnetic sensors. The gates were called vampires. A robot can knock each vampire down by light, blow and magnetic flux respectively. So each student group builded a robot which had three functions as shown in Figure 3(b). They also had to design and manufacture an electronic circuit and solenoid coil to generate magnetic flux pulse. Since the magnetic sensor can be activated from further away by increasing the efficiency of magnetic flux pulse, the students aimed at making critically damped RLC.

However, on the critical damping condition, the large surge current often caused troubles on some circuit elements. They learned a way of solving the problems using electrical measurement, data sheets of circuit elements and estimation of circuit parameters.

Figure 5 shows an image of the second competition in 2013. In this competition, students' robots had to escape from chaser robots called "Titan" and then climb a wall inclined at angle 45° as high as possible. As shown in Figure 3(c), the student robots have three functions as follows: four LEDs to attract titan robot, a catapult to throw an anchor beyond the wall, a winch to wind kite string. Student groups constructed variety of catapult systems and winch ones made by a hobby motor gearbox (TAMIYA 4-Speed High Power Gearbox H.E.) though they do not have enough background knowledge of mechanical engineering. The group also designed and manufactured both a LED lighting circuit and a motor drive one. In this competition, the students learned the importance of the combination of different engineering fields (i.e. electrical and mechanical fields) to solve problems.

Results and Discussion
Survey Results

We shall discuss outcomes of this module based on questionnaire results after the module was completed. Figure 6 shows survey results on radar charts about the student's recognition of their activities in the PBL in 2011 and 2013. A solid line indicates what they recognized as meaningful and a dashed line shows the activities they thought they were not good at. Since in 2013 the students did not investigate NXT sensors using electronic instruments, the question #6 in figure 6(b) differ from #6 in figure 6(a). For the questions #1 and #2, the usefulness decreases and the weakness increases in 2011 to 2013. The result about questions #1 means that it was more difficult for them to make tactical program for the competition in 2013. However, the programming itself was not tough for them. Since the number of electronic parts increased from 9 in 2011 to 23 in 2013, it was also more difficult for them to manufacture circuits working correctly. Thus, it also seems that they lost confidence in manufacturing ones a

very low in both 2011 and 2013, the usefulness increases from 51% in 2011 to 78% in 2013. From the result, it is considered that the students really concentrated on the competition in 2013 as compared with 2011. For the question #6, although they have little experience of mechanical engineering, no more than 24% of the students are not good at building robot. Moreover, 51% of them think it is useful. From the results, this module is not only a good introductory learning of mechanical engineering but a good experience to solve practical problems using combination of different engineering fields.

Figure 7 shows a survey result on a five level scale radar chart about the student's recognition of the PBL outcomes. The solid and dashed lines show the results in

(a) 2011

(b) 2013
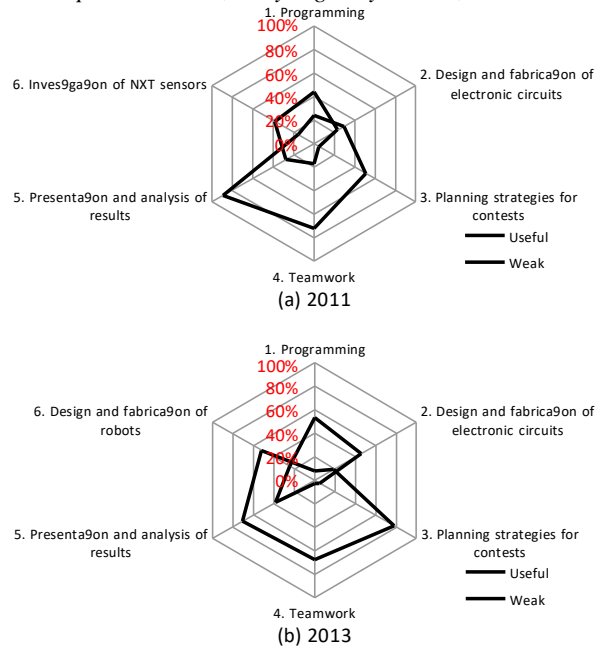
Figure 6 The students' recognition of their activities in the PBL in 2011 and 2013.
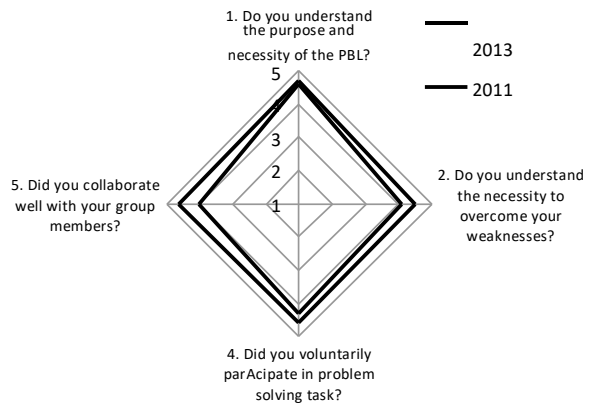
Figure 7 The students' recognition of the PBL outcomes in 2011 and 2013.
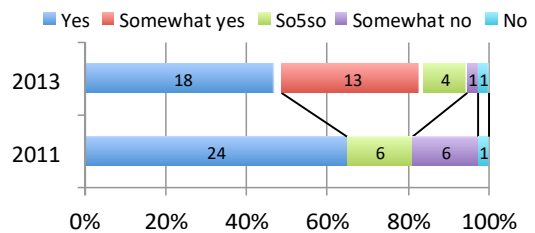
Figure 8 The survey result on the students' recognition of necessity to increase number of PBL subjects in 2011 and 2013.

2013 and 2011 respectively. For all questions, higher positive response rates are obtained in 2013 than in 2011. As the results, it is clear that they were able to understand following things: the purpose and necessity of this subject, necessity to overcome their weakness, significance of self-directed attitude and collaboration

Figure 9 Reasons for necessity to increase number of PBL subjects in 2011 and 2013.

with each other. It is also considered that this PBL module has been improved for the last 3 years.
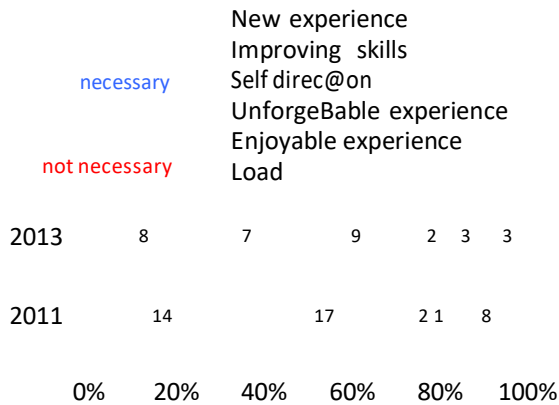
Figure 8 is the survey result on the students' recognition of necessity to increase the number of PBL modules in 2011 and 2013. It is clear that most students want to learn in PBL modules more. It should be also noted that negative response rate decreases from 19% in 2011 to only 5% in 2013.

Figure 9 shows reasons why they want more PBL modules. We classify students' comments into six keywords in this figure. In 2011, rates of "new experience" and "improving skills" are very high. In addition to these reasons, a rate of "self-direction" becomes high in 2013. Moreover, a rate of "enjoyable experience" increases, and a rate of "unforgettable experience" comes up for the first time in 2013. On the other hand, their only objection against the increase of PBL module is that they are overloaded in spite of fact that this module is only one credit. These results suggest that the number of tasks and contents of tasks influence students' learning significantly.

Discussion

Several different points between the PBL modules in 2011 and 2013 are as follows: the presence or absence of sensor examination, the number of tasks such as a red pen revision, the technical level of the second competition. The PBL module in 2011, which may be called task-centered-PBL, is considered to be useful for the students to obtain skills such as measurement, manufacturing, presentation and analysis and so forth. On the other hand, the module in 2013 is considered to be effective to understand significance of self-direction and collaboration, and delight of learning and manufacturing. The former outcomes obtained by the PBL are meaningful for upper-class subjects. The latter outcomes such as self-direction are important in introductory education of engineering. Therefore, the PBL module with combinations of a ready-made LEGO robot kit and original mechanical and electronic parts can contribute to engineering education for all grades effectively.

In addition to the above discussion, we shall discuss titles of the competitions. In 2011, the competition was from the movie "Close Encounters of the Third Kind". Although we authors knew the movie very well, all students knew it little. Therefore, the students thought it was just one of rules that robots communicate with gates using a melody and light. In 2012 and 2013, robots were given same tasks as heroes in popular TV animation programs which many students were watching. As the result, it seems that most students understand rules and purposes of the competitions easily, and all members of a group plan strategies for the competitions effectively and collaboratively. Furthermore, the students were all excited in the competitions, and they had sense of accomplishment after the competition over. In the questionnaire survey, some students answered that they had obtained enjoyable and forgettable experiences. It seems that subject outcomes related to these experiences will remain in students' memories in future.

Conclusions

The PBL module with combinations of a ready-made LEGO robot kit and original mechanical and electrical parts can effectively contribute to engineering education for all grades. Furthermore, it seems that students' learning outcomes can be controlled by amount and kind of tasks in the PBL module.

Moreover, the PBL module, which is designed according to students' interest, is effective for students to collaborate in their groups. In such a module, it seems that the students experience activities related to positive feeling. It is considered that enjoyable and forgettable experiences in the activity play important roles to fix outcomes in students.

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DISASTER PREVENTION EDUCATION BY USING E-LEARNING WEBSITES OF DYNAMIC HAZARD MAP

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Abstract

After the 2011 East Japan Earthquake, many local governments made or improved the websites for the disaster prevention education. Some of them, the e-learning system is used to study natural disasters by themselves. In the previous study, the applicability of these websites for the self-studying materials to the disaster prevention engineering was investigated. After the self-study using the websites, normal disaster prevention education in the college was effective to follow up the ambition for study.

In this study, an important issue using any hazard maps in the lectures was pointed out. That is, all students lost their interest after knowing that their houses existed in the safe zone in the hazard map. They didn't want to know about natural disasters except their housing area. Some local government created dynamic hazard maps in which natural hazards were not fixed and the initial conditions were selectable. Users can select one scenario from many initial conditions. A dynamic hazard map on the web-site was used to learn that the output (result) were variable depending on the initial conditions. Consequently, many students understood that the human suffering varied depending on the initial scenario or initial condition.

Keywords: *disaster prevention education, hazard map, e-learning system, initial scenario*

Introduction

After the 2011 East Japan Earthquake, as increasing the civic concerns for the natural disasters, especially huge earthquakes, many local governments made or improved the websites for the disaster prevention education. Some of them are used the e-learning system or the web-GIS system to study natural disasters by themselves. In these websites, the mechanism of natural hazards was explained and the shelters in the area were shown.

In the previous study (Nabeshima, 2013), the questionnaire survey for my college students was carried out to investigate the applicability of the websites for the self-studying materials to the disaster prevention engineering. Three websites of local

governments were selected to compare the applicability. After seeing three websites, 61 students answered the questionnaire and the results were analysed. All websites can be applicable for the self-studying materials to the disaster prevention engineering. Many students were interested in these websites. After the self-study using the websites, the normal disaster prevention education in the lectures was effective to follow up the ambition for study.

To study more details of natural disaster, the normal paper hazard map was used in the lectures about disaster prevention education. However, I realized the difficulty at using paper hazard maps in the lectures. That is, some students lost their interest after knowing that their houses existed in the safe zone in the hazard map. They didn't want to know about natural disasters except their housing area. So, I stopped using a paper hazard map in my lecture. Similar difficulty was recognized in the local governments. Some local government try to overcome this difficulty by using a dynamic hazard map system in which the results of natural hazards were not fixed and the initial conditions were selectable. Users can select one scenario from many initial conditions. The result was variable depending on the initial conditions which were selected by users.

In this study, the dynamic hazard map on the website was used to educate the importance of the initial scenario to make the hazard map for my students. Also, students understand that different results or damage will occur in the natural disaster when the different initial scenario was selected.

Websites of Local Governments for the Disaster Prevention Information and Education

Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT, 2012) started the operation of the hazard map portal site as shown in Fig.1, in which major websites for disaster prevention information such as hazard maps and the disaster prevention education of loacal governments in Japan were summerized.

From this website, the situation of the preparation and development of hazard maps in each prefecture is easily understand. Hazard maps for flood and slope failure were popular and they were prepared in many local governments. Although Japan has many volcanos, the hazard map for volcano was rarely constructed in

Japan. After the 1995 Great Kobe Earthquake, many local governments prepare the hazard maps for the earthquake disasters, such as the earthquake intensity and liquefaction potential. After the 2011 East Japan Earthquake, some of local governments started to prepare the hazard maps for the tsunami disaster because of the urgency.

Fig.1 Hazard map portal site of MLIT

For one example, a disaster information website of Hyogo Prefecture (2012) is shown in Fig.2, because of the my college address. The five categories of hazard maps, which were flood, slope failure, tidal wave and agricaltural irrigation ponds, were shown in this web site. They are able to see the real-time situations on the website by using the web-camera. Viewers can study about the mechanism of each disaster and useful information from this website through the understable explanation and illustrations. Five hazard maps such as flood, high tide wave, tsunami wave and landslide are demonstrated in this website, however, all hazard maps show the hazard area for every natural disasters and the initial conditions are explained by small words but few viewers aware the explanation as shown in Fig.3. Therefore, the hazard map on the website is same with the paper hazard map, it is necessary to introduce the initial conditions to make this hazard maps.

Fig.2 Disaster information website of Hyogo Prefecture

Fig.3 Flood hazard map of Akashi city on the website.

Fig.3 shows the flood hazard map of Akashi city area on the website. It is possoble to enlarge the scale and investigate detail points, however, the hazard areas are fixed and same with the paper hazard map.

Dynamic Hazard Map

Kamaishi city shows the dynamic tsunami wave hazard map collaborated with Gunma University. This website introduces the initial scenario and conditions to viewers at the beginning of the dynamic hazard map. Fig.4 shows the top page of the dynamic hazard map (Katada lab., 2014).

Fig.4 Top page of dynamic hazard map.

In the first scenario, the earthquake occurred at night and Kamaishi city citizen delayed to start the evacuation action because of the late public evacuation directive. Also, the magnitude of the earthquake was explained. After reading these initial conditions, all viewers can proceed to the next page. The dynamic tsunami wave hazard map is shown as shown in Fig.5. The dynamic hazard map shows a simulation of tsunami wave and evacuation response and action of citizen and total number of casualties with elapsing time.

After finishing the tsunami wave simulation along the first scenario, the main points were summarized and next scenario will start. Fig.6 shows the simulation in the second scenario. In the second scenario, all citizen started the evacuation action earlier than the first

scenario, consequently, total number of casualties decreased compared to that in the first scenario. Also, in the third scenario which all citizen started the evacuation action just after the earthquake occurred, the simulation showed no casualties by the tsunami wave.

As explained above, the dynamic hazard map can educate the viewers that the results or outcomes varied depending on the initial scenario or initial condition. Good understanding about the natural disaster and the evacuation action can reduce the human suffering.

Fig.5 Simulation of tsunami wave in the first scenario.

Fig.6 Simulation of tsunami wave in the secod scenario.

Disaster Prevention Education by Using Dynamic Hazard Map

In the lecture of the disaster prevention engineering, the questionnaire survey about the dynamic hazard map mentioned in the previous section was carried out for my college students. In the questionnaire survey, the interestedness, the understandability and the importance of the initial scenario were asked for 42 students.

Fig.7 shows the percentage of the interestedness about the dynamic hazard map. The 26% and the 60% sutudents were very interested or interested in the dynamic hazard map. This rate is bigger than that of the paper hazard map. This means that almost students were intersted in the dynamic hazard map and the dynamic hazard map was a useful tool to educate the natural hazards to the citiszens (Kasada et al., 2004).

Fig.8 shows the percentage of the understandability of the dynamic hazard map. The understandability of the dynamic hazard map was evaluated by comparing to

the paper hazard map. The 29% and the 52% of students answered to the questionnaire as easily understandable and understandable. These rates were much higher compared to the paper hazard map.

Fig.9 shows the awereness of the importance of the initial scenario to the result or the human suffering. The 93% students were aware that the results or outcomes, the human suffering varied depending on the initial scenario or initial condition. As mentioned by Katada et al. (2004), the significant change to the citizens will occur for the natural disaster prevention by using the dynamic hazard map.
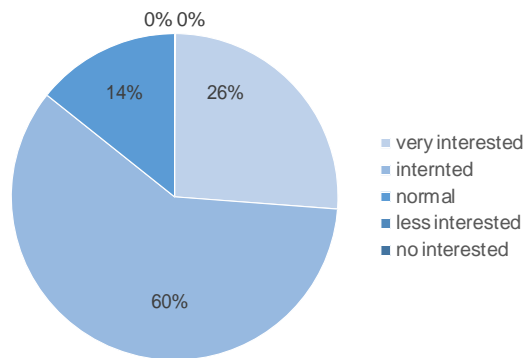

Fig.7 Interestedness about the dynamic hazard map.
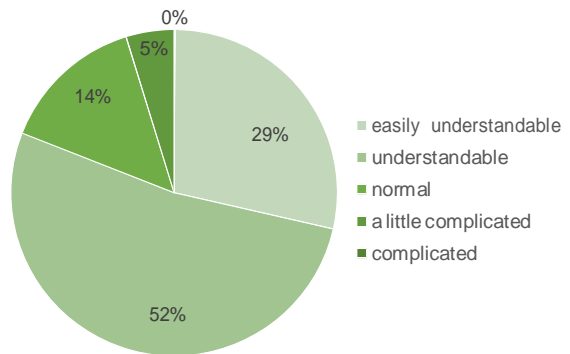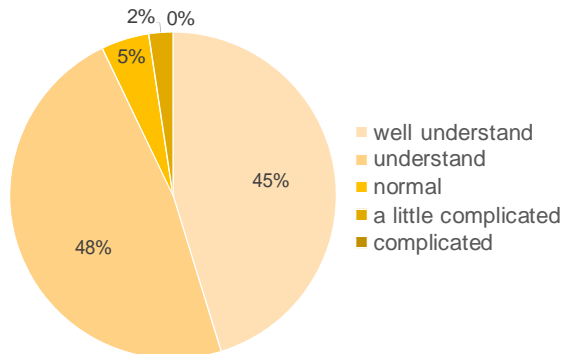

Fig.8 Understandability about the dynamic hazard map.

Fig.9 Awaereness of the importance ot the initial scenario.

Conclusions

In this study, the dynamic hazard map was used to study the disaster prevention education as an alternative

for paper hazard map. Many students were intersted in the dynamic hazard map and the dynamic hazard map was a useful tool to educate the natural hazards. Almost students were aware that the results or outcomes, the human suffering varied depending on the initial scenario or initial condition.

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DEVELOPING PRESENTATION SKILLS FOR FUTURE ENGINEERS IN THE AGE OF GLOBALIZATION

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Abstract

In this paper, we report on our new educational practice started from October 2013: an in-class English poster session for engineering students. This practice aims to develop engineering students' English abilities to properly summarise and present their own research findings. Briefly reviewing basic grammar and layouts for academic posters, 40 students majoring in mechanical, electronic, information and chemical engineering, summarised their own graduation research on A1-sized posters with our help of grammatical and stylistic corrections. They then presented the posters during an in-class English poster session held at the end of the semester.

At this session, the students received positive feedback from each other and their presentations were critically evaluated by three examiners including one English teacher and two engineering faculty members. In terms of the accurate usage of English, there were several incorrect expressions found on the students' posters, such as 'subject-less' sentences, which reflected the linguistic difference between Japanese and English. Also, although most of them were well-prepared to explain their posters, few could respond appropriately to questions asked by the audience at the session.

A questionnaire survey after the session showed that almost all the students were aware of not being well-prepared for questions but were very enthusiastic about their presentations. Also, more than half of them preferred interactive and output-based activities like this poster session, compared to input-based classroom activities like lectures.

Keywords: *in-class poster session, English, graduation research, globalization*

Introduction

For teachers, a sudden visit by graduates is always a pleasant surprise. Some of them tell us exciting experiences of their first job and a radical change in their ways of living since they began their new career.

A few years ago, one such graduate came to my office and reported that he would work in overseas factories in Asian countries for several months. That surprised me a lot: he works for a small branch office in a rural town and at that time he spent just a couple of months working there. His report made me realize that more opportunities to work overseas are open to our students than in the past and that there surely is a social need that our education enable them to communicate in English around the world.

This social need is in harmony with our view of technology education. As an educational institution fostering future engineers in the age of globalization, we believe that we are expected to teach not only essential and recent skills and knowledge of technology but also communicative skills of English so that they will be able to discuss and share their ideas and technology with people who have different linguistic and cultural backgrounds.

An educational practice reported in this paper is one of our challenges reflecting the social need and our view of technology education mentioned above. We have held an in-class English poster session since the fall semester in the academic year of 2013. This paper mainly reports the poster session held in January 2014 as a means of the term-end evaluation, where most of the students presented the posters about their graduation research.

The Course and its Participants

40 Japanese students participated in this educational practice. The students are from 4 different engineering departments ((a) mechanical engineering, (b) electric and electronic engineering, (c) control and information systems engineering and (d) bio-chemical engineering). They were mostly in the age of 20 and belonged to the final year in the five-year curriculum.

The practice was done in the first author's English course called "Language Seminar," with the help of the second author as a teaching assistant. The course is one of elective but mandatory courses of liberal arts available for the fifth-year students. It consists of fifteen

meetings in 15 weeks: each meeting is 50-minute long and we meet one time per week.

The aim of this course is to improve the students' skills of oral and written English expression. Since this information was announced in the form of a syllabus booklet prior to their course registration, the students who registered this course were motivated to express themselves in English. Yet, their English abilities were not so high: the participants' average score of TOEIC was 350.4 points, which approximately corresponds to B1 level of CEFR, according to a standard-setting study conducted by ETS (2007).

Although their English ability was almost in the beginner level, each student had some original ideas to discuss because they belonged to the final year and thus were working on their graduation thesis under our faculty members. Some of the students had already experienced some kinds of presentations on their research topics at the domestic conferences.

These facts just mentioned above led us to the idea of setting up an in-class poster session in English. By making the students prepare for an English poster session, we intended to improve their multiple skills of English: summarizing and visualizing research findings and interacting with audiences, for example.

An additional advantage of an in-class English poster session was to encourage the students to join a real poster session at an international scientific conference after they practiced their presentation in this course. This would be a beneficial offer especially for students who were eager to continue their research even after the graduation from our college.

Before moving on to the next section, let us summarize the basic information of the course and its participants. The information is listed in Table 1 below.

Items	Description
Participants	- 40 students in the fifth year
English Level	- Beginner level - B1 in CEFR scales
Course	- "Language Seminar" (2013 Fall) - 50-min. meeting, 15 times
Aim	- To improve multiple English skills through poster presentations: summarize and visualize research findings and interact with audiences

Table 1: Course and participant information

Methods: Teaching, Presentation and Evaluation

In each 50-minute meeting, we first watched a ten-minute scene from an English movie (*The Devil Wears Prada* for that semester) with English subtitles, and then discussed the events happening and shared the students' opinions about the scene. This was not only for entertaining them but also for their practice of their basic speaking skill. When some of them commented like, "I think Andy became like she's work," we could give them a corrective feedback such as "You mean 'Andy became *to like her job*,' right?" Thus, this interactive discussion was intended for the improvement of their speaking skill to express some basic ideas and opinions.

After discussing the English movie, we learned about typical components, contents and effective visual impact by looking carefully at some academic posters. Several faculty members kindly offered us their data of academic posters which they had already presented in the international conferences.

Figure 1 below shows one example of how we used real academic posters as teaching materials. Figure 1 is a part taken from an academic poster on chemistry research, but it is a little modified with two white boxes hiding some words. In this case, *measurements* and *time range* are hidden by the two boxes, respectively. In the class meeting, the students were asked to guess (or, choose from the listed answers) what were hidden by the boxes, which ranged from a unit to headings frequently found in scientific posters.

Figure 1: A modified part of academic posters
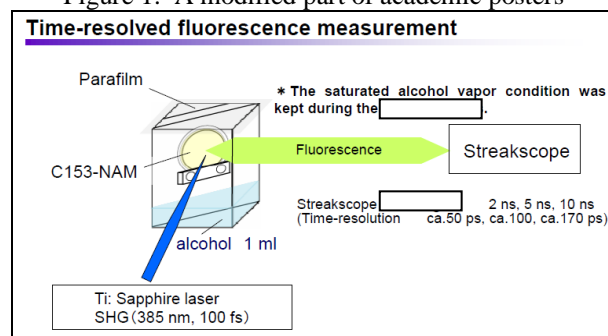
After we discussed the movie scenes and learned the basic components and common expressions found in academic posters from the first to tenth meetings, the students were allowed to spend three meetings to summarize their own graduation research in an A1-sized poster written in English. Once their drafts of the posters were completed, the drafts were sent to us by e-mails in order to be checked in grammar and style, and then sent back to them for the final correction. Lastly, in the last meeting, the in-class poster session was held.

During the poster session, all the students, teachers and guests had to speak only in English. Each student standing by his/her poster was freely spoken to by guests, other students and three examiners. The group of three examiners consisted of two engineering faculty members with a lot of overseas experiences and one English instructor (the first author). The faculty members mainly evaluated the students' ability to explain their research logically and the visual effectiveness of their posters, while the English instructor focused on fluency of English communication and accuracy and appropriateness of English written on their posters.

Besides the evaluation by three examiners, the students could listen to and ask each other and receive some feedbacks in the form of small comment cards. Also, a questionnaire survey was done after the session to know how well they could prepare for the session.

Table 2 below summarizes the methods and what was done in each meeting.

# of Meeting	Methods
1 – 10	- Discuss the movie scenes - Learn components and expressions in academic posters
11 – 13	- Make posters
14	- Check grammar and style
15	- Evaluate presentations at the session - Receive peer feedbacks - Conduct a questionnaire survey

Table 2: Methods in the course schedule

Results and Discussion

In terms of accurate English usage, there were a lot of incorrect expressions found in the students' posters. Of all the incorrect expressions, the most common one was "subject-less" sentences, where there is literally no subject noun phrase in a sentence. The following sentences are such typical examples taken from the students' posters. Note that an underbar "_" in each example indicates the position to be filled with some subject noun phrases.

(a) To win many market shares, _ must be able to construct whole plant.
(b) _ Is shown in Figure 1.2, the strain gauge and infrastructure used in the experimental apparatus.
(c) _ Was made possible this low backlash crown reducer.
(d) _ Must be incorporated into E. coli to amplify the sequence of the metacaspase to make it.
(e) _ Were placed in order from top left this time, but the pattern is limited by this.
(f) As the first one, _ was adopted on the basis of the number of spaces this time, but _ takes too much time in this.

It seems that there is a tendency for subject noun phrases to be wrongly omitted within passive sentences as shown in the above examples (b) to (f).

The students' incorrect subject omission would be due to the effect of their native language, Japanese. In Japanese, words are frequently omitted once they appear and become known in a discourse. For example, in a Japanese discourse like "Taro-wa kooen-ni itta. Tomodachi-to asonda" (Lit. Taro went to park. Played with friend), *Taro* and *kooen* (park) can be omitted in the second sentence because these are already known in the discourse.

In English, on the other hand, subject noun phrases are always necessary in a sentence and not omitted in the discourse. So, a discourse like "John went to the park. He played with his friends (there)" sounds good, but another discourse like "John went to the park. Played with his friends (there)" is grammatically incorrect. Before letting the students start writing, we should have reviewed an essential grammatical rule that subject noun phrases are not omissible in English unlike Japanese.

Let us observe a few more writing samples from the students' posters.

(g) Use of particle filters have been focused in the field of computer vision in recent years performs simultaneous detection and tracking and …
(h) To determine the thermal efficiency, the use of heat loss method.

In (g), although a subject noun phrase *[the] use of particle filters* and a verb phrase *have [has] been focused* are clearly written, an additional verb *performs* appears later without any subject corresponding to it.

Also, what is written in (h) is not a complete sentence but a large chunk. *The use of heat loss method* itself is a noun phrase, so this phrase should be assigned some roles such as 'subject' or 'object,' as shown in *the use of heat loss method is necessary* or *we tested the use of heat loss method.*

These samples from (a) to (h) show that it was necessary for our students to review again the basic structure of an English sentence: an English sentence must contain at least a subject and a verb. Of course this rule is exceptional in some forms of writing such as an itemized writing, but it must be followed when they write a paragraph for any sections in their posters.

As for the students' oral interaction with the examiners and audiences, most of them were so prepared that they were able to state a summary of their own research and to explain about the pictures and graphs shown in the posters. However, they were not able to respond appropriately to various questions randomly asked to them during the session. Some of these questions were like *Why did you adopt this method, not a different one?* or *How do you think your research outcome makes our life better?* They did not seem to have taken enough time to expect what questions would be asked by someone who read their posters.

Our observation of the students' oral interaction mentioned above is reflected by the results of a questionnaire survey after the poster session. In the survey, all the 40 students were asked to answer the following five questions using 4-point Likert scale.

Questions
No. 1: Was your poster presentation visually effective?
No. 2: Was your oral explanation clear?
No. 3: Were you able to answer the questions from the examiners and audiences?
No. 4: Did you enjoy the poster session?
No. 5: Which do you prefer, a course with students' presentations or a course based on teachers' lectures?

The results of the questionnaire survey are shown in Figure 2 and Table 3 below. Figure 2 shows the percentage of the respondents choosing each of the scales ranging from 1 to 4. Table 3 shows an average

point of the respondents' answers to the each question. Note that 1 is for a negative and 4 is for a positive answer to the questions from No. 1 to 4 and also that 1 is for a lecture-based and 4 is for a presentation-based course in the question No. 5.

Figure 2: Distribution of chosen answers
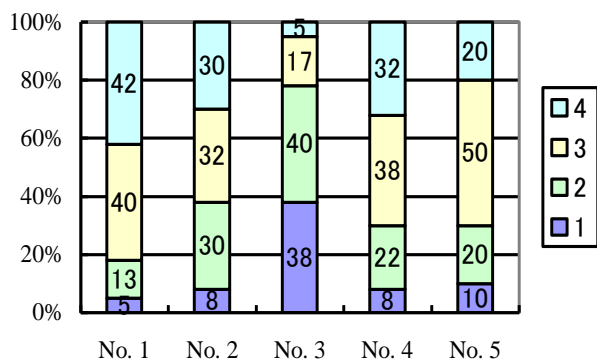
	No. 1	No. 2	No. 3	No. 4	No. 5
Mean	3.2	2.9	1.7	3.0	2.8

Table 3: Average points for each question

It is clear from the above data for the question No. 3 that about 80% of the participants were aware of not being able to respond appropriately to random questions by the examiners and audiences.

However, the data for the other questions show three achievements through the poster session: about 80% of them were almost satisfied to make visually effective poster presentations (No. 1), about 60% could explain their research findings clearly (No. 2), and 70% enjoyed this in-class English poster session (No. 4). Also, from the data for the question No. 5, a lot of participants as many as 70% came to be interested in a student-centered interactive English course.

For a next occasion of an in-class English poster session, it will be important that when our students prepare for English poster presentations, we should advise them not to spend too much time improving visual impressions and writing notes in English for the presentations. Instead, we should emphasize that a poster presentation is one way of communication. Since a poster session is an occasion when presenters and audiences communicate with each other, they must keep in mind how the audiences will read their posters and what comments or questions they will think of while they are preparing for their poster presentations.

Another point we should emphasize for a next occasion is, as mentioned in the first half of this section, the essential English knowledge that an English sentence must always have a subject and a verb within it. Some students with limited English ability tend to depend on a free online translation service to write English sentences, but for such students this knowledge is necessary in order to check whether at least a subject and a verb are included in English sentences they wrote.

Conclusions

In this paper, we have reported on an in-class English poster session as our new educational practice for future engineers. Based on samples written by our students on their posters and the results of a questionnaire survey after the poster session, the following outcomes and future tasks are obtained.

(a) About 80% of of the students were almost satisfied to make their posters visually effective.
(b) About 60% of them could talk about their research findings clearly in their own words.
(c) 70% enjoyed this in-class English poster session
(d) About 80% were not able to answer appropriately to the random questions asked by the examiners and audiences.
(e) 70% showed their interest in a student-centered interactive English course.
(f) Since a poster session is one way of communication, we should emphasize that our students must expect what comments or questions the audiences will think of when they are preparing for their poster presentations.
(g) The essential grammatical knowledge that an English sentence always requires a subject and a verb should be reviewed.

We are currently continuing an in-class English poster session during this 2014 spring semester. Its outcome will be obtained soon and then will be compared with our previous practice, which we have reported in this paper. The comparison of educational effects through the sessions in 2013 fall and 2014 spring will be ready to be presented at the on-site poster session in ISATE 2014.

Acknowledgements

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ENGINEERING ENGLISH:
A SENTENCE DIAGRAMMING APPROACH

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Abstract

Sentence diagramming is explored as a tool for teaching English to engineering students. Engineering students in Japan and in Kosens in particular often have very low English proficiency as demonstrated by their low scores on standardised English tests such as the TOEIC. In an attempt to find a more effective approach to teaching English to these students, we have been using sentence diagramming, based loosely on Chomsky's X bar theory, in the belief that it may be a good match with the engineering student's frame of mind and learning style. The students seem to catch on quickly to the approach and performed well on subsequent diagramming and grammar tests. And since English is both the means and focus of the teaching, it is hoped that this new approach for Japanese students can yield promising results. There are currently no textbooks that use this approach for ESL/EFL teaching, and it is our hope to produce such a textbook in the near future.

The research is in the early stages and we are interested in getting feedback from other students and teachers so as to come up with a more effective programme. We are trying to improve the teaching technique and are also appraising whether it is more useful than the traditional grammar translation approach generally used in Japanese classrooms. The technique may also be generalised to other English learners because it is an excellent tool for grammar consciousness raising and engineering frames of thought.

Keywords: *ESL, EFL, Language Education, X Bar Theory, Sentence Diagramming, Engineering English, TOEIC, Kosen*

I really don't know that anything has ever been more exciting than diagramming sentences.
- Gertrude Stein

Introduction

Sentence diagramming was introduced to the students of Ariake National College of Technology because other methods of teaching English seemed to have had little success. English scores by Kosen students as measured by the TOEIC test tend to be rather low. In fact, 4th year students at Ariake National College of Technology had an average score of about 296 points in January of 2013. This score basically means that after 6+ years of English courses the students are still unusable to perform even the most basic of tasks in English. And they are falling more than 100 points short of the school's goal of 400 points (which is still a low score). The students' prior education in jr high school and their current education in Kosen seems to have largely been a waste of time for all concerned. The technique generally used in Japanese schools, grammar translation, seems to be failing the students and other techniques have yet to gain any real foothold. After teaching in Kosen for several years and trying a variety of techniques with little success and watching students year after year fail to improve, a completely new system was tried in our 5th year courses - sentence diagramming. Engineering students often must use various kinds of diagrams in their core course work, be it schematics, chemical bonds, blue prints, or flow charts. Furthermore, many of the students seem to prefer visual learning, so to capitalise on these propensities a course was designed that might suit their learning style and needs better - sentence diagramming. The caveat was that there were no textbooks available or even any research concerning sentence diagramming for teaching English as a foreign language. Sentence diagramming has not been a popular pedagogy for over 30 years and has rarely if ever been used as the focus of an EFL class. The textbooks that are available on the subject tend to be VERY high level and meant for people studying linguistics who already have a strong command of English and not for the purpose of learning English itself.

To fill the textbook gap, a simplified method of tree diagramming based on X Bar Theory was created with the explicit aim of helping students to visually understand a sentence's structure and to teach students to use diagramming in such a way as to help them when reading, writing, or taking a test.

The end result has been a series of slide presentations explaining the system and practice problems to raise student consciousness about the structure of English through a simplified and slightly modified X-Bar diagramming technique.

The technique has now been taught for 3 years in all the 5th year classes at Ariake National College of Technology. Each year the system has been improved and further refined. It is the hope and goal of this effort to produce a useful pedagogy for the staff and students whom so far have struggled to have success with other techniques and create a textbook so that others can try the method as well. As the 5th year students do not generally retake the TOEIC test, it is hard to know how effective sentence diagramming has been. But student interest at least seems high when they self report, and many students seem to master the technique, scoring well on diagramming tests. How this translates to real world English usage or test scores on the TOEIC is something that has not yet been appraised. That needs to be the next step in this research along with further improving the materials for classroom use by broadening the skills to which diagramming can be applied.

Sentence Diagramming is a visual representation of the grammatical aspects of a sentence. There are several systems in use, but a system Based on Chomsky's X Bar theory was chosen as opposed to the sometimes used Reed - Kellogg system. X-Bar and its closely related cousins are sometimes called tree parse diagrams. X Bar was chosen because it imparts more information visually to the learner and is thus more compelling and easy to understand. And also, you do not have to re-write sentence. But Chomsky's X Bar system was not designed for low level EFL students or for teaching, so we have simplified X Bar diagrams, removing some difficult terminology and deeper structures, and adding some labels for details that are important to Japanese learners of English to help them avoid common errors and better understand the meanings of sentences. Words from the official KOSEN English word list have been used in most examples and exercises, in hopes of reinforcing more pertinent vocabulary than most textbooks employ (this list includes many technical terms that engineers are likely to encounter in their professional live

Materials and Methods or pedagogy

The students are taught all in English to improve their listening skills and following the theory that teaching IN English is better than just teaching ABOUT English. The class is run more like an engineering course than an English class. This is hoped to help reduce anxiety about learning English. Instead, students are focused on learning about sentence diagramming. Very little translation

is done. Keynote was used to make a weekly presentation that would teach one or two new aspects of sentence diagramming. Practice problems are given at the end of each lesson so that students can practice what was taught. Students are asked to work in groups on the practice problems and then give their answers on the board where the whole class appraises them. We have tried hard to foster a caring and supportive environment where everyone has a chance to part-take in using the skills learned.

The basic diagramming process goes something like this: First identify and label the parts of speech of each word using clues like suffixes and word order. Then chunk the sentences into smaller grammatical parts and label their underlying forms and their functions and show these relationships in a tree parse diagram. This gets students to become aware of the grammatical functions of words and phrases and understand better how they fit together. Students also label pertinent details like whether a noun is count singular or count plural or non-count (categories not present in Japanese) and verb tenses, voice, and predicate patterns. This helps students to see the salient details in a sentence - details they might otherwise easily miss or not think about. It forces students to consciously think about many aspects of the sentence in a way that is less threatening than in a more standard English class. Since there is no textbook, students are also encouraged to take notes. This may also help them remember the system better.

Tests are given each quarter to make sure the students are on track and doing well. Students who score low are encouraged to seek help and students who score high are encouraged to give help. Students who seem to totally fail to grasp the system early on are encouraged to work with a better student. They often are paired and work together at the board on problems.

Here is an example of a diagrammed sentence:

Engineers need good grammar because they must write in English

In the previous example sentence the parts

of speech are labeled with lower case letters, phrases and clauses are labeled in upper case letters, and functions are labeled in parentheses while further details are labeled in brackets. The conventions used for the labels are taught in class. This system helps students understand how parts function together, and relate to each other in patterns to make a correct sentence. Students are encouraged to label the parts of speech first, then chunk the sentence into smaller and smaller clauses and phrases working their way down. And finally label the functions and details of each part.

Results and Discussion

Most students have never been exposed to diagramming before, but come to be fairly proficient at diagramming by the end of the course with a low failure rate and a good high pass rate (fail = less than 60% high pass = 80% or better) with some students even getting perfect scores on the quarterly tests. A typical test has a mean score of just shy of 80% with usually less than 5% failing and something more like 30 or better getting a high pass. Most other classes at Ariake National College of Technology have a much more standard bell curve with 10% failing and 10% getting a high pass in other English classes.

Sentence diagramming is a way of raising a student's grammar consciousness without causing as much anxiety about actual English ability. Since diagramming is a visual learning style and does not require any direct communicative use of English in the traditional sense, it seems to put most students at ease while the puzzle like nature of diagramming seems to engage them in a way that regular English classes generally have not. Communication skill in English is not a requirement for doing well in the class, nor is using a large vocabulary. The group work and board work keep the students further engaged and allows the lower students to get help from the better students. Students are allowed to discuss in either English or Japanese, though all interaction with the teacher is encouraged in English. This mix seems to help the students feel less anxiety and resistance to the material, a serious problem in Japanese foreign language classes. The cooperative atmosphere seems to keep more students from tuning out when it does not come easily to them. Fewer students seem to sleep or otherwise become disengaged from the work (roughly 20% of students sleep in a normal lecture style class at ANCT but almost none have done so in the diagramming classes).

Using words from the Kosen vocabulary list makes the lessons more pertinent to Kosen students' studies, and recognising many of these words in class likely gives the students encouragement that the course is worthwhile for them. The average

textbook author is completely unaware of this list and no low level English textbooks seem to be aimed at Engineering students. This method tried to address this through passive vocabulary.

Learning how to analyse a sentence for both form and function and being able to identify pertinent details like tense, count, and voice seems to help students better understand and produce English by raising their grammar consciousness. It is also hoped that by extension this also helps them on standardised English tests and more importantly with English usage in the real world.

Conclusions

Sentence diagramming seems to be a promising technique for teaching KOSEN students and probably other Engineering students as well. Students report being satisfied with the class in their surveys and do well on diagramming tasks in class. However, since the students have yet to be retested on the TOEIC and compared against a control group, it is hard to know exactly how much their actual English ability has improved. Including exercises in future lessons that involve more production of English sentences and also more advice on how to apply the diagramming techniques directly to standardised test grammar questions would likely further enhance the effectiveness of this diagramming technique.

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STUDY ON CONTINUOUS USE OF TEACHING PORTFOLIOS
FOR PROFESSIONAL DEVELOPMENT

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Abstract

Recently, teaching portfolios have attracted much attention as part of faculty development activities. Though various faculty development activities have been conducted at t h e Anan National College of Technology, the portfolio workshop was held for the first time in 2010, with the aim of further improving in the quality of teaching. Creating a teaching portfolio within the National Colleges of Technology has prevailed more so than at universities and other colleges. Eighteen workshops have been held both on and off campus with cooperation between the Colleges of Technology for three-and-a-half years. More than 80% of Anan National College of Technology faculty members created portfolios. The participants successfully created their portfolios and they indicated their satisfaction as a result of the questionnaire.

After the workshop, almost all of respondents felt that the workshop was useful and beneficial for their careers. Since the participants recognized that the workshop is significant for the faculty at the College of Technology, 80 % of the faculty has already participated enthusiastically. One of the most important point is that teaching portfolios benefit educational improvement. Workshops are not the only purpose. Moreover, it is necessary to assess the benefit of teaching portfolios for the participants.

Next, we carried out a follow-up survey about the continuous use of teaching portfolios for participants of the workshops. From the survey, 94% of them answered "very satisfied" or "satisfied" for the workshop. Since more than 50 % recognized alteration of awareness and behavior when comparing their professional ability before their teaching portfolios had been created with the effect of the workshops, the effectiveness of the teaching portfolios is demonstrated. On the other hand, it is found that they don't willingly try to use their teaching portfolios after their workshop.

Finally, we propose a workshop for updating their portfolios. In this paper, the continuation is considered as accompanied by the participant follow-up survey. They are useful in order to achieve the optimum workshop and continuous use of teaching portfolios at the Colleges of Technology.

Keywords: *Teaching improvement, Professional development, Teaching portfolio, Workshop, Reflection*

Introduction

The 2008 report by the Central Council for Education entitled " To Construct Undergraduate Program" states: "In Japan, FD's spread and the efforts of relevant parties are recognized, however it is not enough to develop faculty's ability." The continuing study concerning pedagogy and instructing various cohorts of students is desired, and every college must reconsider faculty development to improve educational abilities. Considering these situation, National Institute of Technology, Anan College (NIT, Anan College) chooses the TP as an educational improvement (e. g., Matsumoto, et. al., 2013).

Teaching Portfolio (TP) and Institutional Research Program of NIT, Anan College is collaboration between Professional Development as an independent active and Institutional Research as objective one. It was adopted by competitive funds of Program for Promoting High-Quality University Education, Ministry of Education, in 2010, which is selected only two colleges of technology and Anan College is one of them.

The Second Basic Plan for the Promotion of Education was adopted upon Cabinet decision on 14 June, 2013. The Basic Plan for the Promotion of Education is a plan drawn up based on Article 17 Clause 1 of the Basic Act on Education which defines the comprehensive and systematic implementation of educational policy. In higher education, the promoting university reform to increase student's overall study hours is required. In order to achieve a transformation of educational quality based on the establishment of a student's independent study, it is getting more important for professional development. Recently, TP activity is gradually spreading in the institutions of higher education in Japan.

Teaching Portfolio

Teaching Portfolio is a record that faculty makes up by his/her own words after reflecting back his/her educational activities with many kinds of evidence that indicate his/her educational performance. The description of upper Report gives more interest to TP. Kurita (2013) pointed out that the four main characteristics of TP as the following:

1) Self-reflection: it is just as the term indicates, reflection by oneself

2) Evidence as proofs: portfolio is a record of one's self-reflection and evidences work to possess high reliability

3) Pliability: faculty freely write our educational activities by selecting the most useful framework

4) Carefully selected information: It is enough to choose the most important information which helps the readers to understand it. Selective evidences to prove faculty's educational activities and works.

Seldin (2004), one of the TP pioneers, suggests "The process, itself to create a Teaching Portfolio is a cue to think about our educational activities, reconsider our educational strategy, and make our future plans. It may be said that the creating process has a direct relation to faculty development.

Teaching Portfolio has been spread in 1990s US, and now more than 2000 universities has adapted. In the US, Teaching Portfolio is also used as required documents at tenure review.

Teaching Portfolio Workshop

The TP workshop schedule at NIT, Anan College is shown in Table 1. The workshop is held for two and half days. As advance preparation, we used a paper; "start-up-sheets" made by Dr. Kurita, National Institution for Academic Degrees and University Evaluation (NIAD-UE).

Basically, the workshop involves three times meetings between Mentee and Mentor, and workings are also set to motivate each other during the workshop: "Exchanging Idea", "How to be a good mentor", and "TP Presentation". Some conversation during creating TP time or uncommon exchanging with other participants, give them some hints and help reconsidering, finding, feeding back to their educational philosophy, or getting new idea. Especially "TP Presentation" gives chances all participants to know

other's educational philosophy or devised performances. At NIT, Anan College, we consider these new findings as good points of workshop, so we positively receive participants from other institution. We also make a plan to have an optional convivial party in the evening.

Concerning mentors' roles, they facilitate their mentees to notice their own worthwhile. During mentoring, mentors don't push their own idea to mentees. For these approaches, mentee could notice their educational philosophy which they are unconscious in usual days. At the cases that mentees need more time to create their TP, we sometimes omit "How to be a good mentor". This group work (Mentoring workshop) use affinity diagrams. In "TP Presentation", mentee normally prepare and share one-page A4 paper to explain their TP contents. Sometimes we choose verbal presentation: it depends on time and participants' characters. At the Table 1, the blank means the time to create TP with reflection.

Records of TP workshop in NIT, Anan College

The workshop records in NIT, Anan College are shown in the Table 2. The first workshop was held for especially NIT, Anan College faculty by only two mentors from NIT, Anan College campus. Author invited two more mentors from other institutes and held by the NIAD-ED style as the example to follow. It had not enough time to prepare, however some positive faculty toward educational improvement attended. As it succeeded, author tried to spread the faculty of other colleges of technology. It seemed that inviting attendances from other institutes gave new successful exchanges and synergetic effects to create TP. The second and third workshops were held for the faculty of colleges of technology of Shikoku-district in joint hosting between NIT, Anan College and SPOD (Shikoku Professional and Organizational Development Network in Higher Education) of which NIT, Anan College is as a member.

Compare to the second workshop, it has been increasing the attendance number from other colleges of technology in third and fourth ones. It seems to cause the trends to be more interested in TP. We took in some attendances outside from Shikoku-district as possible.

The fifth workshop was held in September when NIT, Anan College faculty could easily attend, but there are no attendances from other colleges of Technology of Shikoku-district because it was the examination term.

We held the total twenty times workshops on and off campus. As these results, more than 80 % faculty members already created TP in NIT, Anan College. Except some faculty members who have short time after employment, the rates to create TP will be higher. For the new employment faculty members, we have another system. It is training for new faculties to create TP during two years after they employed. Then NIT, Anan College has the know-how to hold TP workshops by stacking the workshops. It is also important to create a circumstance that the experienced faculty members can attend easily.

Table 1 Typical schedule of workshop.

	First day	Second day	Third day
a.m.		Follow-up meetig (2)	Follow-up meetig (3)
p.m.	Kick-off meeting Follow-up meetig(1)		Mentoring workshop Celebratory Graduation
		Get-together	

Table2 Performance of teaching portfolio workshops.

	Date	Place
1	March 23 ～ 25, 2010	On campus
2	July 26 ～ 28, 2010	On campus
3	Dec. 17 ～ 19, 2010	On campus
4	March 23 ～ 25, 2011	On campus
5	Sep. 14 ～ 16, 2011	On campus
6	Nov. 11 ～ 13, 2011	Off campus
7	Dec. 9 ～ 11, 2011	Off campus
8	March 9 ～ 11, 2012	On campus
9	March 29 ～ 30, 2012	Off campus
10	July 24 ～ 26, 2012	Off campus
11	Sep. 12 ～ 14, 2012	On campus
12	Nov. 16 ～ 18, 2012	Off campus
13	Dec. 21 ～ 23, 2012	Off campus
14	Dec. 25 ～ 26, 2012	Off campus
15	March 11 ～ 12, 2013	On campus
16	March 18 ～ 19, 2013	Off campus
17	Sep. 4 ～ 6, 2013	Off campus
18	Nov. 15 ～ 173, 2013	Off campus
19	March 12 ～ 13, 2013	Off campus
20	March 24 ～ 26, 2013	Off campus

Follow-up Survey

Period: January to March, 2013
Target: 349 participants of TP workshop
Method: using online form
Number of respondents: 193

Affiliations of respondents are as follows: national university is 24%, public university is 8%, private university is 24% and college of technology is 43%. The high ratio of college of technology is a feature. The most common field of specialization of respondents is engineering and the second is nursing. Paying attention to the title of respondents, professors are 29%, associate professors are 43%, lecturers are 12%, assistant professors are 10 % and others are 3%. So the younger faculty members make up a significant part of the respondents.

Results and Discussion

Fig. 1 shows the purpose of creating TP and it shows that there were many participants whose aim was educational self-improvement. Overall participant's satisfaction is shown in Fig. 2. From this, positive answers are the great majority and the creation of TP is highly satisfied. From these points of view, it is considered that the continuous use of teaching portfolios is important for professional development.
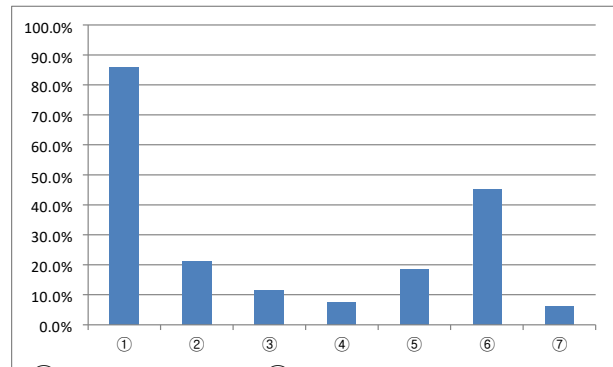
① self-improvement ② performance evaluation
③ share educational resources in the department
④ offering information to society
⑤ understanding TP as a faculty developer
⑥ interested in TP for its own sake
Figure 1 Purpose of creating TP.
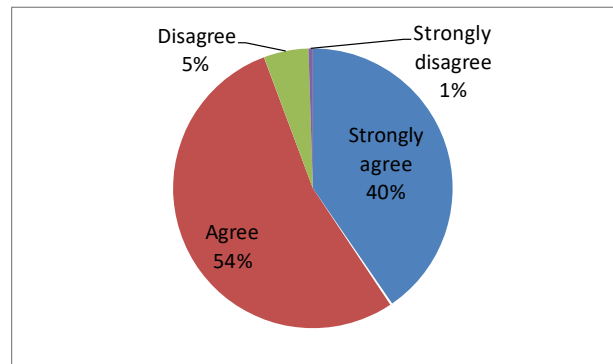
Figure 2 Overall participant's satisfaction.
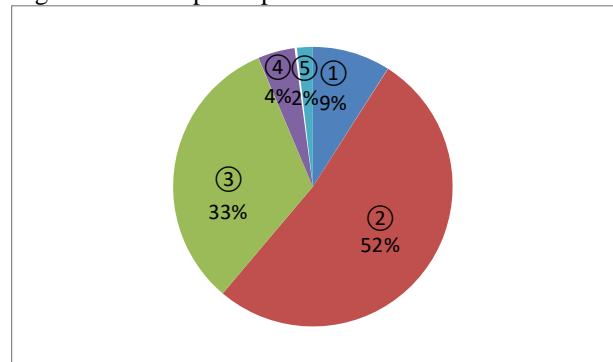
①Significant change ②Change ③A little change
④Unchanged ⑤Changed after, now unchanged
Figure 3 Alteration of awareness after creating teaching portfolios.

Fig. 3 and Fig. 4 show the alteration of awareness and behaviour when comparing their professional ability before their teaching portfolios had been created with the effect of the workshops. Since more than 50 % recognized alteration of awareness and behaviour when comparing their professional ability before their teaching portfolios had been created with the effect of the workshops, the effectiveness of the teaching portfolios is demonstrated. On the other hand, people
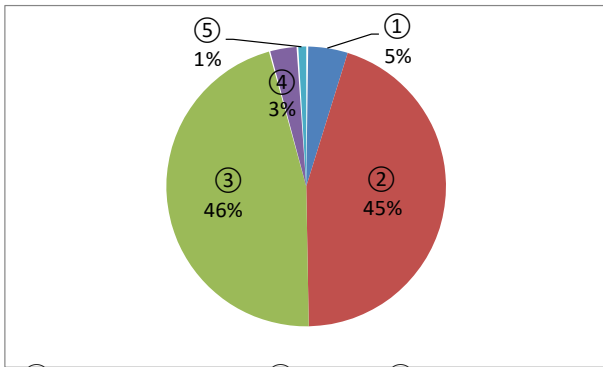
①Significant change   ②Change   ③A little change
④Unchanged   ⑤Changed after, now unchanged
Figure 4 Alteration of behaviour after creating teaching
portfolios.
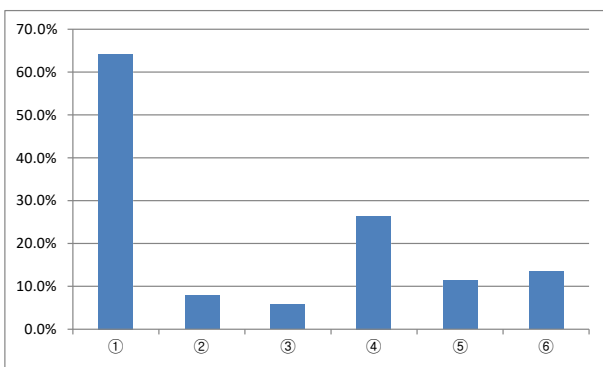
①Just after workshop   ②Before and after semester
③Several times during semester
④At the end of a fiscal year   ⑤Never once   ⑥Others
Figure 5 Do you read over your TP after the workshop?
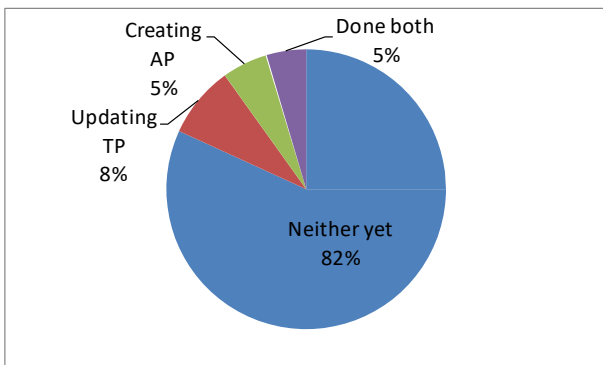
Figure 6 Do you update your TP or create your AP?

who read over after workshop is 40 % from Fig. 5 and
who update TP or create AP is 18 % from Fig. 6. Then
it shows that they are not willing to use their teaching
portfolios after their workshop. So analysing the
reasons why they can't update their TP, "busy and no
time to update" and "just after workshop" are 71 %,
"No chance" is 11 % from Fig. 7. They might be
influenced by the attribution of the responders who are
relatively new to create TP. Then we should offer a
chance of the workshops for updating TP or creating AP.
In the workshop for update at NIT, Anan College, there
were opinions which it is better to update earlier
because updating evaluation for long period is hard.
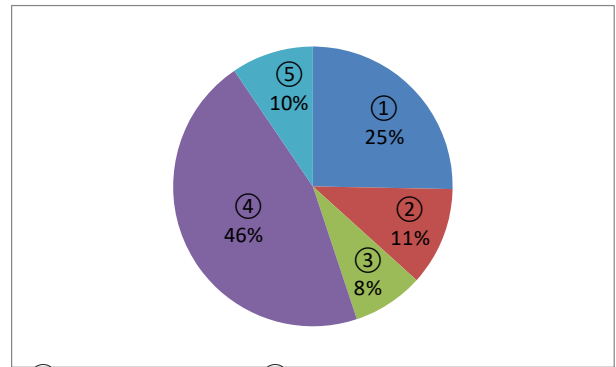
①Busy and no time   ②There isn't any chance
③Unwilling to update
④Unnecessary because newly created TP ⑤ Others
Figure 7 Reason why you don't update.

Conclusions

In conclusion, the participants successfully created
their portfolios and they indicated their satisfaction as a
result of the questionnaire. After the workshop, all of
respondents (100%) felt that the workshop was useful
and beneficial for their careers. Since the participants
recognize that the workshop is significant for the faculty
at the Colleges of Technology, 80 % of the faculty at
NIT, Anan College have already participated positively.
From follow-up survey, the satisfaction is continued.
So we should offer the workshops updating TP in order
to use it for professional development continuously. It
is very important that TP and AP works for educational
improvement, and it is not the purpose only to have
workshops. It is necessary to assess the benefit of TP
and AP for the participants in order to benefit their
future career.

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A CDIO APPROACH AND COLLABORATION ON PROJECT WORK IN MECHANICAL ENGINEERING

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Abstract

The project work in Mechanical Engineering has been set up to improve the educational methodology by an integrated learning experience. This students practice is mainly based on technical knowledge and skills to create a controlled robot, but is focused on design, processing, communication and their teamwork. Students begin to learn some fundamental engineering subjects from third grade and they also have practical machine training in first and second grade in our college. Although this machine training provides a good opportunity to understand how products are made, all products design and manufacturing processes are given or organized by the teacher in advance. Therefore, our department has planned the project work to be a more students-centred learning programme, in order to promote or facilitate the students' abilities like creativity, communication skills and teamwork. Currently, this project work has been conducted through a fiscal year to the third grader under a theme entitled "Auto vegetable harvest robot". The syllabus has been planned as thirty weeks by 180 minutes per week. The syllabus consists of (1) Design & CAD-drawing, (2) Patent research, (3) Purchase of elemental components, (4) Processing & assembly, (5) Submission of report, (6) Presentation, (7) Robot competition and finally (8) Comprehensive assessment by all departmental teachers. This project has been recognized to enhance students' abilities in creativity, communication and teamwork as well as to foster a better understanding of engineering science fundamentals. Also, this project revealed the importance of sufficiently teaching technical skills for teachers. Then, we have decided to conduct this project work with a regional company, to gather feedback from an actual company. Engineering students need to be advised on realistic viewpoints on marketing, management, ethics, and environmental issue or sustainability besides products technology. Another focus point of this collaboration was for students to eventually understand an actual industrial society including a QCD (Quality, Cost and Deliver).

Now we have been discussing how the project can be improved by the concept of CDIO (Conceive, Design, Implement and Operate). The CDIO approach will provide us an idea of systematic assessment for this work and give engineering students more learning outcomes.

Keywords: *Project, Design, Processing, Practice, Communication, Teamwork, Collaboration, CDIO*

1. Introduction

This students practice is mainly based on technical knowledge and skills to create a controlled robot, but is focused on design, processing, communication and their teamwork. Students begin to learn some fundamental engineering subjects from 3rd grade and they also have practical machine training in 1st and 2nd grade in our college. Although this machine training provides a good opportunity to understand how products are made, all products design and manufacturing process are given or organized by teacher in advance. Our department has planned the project work as more students centred learning programme in order to promote or facilitate the student ability such as creativity, communication skill and teamwork. Currently, this project work has been conducting through a fiscal year to the 3rd grader under a theme entitled "Auto vegetable harvest robot".

This paper reports the effects of engineering education by an integrated experienced work. We discuss and analyse how students can learn and think through this project work by taking a questionnaire.

2. Contents of the Project Work

2.1 Practical Subjects

Dapartmental practice subjects are shown as the following. Firstly, practical machine training is carried out through processing a product for 1st and 2nd graders. These graders mainly learn the machine tools and processing such as lathe, cutting, milling, welding and finishing with safety rules, although the products design and its procedure are given by teacher in advance. In 3rd grade, the project work is set up to facilitate and enhance the student ability focused on the term of creativity, teamwork and communication. That is a kind of an integrated learning experience. This project work is to create a controlled robot based on technical knowledges, but is focused on design, processing, communication and their teamwork.

2.2 Syllabus Planning and Schedule

The syllabus has been planned as thirty weeks by 180 minutes per week. The contents of project include (1)design & CAD-drawing, 8weeks (2)patent research,1 week (3)list up & purchase of components, 5weeks (4)processing & assembly, 10weeks (5)submission of report, daily/monthly report (6)presentation, four times (7)robot competition and finally (8)comprehensive assessment by all departmental teachers.

2.3 Grouping and Regulations of Robot

Mechanical engineering students are divided into more than ten groups, and one group consists of four to five students. Robot specification or regulation outline are as the following.
1. Products name: Auto vegetable harvest robot
2. Regulation outline:
  Size: Within L400mm×W400mm×H400mm
  Weight: Not more than 3kg
  Materials: Aluminium alloy, Acrylic polymer
  Power: 1.5V battery, ×2
  Price: Not more than $200

2.4 Design and Machine Work

Before making the design, students learn how to find a patent and research concerning the related idea of robot they are conceiving. Then, they transform the idea into a mechanical design by using CAD-drawing soft, Solid Works. After completing the design, students have to order their needed components by themselves. Assembly and analysis are conducted at a Machine shop in college and at some Engineering design rooms. Figure1 shows a CAD-drawing that student designed and the harvest robot is shown in Figure 2.
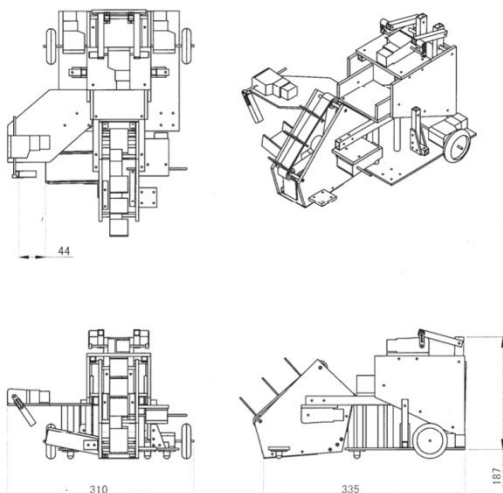
Figure 1 CAD-drawing and an example of design.
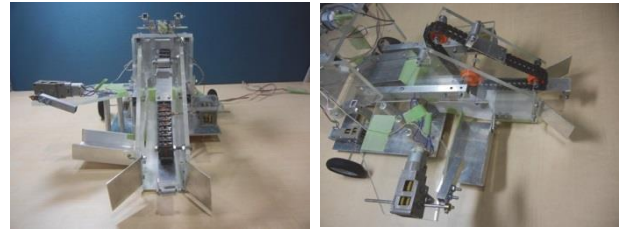
Figure 2 Harvest robot designed by CAD-drawing.

2.5 Presentation

All student groups have to explain with slides what each group is thinking and how they progress in class. This presentation has four times per year.

2.6 Competition

Figure 3 shows the field of competition and vegetables. Figure 4 is a circumstance of the competition where is held at open space in college. Here is the competition and rules (outline).
1. Tournament style, Competition time: first 10min, second 5min
2. Setting up the robot in start area
3. Vegetable (Ball) Harvest, Points
    Ping-Pong ball white colour: 1point
    Ping-Pong ball Orange colour: 3points
    Polystyrene ball: 5points
-Do not re-take vegetables dropped off
-Not rolling the vegetables when deliver to own basket
-Do not take the competitor farm vegetables, but both teams can take it in the ridge field.
-Deliver the vegetables to basket and the number of vegetable are count. Not count the vegetables into Robot when time finished.
-No allow the defence to the competitor
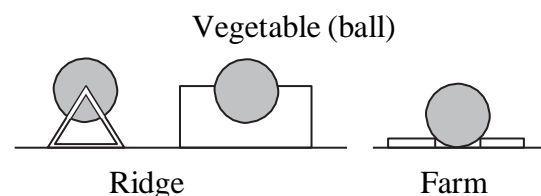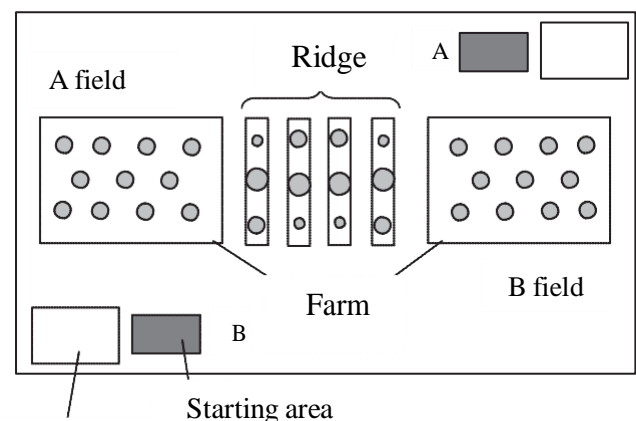
Figure 3 The field of competition and vegetables.

Figure 4 Competition of the harvesting vegetables.

2.7 Assessment

Estimation headings for final assessment are as the following.
1) "Explanation of function & design of a robot" for an estimation of ability of presentation.
2) "Trail running and demonstration" in regard to movement smoothly
3) "Quality and Function of robot" for a point of precision and properly
4) "Safety of products" on safety operation
5) "Creativity, Realizing of idea" with transforming the idea into products

3. Results and Discussion

3.1 Discussion from Questionnaire

We have distributed a questionnaire sheet to the 3rd grader after finishing this Project Work. These results from questionnaire, Q1, Q2 and Q3 are shown as the following.

Questionnaire concerning with Project Work 2013
Q1. What do you learn or think on/after this project work. Please check and find the priority in your mind

Headings:	1st - 2nd - 3rd	total
(1) Practicable Performance	*6-2-5*	*13**
(2) Responsibility	*5-3-1*	*9*
(3) Engineering fundamentals	*1-3-8*	*12**
(4) Leadership	*0-2-0*	*2*
(5) Creativity	*12-4-3*	*19**
(6) Autonomy	*1-6-2*	*9*
(7) Teamwork	*4-9-5*	*18**
(8) Communication	*2-3-5*	*10**
(9) Others#( )	*1-0-1*	*2*

#1) To explain own opinion to others properly and correctly.
#2) To judge calmly.

Q2. In the case of this project, what subject or knowledge is valuable or important?

Headings:	Points
(1) Electric Circuit	*0*
(2) Control	*3*
(3) Materials	*7*
(4) Mechanics	*9*
(5) Driving Mechanism	*15*
(6) CAD-Drawing/Design	*28*
(7) Machine Tool/Processing	*16*
(8)Others ( )	*0*

A symbol of asterisk shows the top five headings of total points in questionnaire Q1. We have to notice that

students can aware the importance of Teamwork, Communication together with Creativity. The result of priority is also shown that students are thinking to be improve ability of design which is supported by an academic engineering background. A top heading at each order is as the following. i.e., the first priority is *Creativity*, and the second shows *Teamwork* and third one is *Engineering Fundamentals*. Design based on technical knowledge with teamwork is the most important things when they discuss and perform the project work smoothly. It is shown from questionnaire Q2 that students needed to have much knowledge about *CAD-Drawing/Design*, *Machine Tool/Processing* and *Driving Mechanism* in this practical work.

Q3. Any other comments
Any other comments from students on Project Work 2013 are as the following;
1) Should respect other opinion
2) Hope to continue similar project in 4th grade
3) Want to improve a communication skill
4) Need to manage the schedule (no delay)
5) Should enhance an operation skill of machine tool
6) Need to be able to solve the accidental issue during the production
7) Need to have a critical viewpoint for design
8) Want to learn more with marketing and sales as well as production processing
9) Need to be understood an idea to group members
10) Should be shown the regulation and the rule of competition clearly in early stage

These comments come from their mind after experiencing this project work, and it is able to feel and think only when they just experienced like this practical training. We could find some excellent viewpoints on their cognition and awareness from these comments. For example, it must be a good point to have a critical analysis against own products design as the comment of No.7, because this might be a first step to improve and develop their design thinking. On the comment of No.8, it is shown that we should give students an opportunity to be thought a comprehensive design from raw materials till sales which is in regard to a study like economics and management.

3.2 Collaboration and Desired attributes

Engineering students need to be advised on viewpoints of marketing, management, ethics, and environmental issue or sustainability besides products technology. Therefore, this project work is conducted with a regional company to take a comments from the company's engineers (Mitsuwa Co.LTD, Tsubame, Niigata, Japan). Another focus point of this collaboration is for students to eventually be able to understand an actual industrial society including a QCD (Quality, Cost and Deliver). For example, Boeing[1] shows a list to be an engineer as shown in Table1. They also suggested students to enhance a basic understanding of the context in which engineering is practiced shown as shown in Table1-4. In previous questionnaire Q3, some students pointed out the

importance of keeping a critical viewpoint as same as in Table1-7. Thus, this project work seems that it can be aware and thought to students what the desired attributes of engineers are.

Table1 Desired Attributes of an Engineer[1]

1. A good understanding of engineering science fundamentals (Mathematics, Physical and life sciences, Information technology)
2. A good understanding of design and manufacturing processes
3. A multi-disciplinary, systems perspective
4. A basic understanding of the context in which engineering is practiced (Economics, History, The environment, Customer and societal needs)
5. Good communication skills - written, oral, graphic, and listening
6. A profound understanding of the importance of teamwork.
7. Personal skills
(High ethical standards)
(Ability to think both critically and creatively— independently and cooperatively)
(Flexibility)
8. Curiosity and a desire to learn for life

On the other hand, CDIO stands for "Conceive-Design-Implement- Operate". This concept includes as (1) Knowledge "Learning to know", (2) Personal skills "Learning to be", (3) Interpersonal skill "Leaning to live together" including teamwork and communication[2]. We have been discussing how this project can be improved by the concept of CDIO. The CDIO approach will provide us an idea of systematic assessment for this work and lead to give engineering students more learning outcomes.

4. Conclusions

Engineers need to be able to lead in the creation of new products, process and sysytems with their personal skills that is ability to think both critically and creatively, sometimes undependently or cooperatively[1]. This project work is one of the way to aproarch to achieve the goal.

Acknowledgements

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NEW PROGRAM FOR ENGINEERING EDUCATION WITH TRIZ FOR KOSEN

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Abstract

Recently, industrial structure has increased in complexity, such as through internationalization, diversification, and the advancement of services. In such industrial structures, intellectual property becomes more important. To improve intellectual productivity, 1) engineering skill (ability of realization through technology) and 2) creative skill (ability to create something new) are necessary for engineers. However, it is difficult to teach both engineering and creative skills in the conventional basic subjects. To foster creative human resources in Kosen curriculum, this paper presents a new education program with a problem-solving methodology. The program introduces TRIZ methodology. In addition, to evaluate the education effects of this program, a Curiosity test is applied. This program will be implemented at Innovative Electrical and Electronic Engineering on National College of Technology (NCT) Oyama College.

Keywords: *Problem solving, Intellectual property, Technological problem, Invention, Engineering skill, Creative skill*

Introduction

Recently, industrial structure has rapidly changing, and increasing in complexity, such as through internationalization, diversification, and the advancement of services. In such industrial structures, although people, goods and capital is important, intellectual property has been becoming an essential component, and the cycle of intellectual creation has become more important. According to increasing an importance of intellectual property, creativity is indispensable for using intellectual property efficiently. The creativity is a way to combine knowledge.

To improve intellectual productivity, engineers need 1) engineering skill (ability of realization through technology) and 2) creative skill (ability to create something new). One's ability in intellectual productivity is shown by these skills. These skills are also needed in engineering development (i.e., product
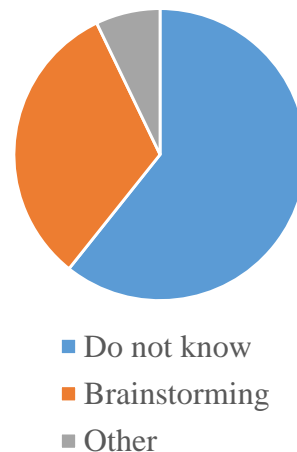
Figure 1. Questionnaire results. (Answers to "Do you know problem-solving methodology?")

planning, research, development, design, production technology, production, and quality control).

However, it is difficult to foster engineers who have both engineering and creative skills, as they need practical development experience. Additionally, fostering creative human resources is difficult in the conventional basic subjects of Kosen. Creativity involves deconstructing conventional knowledge and experiences to recombine them in new engineering. In other words, it is necessary to remove stereotypical ideas and approach engineering with curiosity. Therefore, to develop creative human resources, it is indispensable to introduce a new program with a problem-solving methodology.

There are several problem-solving methodologies, such as brainstorming and so on. However, the current education is not effective at teaching them. Figure 1 shows the results of a questionnaire that asked, "Do you know problem-solving methodology?" and was targeted at fifth-year students in the Department of Electric Control Engineering at NIT Oyama College. As shown in Fig. 1, most of the students reported that they did not know problem-solving methodology. Thus, to foster creative human resources, it is important to introduce problem-solving methodology in the classroom.
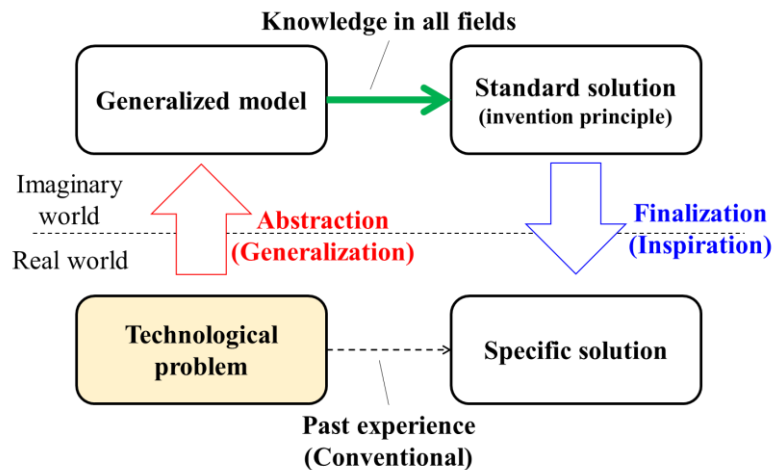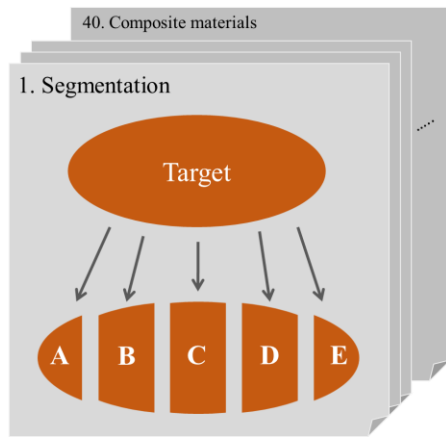
Figure 2. Overview of problem solving process using TRIZ.

Figure 3. Overview of 40-principles. (There are 40 principles for problem solving)

Figure 4. Overview of 9-windows.

Therefore, this study presents a new education program for the development of creative human resources. It applies the Theory of Inventive Problem Solving (TRIZ) [1], which was proposed by Genrich S. Altshuller in 1946, to educate students creatively.

The program's targets for achievement are the following.

(1) Acquisition of proposal skills in technology design and development,

(2) Acquisition of problem-solving skills utilizing creativity.

This program consists of 15 classes that meet over a half-year period. Throughout the program, we give lectures on TRIZ methodology and conduct exercise lessons.

In this paper, first, TRIZ methodology is shown. Next, the proposed program using TRIZ is presented, and the evaluation of the education effect using a Curiosity test is introduced. Finally, we conclude the study.

Problem solving using TRIZ

TRIZ is an inventive problem-solving methodology that was proposed by Genrich S. Altshuller in 1946. It is widely utilized in product development and patent strategy in companies around the world. It is applicable to a wide area, including management, business, and so on.

Figure 2 shows an overview of the problem-solving procedure using TRIZ. The key concept of problem solving with TRIZ is the abstraction a technological problem to a generalized model. First, the technological problem is generalized, and a generalized model is obtained. Then, the standard solution is derived by using knowledge in all fields. To lead to the standard solution effectively, TRIZ uses "40-principles" (Fig. 3), "Effects" and "9-windows" (Fig. 4) tools. Finally, a specific solution is obtained by finalizing the standard solution.
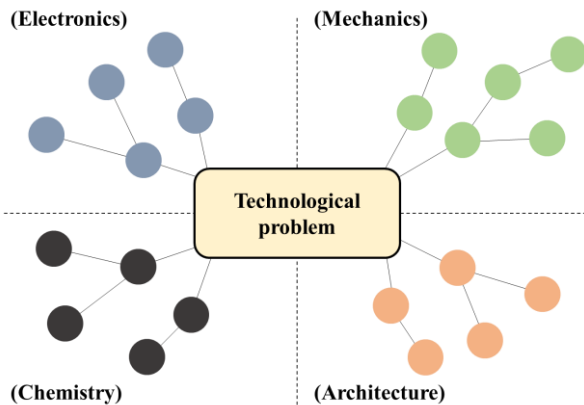
Figure 5. Overview of problem solving with brainstorming. (●: solution)

Conventionally, a specific solution is found from a technological problem directly based on past experiences. For example, in problem solving process of brainstorming methodology, many solutions can be obtained. However, as shown Fig. 5, in problem solving with brainstorming, engineers from different fields cannot think the same way about the problem. For this reason, finding the essential specific solution is often difficult by using brainstorming.

In the problem solving process with TRIZ, by abstracting the problem, engineers from various fields can see the technological problem from the same perspective. This enables them to find the essential specific solution.

Education program using TRIZ

Table 1 shows the proposed education program with TRIZ methodology. The program consists of 15 classes conducted over a half-year period. We give lectures on TRIZ methodology and conduct exercise lessons. The program details are as follows:

(1) Introduction
     Explain the expectations for the engineers and the significance of learning creativeness.
(2) Requirements for becoming a creative engineer
     Explain the point of practicing creativity and the requirements for becoming a creative engineer.
(3) Methodology for developing creativity
     Introduce TRIZ methodology and explain the basic concept of problem solving with TRIZ.
(4) Approach to solving technical problems
     Describe the applications of TRIZ and explain the steps for generating ideas.
(5) 40-principles
     Explain "40-principles," which is a critical tool of TRIZ.
(6) Practice of technical problem solution 1
     Conduct an exercise lesson using "40-principles."
(7) Invention solving technological contradictions

Table 1. Education program with TRIZ.

No.	Contents	
1	Introduction	
2	Requirements for becoming a creative engineer	
3	Methodology for developing creativity (What is TRIZ?)	Basic of TRIZ
4	Approach to solving technical problems	
5	40-principles	
6	**Practice of technical problem solutions 1**	
7	Invention principles with technological contradictions	Application of TRIZ 1
8	Generation of ideas that have identical functions (What is "function?")	
9	Application of "Effects" for generation of ideas	
10	**Practice of technical problem solutions 2**	
11	Future technological forecast using roadmap	Application of TRIZ 2
12	Future spatial prediction using 9-windows	
13	Generation of ideas using TRIZ	
14	**Practice of technical problem solutions 3**	
15	About invention	

Show the technological contradictions with case examples and the introduce procedure of TRIZ application.
(8) Generation of ideas that have an identical function

Explain "function" and the generation of ideas that have an identical function.

(9) Application of "Effects" for the generation of ideas
"Effects" is database of science and technology principles. Explain a creative pattern of ideas by using "Effects."

(10) Practice of technical problem solution 2
Conduct an exercise lesson using "Effects."

(11) Future technological forecast using roadmap
Although technologies may seem to have a chaotic process, there is a regular pattern. In this class, we introduce the roadmap, which shows an evolution pattern of technologies. Then, we predict the future by using the roadmap.

(12) Future spatial prediction using "9-windows"
"9-windows" is a highly effective tool for future prediction of technologies. Introduce it and explain how it is used for future spatial prediction.

(13) Generation of ideas using TRIZ
Explain future prediction using "9-windows," and discuss a resolution of the future prediction using TRIZ

(14) Practice of technical problem solution 3
Conduct an exercise lesson of future prediction using "9-windows," and generation of specific solution using TRIZ.

(15) About Invention
Explain intellectual property rights and the creation of technology via innovation. Then, discuss the importance of the cycle of intellectual creation.

Evaluation of the program

In our program, to evaluate the education effect of the program, a Curiosity test [2] is introduced. To get creative, curiosity is important. Creativity cannot be exert without curiosity. Therefore, we evaluate an effort of this creativity education by using an advance level of curiosity.

Using the Curiosity test, we evaluate students' increase in curiosity both quantitatively and qualitatively. Quantitative curiosity means the breadth of curiosity, and qualitative curiosity refers to the level (high or low). Figure 6 shows an overview of Curiosity test. As shown in Fig.6, Curiosity is measured by answering the level about general interests. Then, the quantitative and qualitative curiosity are calculated from results of answers.

We administer the Curiosity test twice, during the first and last lectures, respectively. The effect of the education program is evaluated through a comparison of the test results.

Conclusion

This study proposed a new evaluation program using TRIZ. Then, to evaluate the effects of the program, an evaluation approach using a curiosity test was presented.

In the future, the new program will be introduced in Innovative Electrical and Electronic Engineering, which was organized at NTI Oyama College in 2013.

Step 1. Select items of interest   Step 2. Select the level of interest

No.	issues	#	A	B	C	D	···	S	T
1	Solar heat utilization								
2	Interior design								
3	Bird-watching								
4	Japanese woodblock prints								
			· · ·						
95	***								
96	***								

*** : Fill out own concerns (No.81～96)

(1) Questioner of Curiosity test.
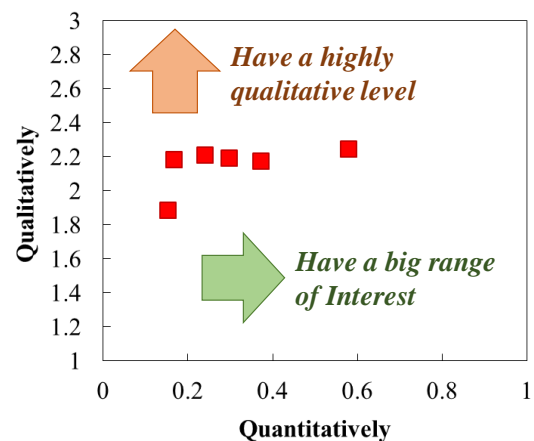
(2) Result of Curiosity test.
(Example in six students)

Figure 6. Overview of Curiosity test.

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EDUCATIONAL OUTCOMES OF A TOTAL ENGLISH IMMERSION GRADUATION RESEARCH PROJECT COURSE IN ELECTRONIC SYSTEMS ENGINEERING AT NATIONAL INSTITUTE OF TECHNOLOGY KAGAWA COLLEGE TAKUMA CAMPUS

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Abstract

With recent internationalization, the necessity of an English education is becoming more important. In the case of the Japanese National Institute of Technology, English teachers generally teach English as a second language, so students seldom learn any English related to their field of engineering study. Students are not well prepared for technical meetings held in English. Hence, it is imperative that students learn the technical English used in their field of engineering.

Over the past two years, Kagawa College decided to increase the emphasis on the technical English used in engineering. A total English immersion research laboratory with a native English speaking professor was established in the Electronic Systems Engineering Department at the Kagawa College. In this paper, we want to report on the effects of this program. The author tackled his graduation research project advised by a professor whose native language is English. During his fifth year, the author conducted research and through the experience learned about technical subjects. At the end of year graduation research presentations, the author presented the results and conducted a Q&A session in English.

The total immersion English research experience also improved the author's English fluency in general conversation and technical discussion. The author achieved an increase in TOEIC score by 240 points. It is the author's opinion that by continuing in a total English immersion research environment, positive learning outcomes will continue to increase further. It is also the author's opinion that by establishing more environments like this will further motivate and cultivate students' English proficiency and feels that it should be mandatory as part of the graduation research curriculum. Moreover, that it is also an effective way for the National Institute of Technology to foster global engineers. Further analysis of the advantages and disadvantages of this experience should be taken and the curriculum should be adapted accordingly.

Keywords: *Educational Outcomes, Total English Immersion, Graduation Research Project, English for Engineers, TOEIC*

1. Introduction

With recent internationalization the necessity of English education is rising even more. Especially, the students in engineering departments read references written in English and have to give presentations at conferences in English. Further, they will have to negotiate for contracts for their companies in future. From these facts, it is obvious that English is necessary for engineering department students. But the present situation is tough. It is difficult to learn English in general classes. Students' English ability of the National Institute of Technology is said to be very low. To solve these problems, we have created a Practical English Education Program at Kagawa College. As a part of it, we established a laboratory with native English speaking professor in the Electric Systems Engineering Department. Some students do their graduation research project with him. The National Institute of Technology Kagawa College aims at increasing the students technical and practical English by establishing this English only laboratory environment.

We confirmed the effects of this program from 2 different viewpoints.
(1) The motivation for learning English.
(2) Increase of the ability of English
(3) The effects which students in the laboratory feels
The author wants to report the detailed information of our program and its educational effects.

2. Methods

In the Electric Systems Engineering department of Kagawa College, the 4th grade students take 180 minutes, the 5th grade students take 360 minutes, and the advanced course students take 675 minutes for research. The program for students to do research with native a speaker has been going on for 2 years. The native speaker had worked as a part-time instructor at the college for the past 4 years. One student did research with the instructor two years ago. 2 students joined last year and 2 more students joined this year. So the total number of lab members is up to 5 students now (including one advanced student). The point of the laboratory is total English immersion. Lab members communicate with each other in every case like general conversation, meetings about research and presentation on campus in English.

2.1 expected effects

Because of the program, students begin to use English for general conversation like greetings and ordinary talking and technical conversation like about programming or electronic circuits. It is thought that students will get practical English abilities from general conversation and technical English abilities from technical conversation. In addition, it is also thought that students can overcome their panic for talking with overseas people. Due to talking with a native English speaking professor, students are expected to feel the necessity of English and begin to learn English on their own.

2.3 Way to measure the effects

The objects are two kinds that ones are in English Native professor's laboratory and others are in Electric System laboratory
(1)By taking questionnaire, we compare the difference of the motivation for learning English.
(2)From increase of TOEIC score, we survey the increase of English abilities and we concluded contribution of the program.
(3)We confirmed program effects students feel by taking a questionnaire in the laboratory.

We want to discuss about effects of this program from these surveys.

3. Result

3.1 Details of graduate research project

One student had done research under instruction of the native English speaking professor last year.
Agriculture is a big part of the economy in Japan, but the population of Japanese primary farmers has decreased suddenly and their average age has increased. Since 2000 the total number of farmers is about 40% down and their average age has increased by about 6 years. From this data, we can guess that the burden for them is becoming bigger. The project focused on green houses and it was decided to make something to help the ageing farmers. The student did research into

developing a system that can monitor and control green house in remote under the theme of "Web-Based Green House Remote Sensing and Control". The student learned about networks, TCP/IP, micro controllers, digital and analogue I/O and electric and electronic circuits through graduate research project with the native English speaking professor.
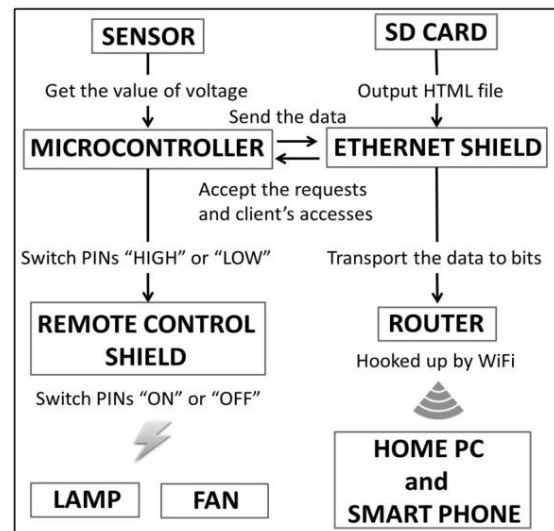
Figure1. System transition map

Figure 2 is a picture of an extended Arduino with an Ethernet shield and a wireless remote control shield. Figure 3 is the control box storing the power supply, micro controller, Ethernet shield, remote control shield, sensors and Wi-Fi router.
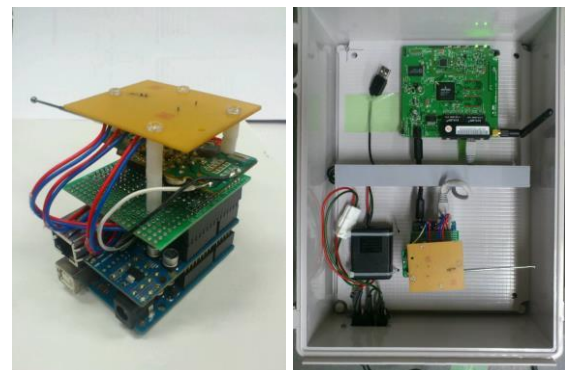

Figure2   figure3

Users can access the system through their PC and smart phone browser to monitor greenhouse data and control the greenhouse equipment remotely.

3.2 The environment of the research lab

Students brainstorm about the current situation and what problems they are having with their research projects. This is shown in the picture that follows.

Figure4. Brainstorming

The native English speaking professor's seat is set close to the students seat so students can ask something about research easily when they have questions. The native English speaking professor holds technical conversations with the students.(figure5)
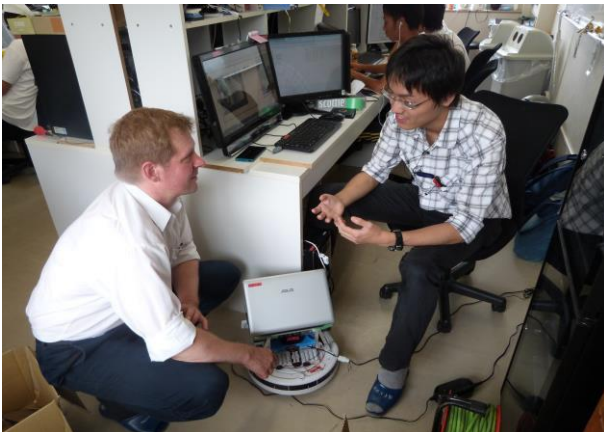

Figure5.Technical conversation

The students in the laboratory make resumes and power point slides and give presentations in English for during their graduate research session, and also respond to questions in English.(figure6) Students struggle to do this, but it is thought that students can learn practical English through this experience.
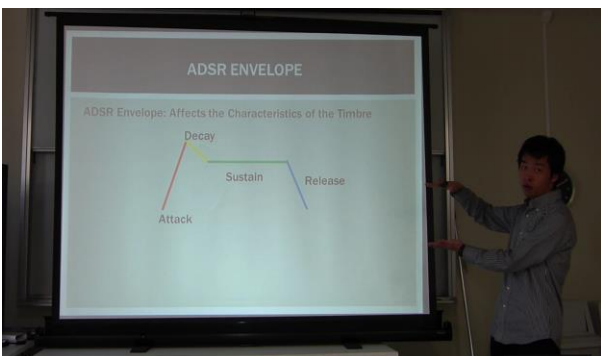
Figure6.Graduate Research presentation

I survey was taken of the students in the laboratory of the Electronic Systems Engineering Department of the three questions below.

Q1:Do you think English is necessary?
Q2:Would you like to be able to speak English well?
Q3:Do you learn English by yourself?

The results of survey are shown below.
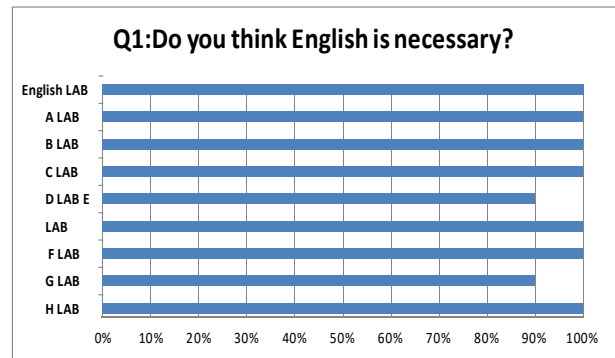
Figure7. Result of Q1

It can be confirmed that almost all of the students of all the different laboratories think that English is necessary.
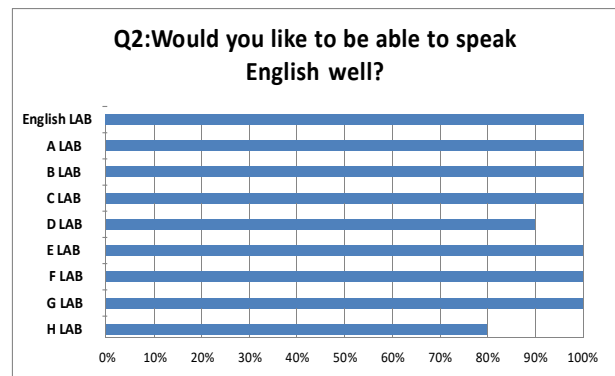
Figure8. Result of Q2

In this question, almost all students also answer yes. They want to be able to speak English well.
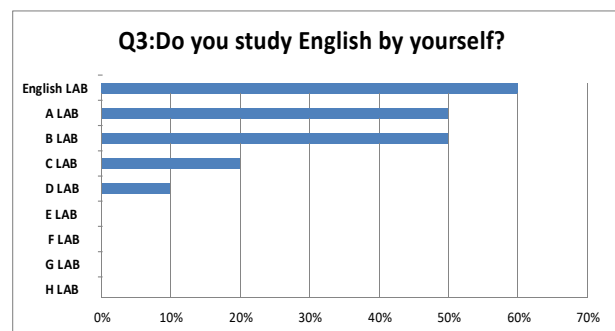
Figure9. Result of Q3

On Q3, we can see the difference clearly between laboratories. The English only laboratory's rate which answered yes is bigger than others, despite that laboratory A and B students tackle English learning actively.
Advanced course student's TOEIC score are shown below. (figure10)

	END OF 4TH YEAR	18 MONTHS LATER	DIFFERENCE
STUDENT A	550	750	200
STUDENT B	535	645	110
STUDENT C	315	555	240
STUDENT D	250	480	230
STUDENT E	235	355	120
STUDENT F	260	345	85
STUDENT G	275	305	30
STUDENT H	225	295	70
STUDENT I	215	260	45
STUDENT J	235	255	20
STUDENT K	295	255	-40
STUDENT L	180	230	50
STUDENT M	170	220	50
STUDENT N	250	215	-35

Figure10.TOEIC Score

Student C is in the native English speaking professor's laboratory, and got a 240 point increase which is the highest among the advanced course students.

A questionnaire was given in the native English speaking professor's laboratory to confirm the effects the students feel. The following figure shows the results.

Question	YES	NO
Q1:Did you choose your laboratory with the purpose for learning English?	60%	40%
Q2:Do you think your laboratory is effective for learning English?	100%	0%
Q3:Do you feel increase of your English ability?	40%	60%
Q4:Do you have any requests for laboratory to implove		
·I want professor to speak more slowly.		
·We should make more opportunities to talk in English.		
·We also should talk in English between students.		

Figure11. Questionnaire

It can be seen that some students don't feel any increase in English ability. We got some requests to improve.

4. Conclusion

It was confirmed that the English only laboratory students' motivation for learning English is higher than others. The cause is that some students specifically choose our laboratory to learn English. The laboratory students feel the need to speak English. The author got an increase of 240 points on the TOEIC. But there is no data showing that the program contributed for increase of student's English ability directly. We think it is difficult to show the contribution as a number. It can't be reasoned out that the program is effective or not, because the program began recently and there in not much data. It is hoped that the program is continued and more data gathered to evaluate. There are some problems. At the first, there are some students that don't feel effects of the program. It is thought to be difficult to do research in a total English immersion environment for them. For students to be good at English, it is

difficult to understand what the native English speaking professor says and to respond. To solve that, it is thought best that the native English speaking professor should speak more slowly as was written in the questionnaire and use easy English. There is a request that "I should make more opportunities to talk in English.". To solve that, Native professor and students have to make opportunities to talk to each other actively. Finally, students not good at English should be advised not to join the laboratory. Having to explain and talking in English is needed in our laboratory. A productive English only laboratory for the purpose of learning English was established.

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EDUCATIONAL MATERIALS DEVELOPMENT
FOR PROJECT-BASED LEARNING UTILIZING GNU RADIO

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Abstract

This correspondence is intended to develop a new learning method to improve students' motivation by utilizing an open-source software defined radio toolkit through project based learning (PBL). The use of software radio enables processing of radio signals up to gigahertz. To make use of real signals, it requires wide range of knowledge and skills. Introductory lecture on digital communications is provided to students before the PBL. It enables improving students' understanding of basic concept of various radio signal processing. The first proposed PBL course was conducted on fall semester in 2011 at Ishikawa National College of Technology for college senior students of advanced course. In this new learning scheme, the students implemented a universal digital radio controller for remote-controlled toy cars. In 2013, the students who got this PBL course implemented a prototype modulator for wireless energy transfer system. To implement both projects, the proposed methodology was effective.

Keywords: *signal processing, software defined radio, active learning, digital radio communications*

Introduction

Recently, the personal digital assistants which integrate radio communication capabilities and various sensors are widely used. This breakthrough in communication devices causes a paradigm shift as described in Moschell (1997). It is obvious that a fundamental education is one of the most important part of school.

However, the situation is changing and a gap between real world and fundamental education is widening. This situation causes a lack of students' motivation for learning fundamental theories such as signal processing or radio communication theories. To prevent this situation, we propose a use of an open-source software defined radio toolkit to implement project based learning (PBL).

Software development toolkit GNU Radio

GNU Radio is an open-source software development toolkit for software radio. Figure 1 shows architecture and signal flow of GNU Radio (2014) and universal software radio peripheral (USRP2) of Ettus Research (2014). A combination of GNU Radio and USRP enable quasi real-time signal processing up to 4.4 GHz.
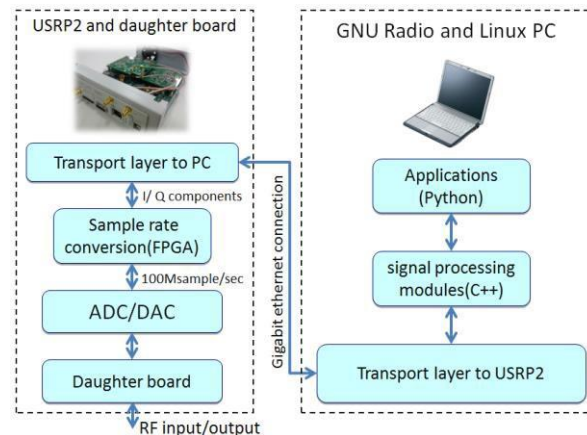
Figure 1 Signal flow of GNU Radio and USRP2.
*Rewrite and revised edition of Morikawa & Saruwatari (2010).

There are some advantages to use of GNU Radio / USRP2 for PBL. The advantages are summarised as follows:

- Free and open-source software.
- Processing the real radio signals.
- Simulink-like graphical tool to design signal processing flow graphs, the GNU Radio Companion (GRC), is available.
- Various radio signal processing modules which include user datagram protocol (UDP) and transmission control protocol (TCP) are available.

Effective educational materials to implement the PBL utilizing software radio

Before starting the proposed educational scheme, we made several arrangements to implement effective PBL. They are summarised as follows:

- Introductory lecture on radio signal processing
- Various signal processing flow graph examples of GRC
- Supporting equipment and materials

In this introductory lecture, we taught basic concept of various radio signal processing such as symbol rate, bandwidth, quadrature modulation, demodulation, quadrature signals and sub-sampling. Basic analog and digital modulation examples using GNU Radio and USRP2 are provided.

In our laboratory, several measurement equipments are available. It includes spectrum analyzer, signal generator, oscilloscope and vector network analyzer. Figure 2 shows numerically-controlled milling machine for printed-circuit board. By using of this useful machine, students can create their own specified printed-circuit board (PCB) including PCB antenna.
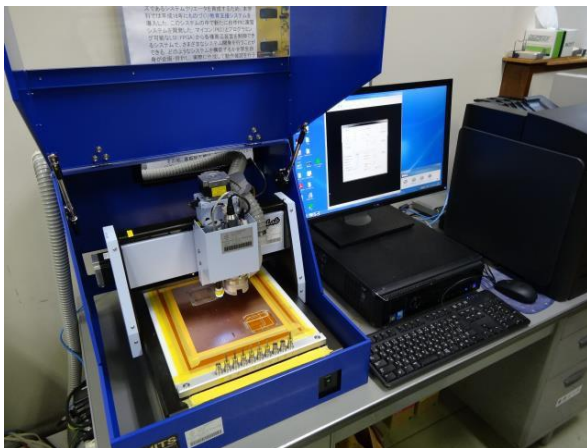
Figure 2 A numerically-controlled milling machine for printed-circuit board.

To make use of real signals, it requires wide range of knowledge and skills. They are not only software defined radio but also transmission line, matching circuits, antenna, radio frequency analog filters, chip components, mounting technology, measurement, apparatus and so on. In addition, understanding of Radio Law, spurious suppression, band plan, regulatory and administrative frameworks are required in real world applications.

A PBL practice in 2011 fall semester

To make improvement in the learning process of students, we introduced proposed 16 weeks PBL in 2011 at Ishikawa National College of Technology (INCT). Table 1 shows the main course objectives of

the PBL course utilizing open-source software radio toolkit for college senior students of advanced course.

For these objectives, students formulated their action plan as shown in Table 2. Based on the plan, students developed a universal digital radio controller for remote-controlled toy cars as shown in Figure 3. This system can control different manufactured radio controlled toy cars by replacing baseband signals with different one. It solved compatibility issues with radio controllers.

Table 1 Course objectives of the PBL course utilizing open-source software radio toolkit.

Required, 6 hours/week, total 16 weeks. For college senior students of advanced course.
Students should be able to: ✓ Design the best plan.   ✓ Consider constraint condition such as cost, safety, environment and social effects.   ✓ Doing quantitative approach with analysis and consideration.   ✓ Develop communication skills through presentation and discussions.

Table 2 Students formulated action plan for handling software radio to implement the PBL.

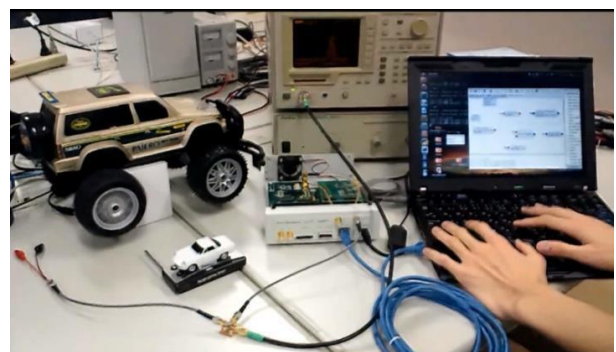| ✓ Preparation process to apply software radio environment.
   ➢ Setup
   ➢ Evaluation of GNU Radio / USRP2
     ➢ Measurement of spurious suppression
 ✓ Developing a specific goal.
   ➢ Implementation of a universal digital radio controller for remote-controlled toy cars
 ✓ Facilitate effective information sharing.
   ➢ Setting up project Wiki |
| --- |

Figure 3 Development of a universal digital radio controller for remote-controlled toy cars.

A PBL practice in 2013 fall semester

Let us introduce another PBL practice in 2013. In this year, students implemented a prototype modulator for wireless energy transfer system. They formulated the following specifications.

- The envelope of modulated signal should be nearly constant.

- Implement less than 80 kHz bandwidth at 13.56 MHz industrial, scientific and medical (ISM) radio band to keep band plan of Japanese government.
- Overlapped with control signals and energy transfer carrier at 13.56 MHz.
- Guarantee 25 kbps transmission rate for control signals during energy transfer.

The students solved this problem by using of quadrature signals. The other activities were making and evaluating measurement apparatus, preparing an antenna and filters and so on.

A proposal to the model core curriculum of National Institute of Technology, Japan

Administration officer Kiya (2012) of National Institute of Technology, Japan has announced a model core curriculum (MCC) of National College of Technology (NCT). The primary and fundamental aims of this model core curriculum are summarised as follows:

- To stablish minimum standards for core curriculum of the NCT.
- To present a clear guideline for model future curriculum of the NCT.

The announcement itself is a ground-breaking step to the future of the NCT. The MCC covers seven major department of the NCT such as Mechanical Engineering, Material Engineering, Electrical and Electronics Engineering and Information Engineering and so on.

However, there is a problem to be fixed. In the MCC, there are no subjects concerning sampling, filters, transforms, modulation and demodulation, even if for Electrical and Electronics Engineering and Information Engineering department. This arises from segmentation problem of various subjects in department. We hope for an early resolution of this problem.

Conclusions

In this correspondence, we proposed a use of an open-source software defined radio toolkit to implement the PBL. By using of software radio, we can process real radio signals up to gigahertz. To make use of real signals, it requires wide range of knowledge and skills. It enables attractive PBL.

The first proposed PBL course was conducted on fall semester in 2011 at INCT for college senior students of advanced course. In this new learning scheme, the students implemented a universal digital radio controller for remote-controlled toy cars. This system can control different manufactured radio controlled toy cars by replacing baseband signals with different one. We can easily adapt carrier frequencies for required specification of radio controlled toy cars. It solved compatibility issues with radio controllers.

In 2013, the students who got this PBL course implemented a prototype modulator for wireless energy transfer system. In this PBL, the students formulated their own specifications by referencing the radio band plan of Japanese government. They considered bandwidth, spurious suppression, modulation formats and data transmission rate. We hope that they will get smarter from experience of tradeoff between performance and Radio Law. As a result, all of these requirements are aimed at helping improve student skills through PBL.

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DEVELOPMENT AND EVALUATION OF THE WEB INTERFACE OF NS2 FOR NETWORK ENGINEERING EDUCATION

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Abstract

With progress of the information-oriented society, the education of network engineering at institutions of higher education is very important. However, it is not easy to understand network engineering for some students because the behavior of the network is invisible. A method to solve this includes the network engineering education using the network simulator, since it treats a network visually to some extent. Nevertheless, its operation is too difficult for the beginner of network, because the knowledge such as UNIX and programming language is necessary. Then, we develop a web interface and web applications which enables the beginner to use a network simulator on a web browser. Furthermore, based on the recollection method, we evaluated the usability and it is found that our system is easy to use.

Keywords: *Network Engineering, Network Engineering Education, NS2, Network Simulatior, Web Interface, Web Application*

Introduction

Many network engineers are demanded in the modern society all over the world, because ICT (Information and Communication Technology) spreads rapidly, and education of network engineering at institutions of higher education is very important. However, we suffer a problem that it is not easy to understand network engineering for some students because the behavior of it is invisible. In our college, we have carried out such education energetically using the network simulator. NS2 (The Network Simulator version 2) is the one of the major network simulators and is provided as an open source program. It is used for not only research, but also education in network engineering. The user can build virtual network and study the characteristics of the network. The behavior of the network designed on the system is observed visually by the animation tool called, Nam. In this way, NS2 is very useful for network engineering education. However, its operation is too difficult for learners, because the knowledge such as UNIX or programming language is necessary. Recently, by new web technology (e.g. HTML5), high-performance web applications are developed. Thus, we develop a web interface and web applications which enables them to run NS2 easily on the web browser. In addition, we design the user interface so that the user can perform basic operation without referring to a detailed manual.

Network Engineering Education and NS2

Network simulation is one of the methods of research of network technology and indispensable for development and evaluation of new network protocol. There are many network simulators, especially, NS2 (The Network Simulator ver. 2) is recognized as a representative network simulator by many researchers in the world. While some simulators are payware, NS2 is publicly available under the GNU GPLv2 license and runs on Linux, FreeBSD UNIX, Mac OS X, and so on.

By the way, Figure 1 shows the result of a questionnaire which asks about studying network in our class. From this, it is found that some students learning the network engineering think that it is not easy to understand, as the behavior of the netwok is invisible. It can be one technique to solve this problem to introduce a network simulator into network engineering education, because it treats a network visually to some extent.

NS2 has an animation tool and an analysis tool. It is expected an effect to understand network protocol and topology by using it, as well as a research purpose. Therefore, we think that NS2 is useful for education tool.
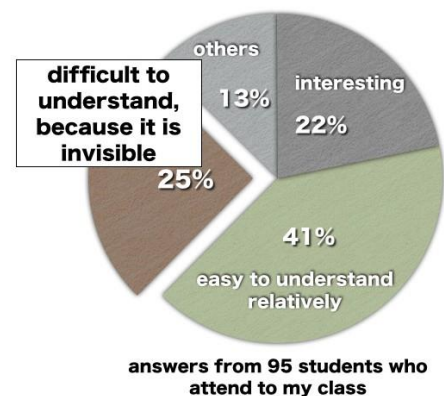

Figure 1 The result of a questionnaire about studying network engineering.
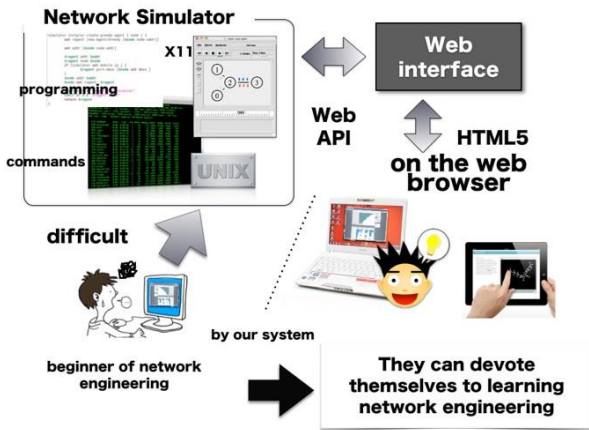
Figure 2 The Difficulty of using the network simulator for beginner of network engineering.

However, for the beginner of the network engineering, it is difficult to use NS2 (Figure 2), as it has problems as follows:

· Somewhat network knowledge is necessary.
· Many skills of UNIX system and programming are required.
· It is a little difficult to install.

A web-based network simulator was developed by Kimura, in 2008. It indicates the possibility that NS2 can be an e-Learning system on the browser. But, it is lacking in portability due to dependence on plug-in in this system. Moreover, it has a problem that a user can run only by topologies given beforehand.

Thus, we decided to develop the web interface system that enables the user to operate NS2 on the web browser easily for network engineering education.

Flow of simulation by using NS2

At first, we describe the overview of the flow of the simulation using NS2 directly (without our system).

1) Definition of the scenario
   The user of NS2 should describe the scenario in order to define the network to simulate. The scenario is programmed by OTcl language.
2) Running simulation
   According to the scenario, the simulation is run out by commands on the terminal tool (i.e. by CUI). The results of the simulation are written out to the trace file.
3) Analyzing the trace file
   The user can analyze the characteristics of the network from the results of the simulation. For example, the flow of packets is observed by animation tool, 'Nam' and the throughput or the jitter is analyzed by the graph function.

These any functions are carried out by commands on UNIX/Linux (or other platforms).

Development Methodology

The overview of our development system is shown in Figure 3. This system consists of the web interface (Web API) and web applications mainly. Since all functions of NS2 are carried out within the system, it does not have the mechanism which coordinates to other systems. However, the development of the interface is not difficult because of the text-based input/output from NS2. Hence, we develop the web API in order to exchange requests and responses between client and NS2 at first. This is implemented by using a concept called REST (Representational State Transfer) which can incorporate plural software on distributed systems.

Then, we develop the following web application.

1. GUI scenario editor (in order to define network to simulate)
2. Simulation results analysis tool
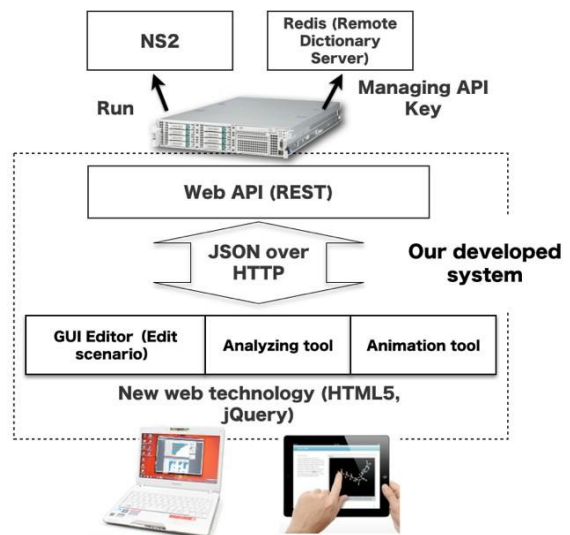3. Simulation results animation tool

Figure 3 The overview of our development system.

Each tool can realize a stable and high speed performance without depending on the special plug-in in the web browser by using the latest web techniques such as JQuery and Canvas function included in HTML5. These web applications connect to the web API with data description language called, JSON (JavaScript object Notation) on HTTP.

Development System

First of all, we explain the GUI scenario editor mentioned preceding section. It was necessary to describe the topology of the network for the simulation using a programming language in a scenario file conventionally (Figure 4). Using this editor, by simple mouse operation, the user able to perform a definition of topology and traffic of the network in GUI (Figure 5).

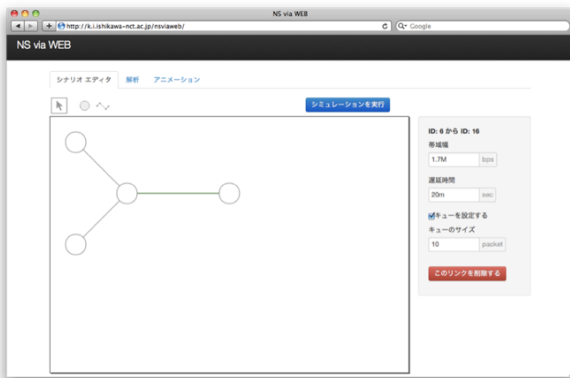Figure 4 An example of scenario file described by OTcl language.

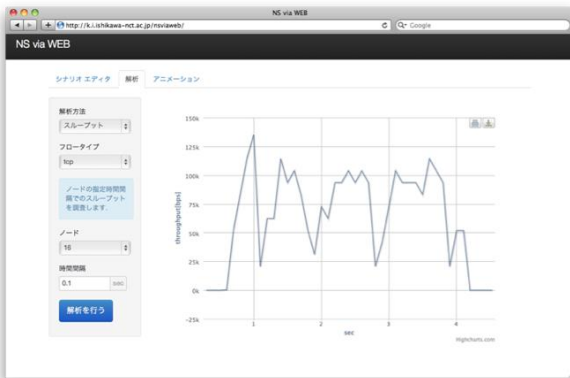Figure 5 An example of the GUI scenario editor

Figure 6 An example of throughput analysis by the simulation results analysis tool.

Next, we introduce the simulation results analysis tool. It was necessary to analyze simulation results by the user describing commands and scripts in NS2. Our development tool makes it possible to analyze the behavior of the network only by simple operation on the web browser. Figure 6 and 7 show an example of throughput analysis and statistics of the network respectively.

And then, we explain the animation tool. In NS2, using an animation tool working on X11 window

system called, Nam, the user can observe the behavior of packets. Nam shows an animation tracing the Nam formatted file written out by the simulator. Figure 8 shows Nam. Our development system displays an animation in a form very similar to Nam (Figure 9). HTML5 technique realizes this effect.
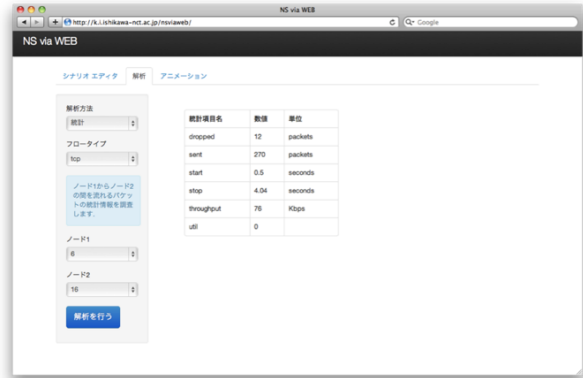
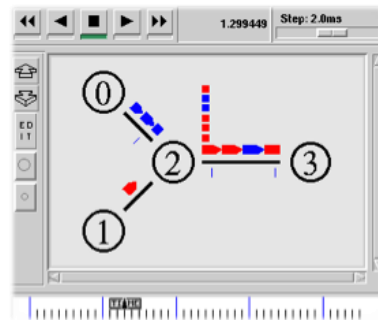Figure 7 An example of the statistics of the network by simulation results analysis tool.

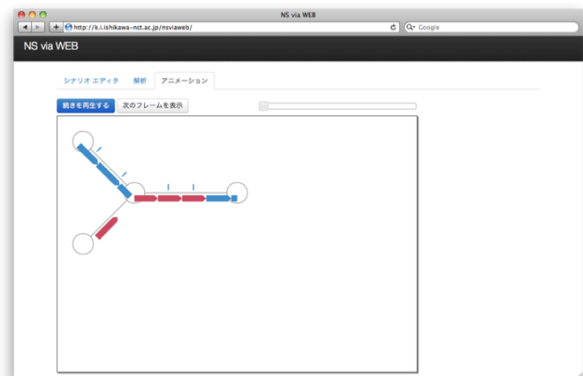
Figure 8 A screen shot of Nam (working on X11).

Figure 9 An example of the animation tool on the web browser.

Usability Evaluation

For the purpose of improvement of the user interface, we performed a simple usability evaluation. The recollection method is used as evaluation technique.

This is a technique to ask research participants about the cognitive process after executing given task. Research participants consist of 5 students (the beginner of the network engineering) in our college.

Table 1 shows the result of task achievement. In this table, "Good", "Fair" and "Poor" means as follows, respectively:

- Good : The user could achieve the task by oneself.
- Fair : The user could achieve the task according to hints of the manual.
- Poor : The user could not achieve the task.

From this result, it is found that research participants achieved almost all tasks. But, in "Flow definition", an achievement degree was low. This reason is because the setting of the destination of the flow of the packet was incomprehensible by the GUI scenario editor. Therefore, we improved this function to be able to define it distinctly.

Table 1 The result of task achievement

	User A	User B	User C	User D	User E
Node definition	Good	Good	Good	Good	Good
Link definition	Good	Good	Good	Good	Good
Flow definition	Fair	Good	Poor	Fair	Good
Jitter analysis	Good	Good	Fair	Good	Good
Change the scenario	Good	Good	Good	Good	Good

Results and Discussion

By the system which we developed, even a beginner of network engineering is able to carry out network simulation by NS2. It is thought that the value of what they can simulate without the knowledge of a network, programming or the system is big. In this way, one of our aims was able to be accomplished.

We must utilize this system for network engineering education in earnest and evaluate the education effect.

Conclusions

We developed a web interface and the web application to use a network simulator, NS2 on a web browser. Even a beginner of network engineering is able to run network simulation by the system. From the result of the usability evaluation, the user could carry out a series of procedures of the network simulation by oneself, and it is revealed that our system has almost high usability. Moreover, we improved the system.

We will utilize this system for network engineering education in our class and evaluate the education effect

and develop the electronic book which this system is incorporated in, as future work.

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DEVELOPMENT OF TEACHING MATERIALS FOR THE ELEMENTARY PROGRAMMING EDUCATION

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Abstract

Most students who learn programming have a negative impression of it, decreasing their interest to learn more. We had developed a questionnaire for students of the Elementary Programming Education in Nara National College of Technology.

Students who held negative impressions of programming stated that the reasons were "I can't understand the flow of the program" and "I can't understand the thinking way of a program". This is because programming education focuses on the programming syntax and notation rather than on problem solving. . The purpose of this research was to develop a Development of Teaching Materials for Elementary Programming Education to address the issues stated above.

The approach to this research was:
1)   To acquire Computational Thinking skills based on Computational Concepts in programming
2)   To produce teaching materials using a visual-based programming environment (Scratch)

We evaluated our teaching materials in a controlled experiment with 21 subject students. We separated students into three groups. Group A's students learnt using the materials; Group B's students learnt without using the content; while Group C's students learn through the conventional lecture class. After this, all students took an examination about Computational Thinking skills based on Computational Concepts. The results showed that Group A students achieved the highest average marks. In addition, the result showed a statistical significance between Group A and Group C.

Keywords: *Computational Thinking, Elementary Programming Education, Visual based programming*

Introduction

Most of students who learn programming will hold a negative image toward programming. These kinds of images may be to decrease the student's desire for learning. A lot of reasons exist, but to prevent the student from holding the negative image, the guidance of contents of programming education (elementary programming education stage) are very important.

The purpose of this research is the development of Teaching Material for the Elementary Programming Education. Firstly, we had executed a questionnaire regarding the image toward programming to the first and second year students of Information Engineering in Nara National College of Technology. As the result, 18 out of 83 people (22%) answered "dislike programming". The top two reasons for "dislike programming" are listed below.

R1: can't understand the thinking way of a program
R2: can't understand the program flow

Attaching importance to these two points, we developed the teaching material.

Research Methods

Approach

For R1 solving is by using daily life routines and habits as material. The thinking way of a program refers to the way the program solve a problem. Generally, most of materials for programming usually require a prerequisite knowledge about mathematics and physics. The prerequisite knowledge regarding the material will cause an increase in burden for students. As a result, the student holds the negative image for programming. Most students already have prerequisite (beforehand) knowledge regarding daily life routines and habits. Thus it will help reduce the burden for programming.

For R2 solving is by adopting a visual programming environment. The program flow refers to the order in which the individual statements are executed or evaluated. In creating a program, it is necessary to imagine the behaviour of the program during execution while making the program. However, with the traditional text-based programming languages, the flow of the program can't be expressed directly. Thus it makes difficult to understand program flow. Especially for programming beginners, it is difficult to imagine the behaviour of the program during execution while creating a program. As a result, the student holds the negative image for programming. The visual programming is any programming language that lets

users create programs by manipulating program elements graphically rather than by specifying them textually. So it is easy to understand (intuitively understandable) for programming beginners.

From the above, the development of the material will be using Scratch[1] and will be adopting the Computational Thinking[2] concepts from daily life. Scratch is a visual programming language. It can make it easy to create interactive stories, animations, games, music, and art and share these creations on the web. Computational Thinking is a problem solving method that uses computer science techniques. Programming concepts based on Computational Thinking has 8 concepts[3]. We focused on 3 out of 8 concepts; Sequences, Conditionals and Loops.

Development of Materials

We developed 6 materials (2 sequences materials, 2 conditionals materials, 2 loops materials). Each materials have the correct animation answers. The materials were uploaded on Scratch home page with a shared access. （http://scratch.mit.edu/studios/349814/）.

Figure 1 shows a snap shot of the material related to the action of crossing a crossroad with a traffic light. It is a conditionals material. At first, students must watch the correct animation answers on published web site. Then, the students will create a program on the right side of the material that matches the correct animation answer on the left side of the material. The programming is performed in Scratch. Students will create the program in Scratch through trial and error using parts for the program that are given in advance.
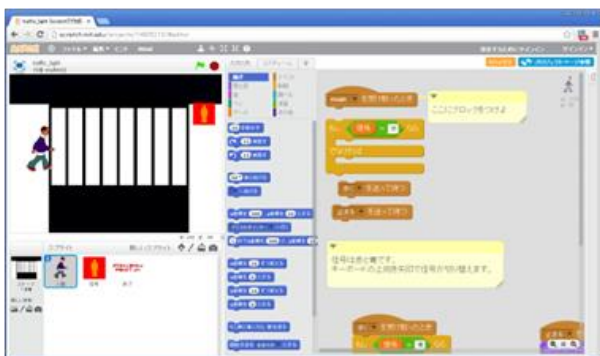

Figure 1 Screen shot of conditional material

Evaluation Experiment
Experimental Purpose and Method

In order to evaluate our materials, we conducted participants experiment for first and second grade students of the Department of Information Engineering in this school. First grade students had never studied programming. Second grade students had still just started studying Java programming.

At first, we divided them into three groups(A, B and C). One group was five people. Group A and B consist of first grade students, group C consist of second grade

students. That is, Group A and B were states that they don't have a programming knowledge. On the other hand Group C is a state that they learned by lecture style traditional at least three concepts (sequential, conditional branching, repeat).

For group A, teach the concepts in a lecture form and make them practice Scratch and learn the contents of six materials. After that they do a test to check the level of understanding and a questionnaire for the content. For group B, teach the concepts in a lecture form only and after that do the test. For group C, do the test only.

Results and Analysis

Table 1 shows that the result of the test. The score of the test is on a scale of a hundred. From the table, it was found that score of group A is higher than score of group B. In addition, score of group A is higher than score of group C. It suggests that our materials are better than the traditional lecture style. Table 2 shows that p value of the values related to the paired T-Test.

The results of the questionnaire about the contents for the A, all people of group A answered that the contents are interesting and easy to understand. And, they answered that they felt knowledge of programming concepts has increased. Other say, "I could understand well the flow of the program", "These are simple and easy-to-understand content for the beginner" and "Possible to easily see the contents of the content". In conclusion, created contents are suitable for beginners, these can be appreciated the program flow programming concepts, these are easy-to-understand content and popular with students.

Table 1 The result of the test

Group	Average of score	Standard Deviation
A	86.67	4.08
B	70.00	12.47
C	73.33	9.72

Table 2 Paired Groups test

Pair	p value
A – B	0.051
A – C	0.035
B – C	0.684

Conclusions

In this study, we developed "Teaching Materials to Learn for Education of Elementary Programming". By consider the negative image factors of programming that obtained in a pre-questionnaire, we created contents employing "Computational Thinking" in daily-life by using Scratch. From the results of evaluation experiment using the contents, confirmed the usefulness

of these.   But, it is purpose of the content that understanding of programming concepts created.

Future issue is the creation of new contents to connect the ability to write programs, as a foothold to this content.

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THE PROJECT TO EDUCATE FOR FEMALE STUDENTS
-ACT GIRLS' NETWORK-

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Abstract

This project, called the ACT Girls' Network, was to support female students to have careers as engineers. 157 female students, making up 17.2% of all students, were enrolled in the National Institute of Technology, Akashi College. However, there were no female students in some classes of some departments. This made it difficult for female students to get enough information from senior female students and they had practically no information about how to achieve a work-life balance as a female engineer.

In 2012, 18 female students, approximately 10% of all female students, joined the collaboration project for KOSEN female student branding (the chief editor was National Institute of Technology, Nara College). On the basis of this experience, policies of this project were set as 1) To build up the network with face-to-face and groupware system, 2) To arrange career seminars, 3) To use knowledge or experiences of speciality.

The following events were practised: to present information about careers at female students' forum, to get training as a facilitator of SCSK CAMP, to design a science event with their knowledge or experiences of specialty for elementary and junior high school girl students, to exchange information or ideas with female students of other NITs with TV meeting system, to set up booths to advise about each department, college life, how to study for the entrance examination, and so on for junior high school girl students at open campus.

Keywords: *female student, career education, network between female students, to use knowledge of specialty, science event for elementary and junior high school girl students, to realise the value of themselves*

Introduction

This project was practiced for support of female students to make careers as female engineers from the network over school years and departments that called "the ACT Girls' Network". 157 female students, the ratio was 17.2% of all students, were enrolled in National Institute of Technology, Akashi College. There were no female students in some classes of some department. This situation was difficult to make network between female students to get enough information from elder female student and there had practically no information about how to keep working and life-work balance as engineer.

In 2012, 18 female students, the ratio was 10% of all female students, joined the collaboration project for KOSEN female student branding (the chief editor was National Institute of Technology, Nara College). The forum of KOSEN female students was held at Tokyo, the capital city of Japan (Figure 1). The encyclopaedia of KOSEN female students and the encyclopaedia of KOSEN female students Jr., about each KOSEN, were published as results of this collaboration project. All female students who joined the project said the project was important and should continue the project at Akashi College. Then a new project was started at Akashi College since 2013.

Policies of the project

On the basis of this experience policies of this project were set as 1: to build network with face to face and groupware system, 2: to arrange career seminars, 3: to use knowledge or experiences of speciality. Almost contents were proposed from students at meeting.

Figure 1 At the forum of KOSEN female students

Contents of the project
1: To build network between female students

Meetings and using a groupware system: Some meetings were held. And a groupware system was used for scheduling, meeting and sharing information.

Using a TV meeting system: TV meeting system was used to meet with other NIT all parts of Japan especially Kansai area.

Visiting to other NIT campus: TV meeting system was some female students visited to other NIT campus and exchanged much information, college life, how to design own careers

2: To arrange career seminars to grow female engineer

The career seminars wasn't held in Akashi college yet.

3: To use knowledge or experiences of speciality

Take with junior high school girl students: To set up booths to advice about each department, college life, how to study for the entrance examination, and so on for junior high school girl students at open campus (Figure 2). 12 female studens joined as adviser.

Open seminar about making silver accessory: The open seminar about making silver accessory was arranged by female students. A second year student of mechanical engineering department was a leader of this seminar and 12 students joined as assistant. The flier designed (Figure 3) by a student was very different from other open seminars'. They explained about process (Figure 4) and each department of Akashi college (Figure 5).

Open seminar about work with LED: The open seminar about work with LED was arranged by female students. This work means felt work. A lampshade was made with felt and the lamp made by LED. Work and LED technology were combined in this seminar. A boy joined this program however he couldn't do felt work. The ability of work and to create pretty things is one of strength of female students (Figure 6-8).

Presentation in forum of female students at KOSEN: The following events were practiced: to present about their careers at female students' forum. 16 female students presented about studies, researches, license seminar and club activities. And 4 female students

Figure 3 Flier of open seminar about making silver accessory that was designed by a female student

Figure 4 Female student was explaining how to make silver accessories

Figure 2 Take with junior high school girl students at open campus

Figure 5 They explained about each department of Akashi college

Figure 6 Guidance to make circuit of LED

Figure 7 Lampshade of LED

Figure 8 Works of female students

Figure 7 Presenting at forum of female students at KOSEN

joined this forum as staff. They were first year students of Akashi college.

Results of this project and expected results of future

1: To build network between female students

Sources of information increase for the female students who are the minority in a class and are a chance to cancel everyday slight uneasiness. Furthermore, improve more towards a high place; help.

2: To arrange career seminars to grow female engineer

Female students can get how to spend school days to form their carrier as a female engineer and can get knowledge about the carrier formation after the graduation. At first, with information, choice of produced way of life of the life work balance corresponding to the change of the life stage is enabled by assuming it knowledge.

3: To use knowledge or experiences of speciality

To realize own value through the lecture about that learned about their major and technique to elementary school students, junior high school students and company person. And, with stronger confidence, they can grow as the female engineer.

Conclusions

The following events were practiced: to present about their careers at female students' forum, to get training as facilitator of SCSK CAMP, to design science event with their knowledge or experiences of specialty for elementary and junior high school girl students, to exchange information or ideas with female students of other NCTs with TV meeting system, to set up booths to advise about each department, college life, how to study for the entrance examination, and so on for junior high school girl students at open campus.

The project hereafter will be spreded to all female students at NIT Akashi and career seminar must be held to give informations for them.

Acknowledgements

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DEVELOPMENT AND EVALUATION OF ENGLISH TEACHING TEXTBOOKS FOR STUDENTS IN COLLEGES OF TECHNOLOGY

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Abstract

This paper describes our attempt to extract useful means to develop teaching textbooks for college-level Japanese learners of English. Results emphasize the importance of developing effective reading textbooks.

First, we evaluated the quality of English textbooks developed by the author's group. We developed English teaching materials for students of colleges of technology, incorporating recent second/foreign language reading research, and published more than 20 textbooks and CD-ROMs. Some English reading textbooks offer reading materials about domestic and international issues. Others address topics related to science and technology.

Secondly, we discuss the practical use of our textbooks in English classes taught at Sendai National College of Technology. We used them not only as English reading materials but also as information resources that provide students with interesting topics when they chose their oral presentation themes. Questionnaire responses about our textbooks show crucially important factors that English textbooks should offer to motivate students to practice English: contents including issues that attract students' interest.

The following issues must be discussed to propose more useful teaching materials for students' English learning. The first is consideration of what to offer science and technology majors in our textbooks in light of the students' interests, their related fields, and development of science and technology. The second is to discuss English textbook development based on the model core curriculum produced by the Institute of National Colleges of Technology in 2012. Finally, we should propose English learning systems from the viewpoint of students who specialize in science and technology studies.

The English textbooks that the author's group developed were directed originally to their own students at colleges of technology. The books, however, were published and are used in many universities and high schools, which indicates that our attempts at English education in colleges of technology have indicated opportunities for wider application throughout Japan.

Keywords: *science, technology, reading, summary, presentation*

Introduction

This paper presents a discussion of the development of English teaching materials for college students studying at colleges of technology in Japan.

English teaching materials play an important role in English classes. Junior and senior high schools in Japan are required to educate their students in accordance with the course of study and to use English textbooks authorized by the Ministry of Education, Culture, Sports, Science and Technology. At colleges of technology, however, teachers in charge of English classes are expected to organize course syllabuses and choose appropriate teaching materials for their classes, just as they do at universities. Teaching materials are often selected from textbooks for high school or university students.

In light of the great influence that teaching materials have on English classes, we chose to develop English textbooks worthy of selection as teaching materials at our colleges by ourselves, incorporating recent research such as that by Muranoi, Chiba, and Hatanaka (2001). Our aim was to motivate students to study English and to enjoy learning English despite their busy college schedule.

We published 13 general English textbooks for 1st-to-3rd year students at colleges of technology, including *New palette* vols. 1–3 (Okazaki, 1997), *New grove* vols. 1–4 (Okazaki, 1998, 1999), and *New palette* Second ed. vols. 1–3 (Okazaki, 2004), which have been used not only at colleges of technology but also in equivalent grades in high schools throughout Japan. We also published six textbooks of English reading, including *Reading landmarks of the world* (Chiba, Matsuo, & Okazaki, 2001), *Reading mainstream of the world* (Chiba, Matsuo, & Okazaki, 2003), *Reading focus of the world* (Matsuo, Chiba, & Okazaki, 2006), and *Reading forerunner* (Matsuo, Okazaki, Ohsato, & Ishinuki, 2008) for 4th-year and more advanced students at colleges of technology. They have been used at

universities and companies throughout Japan. We also published other textbooks for junior high school students and adults who learn English.

Textbooks developed by teachers targeting their own students and which are subsequently edited for publication are the most effective teaching materials in the following three respects. First, if the teachers develop a textbook especially for the students to whom they teach English, then it is possible to adjust the contents, level of difficulty, and the quantity of the materials to the proficiency level of the students. They also offer topics that are new and familiar to the students. Secondly, it is possible to propose suitable teaching materials for the unique educational system of colleges of technology. Thirdly, user-friendliness of the textbooks increases for both teachers and students through the process of editing for publication, adding more reference data related to the contents of the textbooks and detailed teachers' manuals, and so on. The higher degree of sophistication enhances the versatility of the texts and their usefulness not only for students at the author's college but also for other students in high schools and universities throughout Japan.

English Textbook Development

We begin our discussion of the evaluation of the English textbooks developed by the author's group, specifically examining the textbooks developed for 4th-year and more advanced students at colleges of technology.

At the beginning of textbook development, the author's group conceptualized the textbooks, such as the object of the class, target grades of the students, fields of the contents of the text, and general editorial policy, based on the students' needs.

Our reading textbooks comprise a certain number of units designed as a set of teaching materials for one English class that is presumed to last for approximately 90–100 min. A unit has one reading text in English, with several tasks organized systematically to facilitate students' understanding of the reading texts. We assigned four pages to each unit, which offers different topics. The number of units in a textbook depends on the estimated number of English classes in which the textbooks are used during a semester or during an academic year.

When editing textbook units, we discussed several aspects including the following two points: reading material contents and the framework of the units in the textbooks.

An important point about English reading textbooks is that the reading materials to be adopted for a textbook must have contents that attract students' interest by stimulating their intellectual desire. Therefore, we selected reading materials and data related to the materials from numerous essays and papers that had been collected from books, newspapers, journals, magazines, and the internet, and thereafter edited them minimally. Our textbooks offer widely various topics

from various fields of modern science and technology to some current topics in our modern society to meet various students' interests: Some of them offer reading materials about domestic and international issues in our society; others specifically address topics from the fields of science and technology. Some examples of the subjects of the English texts are GM food, junk food, *Shonen Jump* in the US, electric money, cellular phone strategy, a major league player, a female astronaut, alternative energy, GPS, mystery of time, earthquake research, organ transportation, a rooftop garden, and science and religion.

Another important factor is related to the framework of the units in the textbooks. We designed each unit with a proposal for the way an English class is to be organized effectively with various activities. English classes are made up of some different activities that support students' reading practice: pre-reading activities, while-reading activities, and post-reading activities. We proposed several fundamental frameworks with four stages in a unit of our textbooks, such as (1) pre-reading information, (2) reading texts, (3) word check, and (4) comprehension and activities. They encourage reading activities, which can be regarded as mutual communication with the author of the text.

In the first stage of pre-reading information, we present new data, pictures, illustrations, or simple questions related directly or indirectly to the texts for attracting student interest to the English texts, based on schema theory developed based on Goodman (1967).

The second stage of reading texts in English is preceded by a short introduction in Japanese, with marginal notes added, if necessary. We selected reading texts from expository prose, with which readers can best learn the general structure of English texts.

The word check section offers keywords of the text or knowledge of vocabulary to facilitate the students' reading practice.

We intend that the last section of comprehension present some suitable tasks that facilitate students' grasp of the main idea, such as chart completion and summary completion, incorporating previous studies of information transfer by Alderson (2000), the structure of English texts by Leggett (1966), reading skills in skimming and scanning, and others. In the activity section, students are recommended to do advanced research or have a discussion to consider the text contents critically.

We considered the page layout, total balance, and arrangement of the reading texts in accordance with the variety of major studies of the students. Any responses given by the students have been reflected to the following textbook development for continuous improvement. We hope that the students will be independent readers who will work to improve society in the future. Figures 1 and 2 respectively portray examples of pre-reading information and comprehension sections. The reading text and word check sections are located between them on two facing pages.

Figure 1 Example of pre-reading information.

Figure 2 Example of comprehension.

Results and Discussion

We discuss the practical use of our textbooks in the English classes in Sendai National College of Technology in the present section. We select different textbooks in accordance with the purposes of the classes, intended uses in the classes, and the grades of the students. We present results for two cases in which we used *Nature and science* (Chiba, Okazaki, Kanazawa, & Yamazaki, 2006) and *Science and culture* (Chiba, Okazaki, & Pak, 2007), respectively, as textbooks in the English classes.

These two textbooks, which were developed for 4th-year and more advanced students at colleges of technology, comprise 15 units, the subjects of which are all concerned with science and technology, while two supplementary reading sections deal with problems related to social life, intended to broaden readers' horizons. Each unit has a short Japanese introduction, reading texts, and exercises of some kind, either in (1) summary or T/F questions, grammar, expression, and vocabulary, or (2) summary or T/F questions, expression and grammar, vocabulary, and activity. At the end of the textbooks are editorial notes that have approximately the same amount of data as the English texts so that the students might enjoy reading the texts independently. We used these textbooks not only as English reading materials but also as information resources that provided students with interesting topics when the students chose the theme of their oral presentation in English.

The first example of practical use of our textbook is an English reading class of 26 5th-year students at Sendai National College of Technology. At the beginning of the classes, the students belonging to different departments shared their technical knowledge to motivate themselves to read the texts and to activate their schema about the contents.

We conducted an anonymous survey of *Nature and science* at the end of the academic year. The questionnaire items were the following: (1) How did you like the contents of the textbook in this class? Interesting/average/not interesting/other comment. (2) How did you feel about the difficulty level of the textbook? Difficult/just right/easy/other comment. (3) Make a comprehensive evaluation of the textbook. 80–100 (A)/60–79 (B or C)/under 59 (F). (4) Feel free to describe what you think is good and bad about the textbook.

Figure 3 on the next page shows that students found each unit interesting. The units for which more than 70 percent of the students chose "interesting" as a response were Unit 1 Stephen Hawking and black holes, Unit 15 Cassini–Huygens at Saturn, Unit 7 T. Rex lived fast and died young, and Unit 14 The valley of the golden mummies. The students highly evaluated the units, which deal with new discoveries in the fields of interdisciplinary studies and the themes that made them
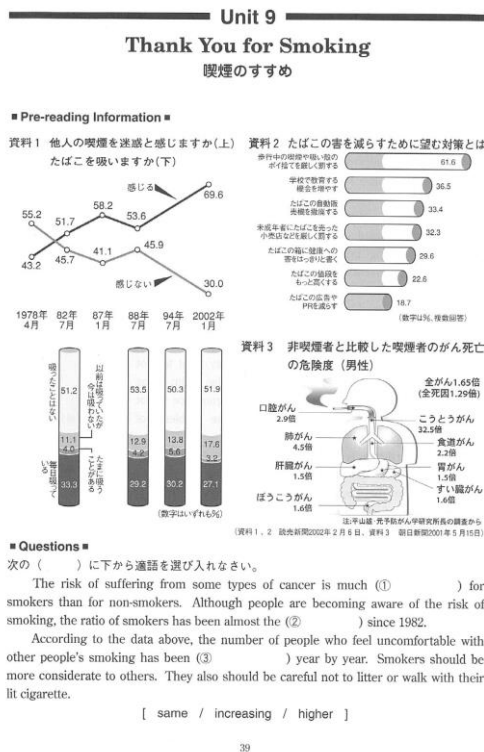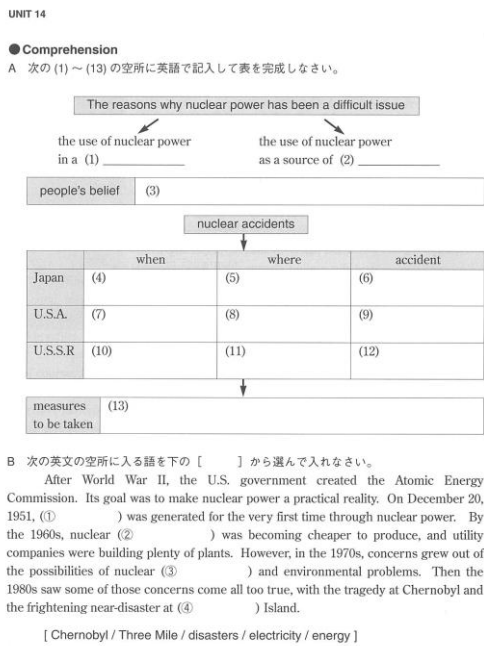
reconsider their beliefs. It is noticeable that these topics attracted technology majors more than topics related to medical fields, which are often featured in general newspapers and magazines. Unit 9 North Carolina lighthouses and Unit 11 Jacqueline Cochran, which fewer than 20 percent of the students found interesting, are to be improved in editorial notes or class activities.

Figure 4 demonstrates that the students who found the level of difficulty of the texts to be appropriate exceeded 70 percent for 14 out of 15 units. The exception was Unit 1 Stephen Hawking and black holes, which the students found most difficult. The unit, however, highly attracted students' interest, as shown in the previous question (1). The result suggests that attractive contents of the texts should be valued more than their difficulty level during textbook development.

Figure 5 shows that more than 80 percent of the students chose 80–100 points, which is comparable to grade A.

Some free descriptions of the textbook are the following: I became interested in scientific fields through reading the English essays. I learned something more than English in reading English essays. I learned technical terms in reading activities. I can enjoy reading it more if it has more pictures or illustrations. Frequent responses indicating satisfaction with the textbook include the following: interesting (nine people), appropriate difficulty level (nine), helpful editorial notes (eight), and scientific topics (five). Aspects to be improved are the following: more difficult (three people), easier (three), notes (three), nothing (16). Students' equivalent requests in wholly opposite directions suggest the necessity of assessing the variety of the students in textbook development as well as in classroom teaching activities.
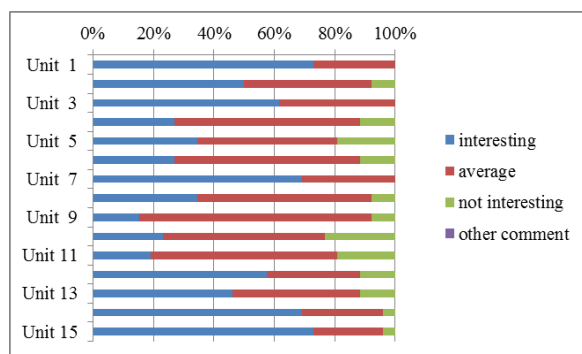

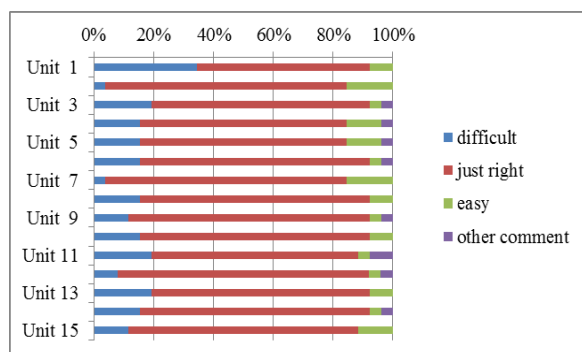Figure 3 Student evaluation: interest level.

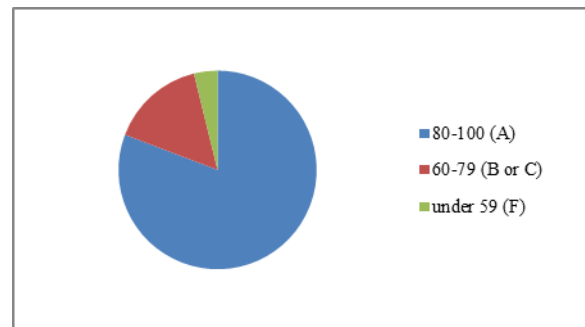Figure 4 Student evaluation: difficulty level.

Figure 5 Students' comprehensive evaluation.

Another example is the use of *Science and culture* in general English classes for 2nd year students of the Advanced Course at the author's college. Using presentation software, students made an oral presentation with two portions of summary and their research related to the texts. They outlined the essays they had chosen in the textbook depending on their interest. Thereafter, they composed their thoughts in doing their own research, which was stimulated by the essay contents. They were also requested to think critically to make comments on their classmates' presentations. It was intended that the student activities include all four skills of English proficiency of reading, writing, listening, and speaking, as Brown (2007) and others insisted. It was also expected that they thought intensively to act as science communicators who can explain science and technology in plain English, presuming that the audience are freshmen studying at colleges of technology, who have no technical knowledge.

The questionnaire data which were provided with the same questions as the previous ones were the following: Of 15 students, 10 found the textbooks interesting. Thirteen students found the difficulty level to be adequate. Nine students gave a comprehensive evaluation of 80–100 points (A). Eleven students wrote in free descriptions that they were able to choose interesting topics, which motivated them to read essays written in English. Five students reported that they learned how they should compose a summary in English. Two described the contents, and the other two described topics related to scientific issues as good points of the textbooks. Three students reported that the technical terms were difficult to understand.

Results showed that our textbook was suitable for an English class of this kind in that the scientific themes were sufficiently various to be chosen by the students having various interests and that the short Japanese introduction made the students' choice of units easier.

Conclusions and Prospects

The author's group engaged in research and development of English textbooks for students at colleges of technology and used them in their English classes. The questionnaire data for our textbooks indicate that our textbooks are acceptable as user-friendly textbooks among our students and that an important component that English textbooks should offer for motivating students into English practice is the interesting contents of their texts.

The issues to be discussed in the future to propose more useful teaching materials to support students' English learning are summarized based on the three points discussed in the Introduction of this paper.

First, we must continually consider what to offer science and technology majors in our textbooks in light of the students' interests, their related fields, and development of science and technology. Another important aspect of textbooks that offer current scientific themes is that they are recommended not only for science majors but also for all students to cultivate science literacy in modern society. English textbook development efforts must provide teachers with detailed information and properly prepared materials related to science and technology, especially in light of the existing situation: Science contents are not positively chosen by English teachers. In fact, they account for only 7% of all the contents that teachers want to use best for English instruction at universities in Japan (JACET Teaching Material Development Group Kansai Chapter, 1998).

Secondly, English textbook development must be discussed based on the model core curriculum, which was produced by the Institute of National Colleges of Technology in 2012, examining the course of study for high schools.

The last important aspect is that English learning systems must be proposed from the viewpoint of students majoring in science and technology, considering various excellent English teaching materials and teaching practice along with better use of information and communications technology.

The English textbook development in which the author's group engaged was directed originally to their own students at colleges of technology. The textbooks developed by the author's group, however, were produced for use at many universities and high schools, other schools, and companies because our textbook development shares the aims of education at other universities and high schools. Our attempts at English education at colleges of technology can yield benefits for wider application throughout Japan.

Acknowledgements

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COOPERATIVE EDUCATIONAL PROJECTS BETWEEN NIT-NAGAOKA AND HIGHER EDUCATION INSTITUTIONS IN ASIA

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Abstract

National College of Technology, Nagaoka College (NCT-Nagaoka) has been accepting international students since 1985, and has graduated 116 international students. Up to the present, we have had international students from Malaysia, Mongolia, Vietnam, Indonesia, Bangladesh, Gabon, China, etc. At NCT-Nagaoka, we foster well-rounded students through technical school education incorporating activities with the purpose of creating international, cross-cultural understanding.

Among the activities promoting international exchange, we have been engaged in overseas dispatch training since 2005. This activity aims to make the most effective use of many international students learning at Nagaoka, and we dispatch Japanese students to their country so as to deepen mutual understanding of various cultures and promote international exchange among students.

Also, one part of the overseas training is designated as "Overseas Training Workshop" where groups of Japanese and local students carry out collaborative programming practice using microcomputers and LEGO MINDSTORMS®. We consider that it is also important to allow students to experience other cultures at the beginning of their engineering education. So far students have been trained on collaborative projects together with local students in China, Malaysia, Vietnam, and Thailand.

In the project, students perform a workshop using a microcomputer board, an Android terminal, and LEGO MINDSTORMS®. The combined teams of Japanese students and the students of the school in the visit, collaborate to assemble the robots, work on the control software and participate in contests such as time race.

In this paper, we will introduce the projects carried out at Hanoi Community College, Thai-Nichi Institute of Technology, and NCT-Nagaoka.

Keywords: *Overseas Training, microcomputer, LEGO MINDSTORMS, cooperative education, international exchange*

Introduction

Considering the essential change of global industry and economy in the coming era, the new educational system for engineers, including collaboration with students of different countries, should be introduced in college technologies. NIT-Nagaoka has been accepting international students since 1985, and has graduated more than one hundred international students. At NIT-Nagaoka, we foster well-rounded students through technical school education incorporating activities with the purpose of creating international, cross-cultural understanding. Among the activities promoting international exchange, we have been engaged in overseas dispatch training since 2005. This activity aims to make the most effective use of many international students learning at NIT-Nagaoka, and we dispatch Japanese students to their country so as to deepen mutual understanding of various cultures and promote international exchange among students. A part of the overseas training is designated as "Overseas Training Workshop" where groups of Japanese and local students carry out collaborative programming practice using microcomputers and LEGO MINDSTORMS®. So far students have been trained on collaborative projects together with local students in China, Malaysia, Vietnam, and Thailand. From these activities, the projects with in Vietnam and Thailand are described.

Robot Project 2013 in Hanoi

Overseas Training Workshop was held in in Vietnam from September 11 to 17, 2013. The schedule of the training is shown in Table 1. Twelve students and two teachers visited Hanoi and Hue in Vietnam. In this oversea training, workshop with a robot, factory visit of the Japanese company, Vietnam Nippon Seiki Co., Ltd., student exchange at College of Foreign Languages (Hue University), city tour at Hue. The workshop, "Monozukuri" abroad using LEGO MINDSTORMS, was carried out at Hanoi Community

College. In the workshop, six groups performed building a robots and making a program for the robot. Each team is consists of Vietnamese and Japanese students. Competitions were done at the end of the workshop as shown in Fig.1 and Fig.2.

Table 1. Timetable of the workshop at HCC

No.	TIME	CONTENT
1	10:00-10:10	Greeting ceremony
2	10:10-10:25	Welcome speech by HCC
3	10:25-10:40	Speech by NIT-Nagaoka
4	10:40-11:00	Introduction of workshop
5	11:00-12:00	Building robot
6	12:00-13:30	Lunch
7	13:30-15:00	Programming for robot
8	15:00-16:00	Competition
9	16:00-16:30	Discussion
10	16:40-16:45	Summary

Fig. 1 Cooperative work at HCC.

Fig. 2 Competition for robot at HCC.

In Hue, cultural exchange between Japanese students and Vietnamese students was performed for self-introduction, ice breaking, singing a Japanese song, *Rakugo*, and games. In addition, a city tour in Hue, the old Nguyen dynasty, guided by the students of Hue University was done.

AFR 2013 in Bangkok

An overseas training for Thailand was performed from Aug. 27 to Sep. 3, 2013. Eleven students and two leading teachers were participated in the training. In the workshop, ~~teams consists~~a team consists of students of Thai-Nichi Institute of Technology and students of NIT-Nagaoka were making robots for following line. Four teams competed the time. At first, we want to create four mix teams by mixing the member of each team. This is because to promote the friendship and culture exchange. The teams were reconstructed before the start workshop. Each team consisted from TNI programmers and NIT-Nagaoka mechanics or TNI mechanics amd NIT-Nagaoka programmers. The schedule of the training is shown in Table 2 and the photographs of the workshop are shown in Fig.3 and 4.

In addition, students performed the culture sight-seeing such as temple or the Ayutthaya ruins in Bangkok and visited two Japanese companies.

AFR (Android-bot Follow-line Racing) is the line following robot competition. The details of AFR are as follows.

- Robot components consist with a smartphone or a computer terminal including operating system, Bluetooth devices, back camera and application and a vehicle system including a microcontroller, drive system, communication system and energy.
- The operating system must be Android.
- An application must support a camera and a communication with other devices through Bluetooth.
- Any reflective optical sensor is not allowed to be used for tracking a line,
- Communication through Bluetooth.
- Robots must touch the ground while the ground while moving.
- The robot's power source must be 4 cells of 1.5v AA batteries.
- The starting points are determined (right for the best and left for the second best, and vice verse), and the direction is chosen by the second best team.
- If a robot finishes a round run within 5 minutes, the score will be the time it spends.
- If a robot does not finish a 5-round run within 5 minutes, the score will be the total rounds it finishes.
- The two robots start a race at the same time in the same running direction.
- The winner is the fastest robot, namely the first robot to hit or pass the other one.
- If the competition is not finished in 5 minutes, the robot that goes farther from the starting point is the winner.

Table 2. Timetable of the workshop at TNI
Day 1 (29 August 2013)

No.	TIME	CONTENT
1	9:15-9:30	Registration
2	9:30-10:00	Introductions to the Competition and Rules
3	10:00-10:30	Demo of AFR Robots from TNI
4	10:30-10:45	Coffee Break
5	10:45-11:45	Teams Presentations

6	11:45-12:00	Mix-Team Matching
7	12:00-13:00	Lunch
8	13:00-15:00	Workshop and Practice
9	15:00-15:30	Coffee Break
10	15:30-17:00	Worksop and Practice

Day 2 (30 August 2013)

No.	TIME	CONTENT
1	9:15-9:30	Registration
2	9:30-12:00	Opening the Competition Knock-Out Qualifying Round: 4 Teams Final Round: 2 Teams
6	12:00-13:00	Lunch
7	13:00-13:30	Giving Certificates, Closing the Competition, and Taking a Group Photo
8	13:30-14:00	Coffee Break
	14:00-14:30	Demo of LEGO Robots from NNCT
9	15:30-17:00	Training LEGO Robots and Workshop

Fig. 3 Cooperative work at TNI.

Fig. 4 Competition of AFR at TNI.

GLMD 2014 in Nagaoka

GLMD (GR-SAKURA LED+MUSIC+DANCE) CONTEST was held at NIT-Nagaoka from 26th to 29th of May, 2014. The schedule of the workshop is listed in Table 3. "Dancing with LED light" means that you and some microcomputers integrate to music through original and matched actions. These will be very important things when you dance to the LED light which is controlled by a microcomputer board.

The photographs of the workshop are shown in Fig.5 and 6.

Table 3. Timetable of the workshop at NNCT

Day 1 (25 May 2014)

No.	TIME	CONTENT
1	9:30-10:30	Welcome Meeting
2	10:35-11:30	Campus Tour of NIT-Nagaoka
3	11:40-13:00	Lunch at NIT-Nagaoka cafeteria
4	13:10-15:20	GMLD Notification to rules and schedule
5	15:30-17:00	Cooperative work
6	17:30-19:00	Welcome Partty at NIT-Nagaoka cafeteria

Day 2 (27 May 2014)

No.	TIME	CONTENT
1	9:00-9:15	Registration
2	9:20-11:30	Cooperative work
3	11:40-12:50	Lunch at NIT-Nagaoka cafeteria
4	13:00-17:00	Cooperative work

Day 3 (29 May 2014)

No.	TIME	CONTENT
1	9:00-11:30	Cooperative work
2	11:40-12:50	Lunch at NIT-Nagaoka cafeteria
3	13:00-16:00	Open GMLD 2014@NIT-Nagaoka and start the contest
4	16:30-17:00	Awards ceremony
5	17:30-19:30	Farewell Party (Karaoke in foront of the Nagaoka station

The detailed regulations of this CONTEST are shown as follows.

(1)PERFORMANCE
Kind of Performance
The contest allows teams to 1 to 3 minute creative stage performance using autonomous microcomputer that teams have designed, built and programmed. Teams can choose to create either a Dance or a Theater performance.
Dance performance
Dance is a performance closely synchronized to the music. The LED light and human are required to move in time to the beat or rhythm of the music selected in the same way that a human may listen to the beat of music and dance to it. The Dance assessment focuses on the choreography and movement of LED light and human synchronization to music beats.
A dance performance will use music as an integral part of the performance with deliberate, accurate and synchronized movements to music. It will also use choreography of the LED light to music as the focus of the performance.
TheaterTheatre performance
TheaterTheatre is performances in which the LED light that controlled by an autonomous microcomputer tell a story or develop a theme

supported by music. ~~Theater~~Theatre assessment is focused on the overall theatrical performance. The performance will be judged by how effectively the autonomous microcomputer is used to present a theatrical theme.

A ~~theater~~theatre performance will use movement and music to create a performance that tells a story. Music is used as background to supplement the performance. The performance will use a story as a focus of the performance.

Duration

Each team will have a total of 5 minutes for their performance. This time includes stage performance setup, introduction and the performance, including any re-starts due to factors under the teams' control. It does not include time needed for packing up and cleaning the stage.

Following each performance, a team must fully tidy up the stage, pack up and remove any objects related to their performance. The performing team has a maximum of one minute to clear the stage after the end of their performance. The maximum time onstage is therefore six minutes.

The duration of a performance routine must be no less than 1 minute and no more than 3 minutes.

If a team exceeds the time limits explained above, the team will be penalized by the loss of marks. If the time limit is exceeded due to circumstances outside the team's control (for example problems with starting the music by the technicians) there will be no time penalty. The judges have the final say on any time penalties.

Music

Regarding the relation of the copyright, teams must provide the original CD which is marketed on. If the music is bought by the download, teams must provide the downloaded equipment because the downloaded equipment has the copyright which is the same as the marketing CD.

Teams are strongly encouraged to bring a good quality audio music source file since their evaluation also depends on the music quality.

It is the responsibility of the team to ensure that the music is playing correctly before their first performance by liaising with the staffs.

Team member

Human team members are encouraged to perform with their microcomputer. There is no penalty for humans not performing with their microcomputer.

The only physical contact humans may have with their microcomputers is to start them at the beginning of a performance.

The maximum recommended number of members allowed on each team is 10.

Scenery and Presentations

Teams are encouraged to provide their own scenery.

Teams are encouraged to provide a visual or multimedia presentation as part of their performance. This can take the form of a video, animation, slide-show etc. Teams are encouraged to be creative is designing the presentation. Staffs will try their best to provide a projector and a projection screen for teams wishing to incorporate a presentation as part of their performance.

A certificate is awarded to the team with the "Best Creative Presentation".

Teams should ensure that any presentation is being displayed correctly before their first performance by liaising with staffs.

Performance routine

Each team may perform one and only one Dance or Theatre performance routine.

A member of the team has to start the music and the audio visual/multimedia presentation for the routine.

Restarts

Teams are allowed to restart their routine if necessary. Unless a problem is not the fault of the team, any restart will result in a score penalty. There is no limit on the number of restarts a team can perform within their 5 minutes performance time. However, it will result in a score penalty if the performance time passes over 5 minutes.

Stage setup time

Teams are strongly encouraged to use the time while they are setting up the stage for their performance to introduce to the audience the features of their microcomputers, technology used and highlights of the performance and to introduce their team.

(2)JUDGING

Scoring

The performance and technical score sheets will be opened from. Teams are encouraged to study the score sheets in detail in order to understand how they will be judged.

The marks are allocated as follows:

· 50% of the marks - technical scoring which is undertaken by an interview.

· 50% of the marks – performance scoring.

There is a performance score sheet for marking the Dance and ~~Theater~~Theatre categories.

Technical Creativity

The Dance challenge is intended to be very open-ended! Teams are encouraged to be as technically creative and entertaining as they can. Teams who show creativity and innovation will be rewarded with high point scores in the relevant sections.

Technical Interviews

All teams will have a 15 minute technical interview during the competition. It is strongly suggested for teams to read the interview score sheets before the interview to make sure good use of the interview.

Teams should ensure that they bring all their microcomputer boards, LEDs, electronic circuit, copies of the programs and a completed GLMD technical sheet.

Prizes and Awards

The following prizes will be awarded in each category
- Programming
- The construction of the microcomputer board
- The entertainment value
- The electronics

In GLMD contest result, the two teams try to show the theatre and other show the dance performance. In theatre performance, one of the team shows festivals of Japan and Thailand or other team shows the Thai folklore. The contents of the performance show the culture of each country. It was a good cultural exchange.

Fig. 5 Workshop at NIT-Nagaoka

Fig. 6 Performace of GLMD

Credit system of oversea training

As the first attempt, NIT-Nagaoka was certified as 2 units of internship overseas training for Thailand. The internship credits are including a factory tour of Japanese companies in Thailand, AFR contest participation and one week pre-training in Japan. In 2013, students of 11 people participated, they acquired the unit.

GR-Sakura e-learning contents

GR-sakura micro-computer board was using for GLMD contest. The NIT-Nagaoka has been active as a member of the embedded software education project with the GR-SAKURA board funded from Program for Promoting Inter-University Collaborative Education in 2011. So there are assets of e-learning contents of GR-SAKURA. It was used GLMD contest which held in 2014. Fig.7 shows the GR-SAKURA e-learning kits, it was used for pre-training of the contest.

Fig. 7 GR-SAKURA e-learning kits

The kits were sent to TNI in Thailand a month ago. This is because the participants to be able to learn in advance. And GR-Sakura has special web development environment so participants can be developed without the need to establish a development environment of the installation process such as compiler and linker to the own PC. Therefore, students from abroad have become possible to create a program for the contest soon in Japan.

Conclusions

Cooperative educational projects between NIT-Nagaoka and higher education institut have been introduced. In the project, Japanese students and local students performed a worksop using a micorcomputer board and LEGO MINDSTORMS as a cooperative work.

It is important that the educational projects between KOSEN and Asian institutes develop and more students experience this kind of oversea training.

USE OF VISUAL TEACHING MATERIALS AND COGNITIVE PROCESS IN EDUCATION

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Abstract

It is true that "Seeing is Believing" is an important factor in learning. In the education, "Seeing" is a key for students' understanding and easily affect on their quality of memory (i.e. the long term memory). Therefore, there are many visual teaching materials to enhance learning quality. In this paper, use of high-speed digital movies and cognitive process of seeing for teaching are discussed. High-speed digital movies are very attractive, because they show us what we cannot see. In addition to the digital image processing technology, a consideration of a cognitive process of seeing, how we recognize what we see, is discussed for the development of effective teaching materials and education. The basis of cognitive process of seeing is reviewed from technical viewpoints as well as an educational one. Several optical illusions are demonstrated to understand cognitive process of seeing as human nature. Basing on the knowledge and experience of the cognitive process of seeing and digital movies, the points of their use for teaching materials and learning is discussed. This workshop provides participants with opportunities to understand the great potential of the cognitive process of seeing for the education.

Keywords: *visual teaching materials, high-speed movie, cognitive process, optical illusion*

Introduction
Seeing and human eye

It is said that the resolution of human eye is equivalent to a 576 megapixel digital camera. Thus, the human eye is far superior to the state of the art digital camera in terms of resolution. On the other hand, the time resolution of human eye is limited to be about 20 Hz (50 ms); when a light is blinking at frequencies above 20 Hz(flicker fusion threshold), we cannot see the blinking. This is the reason why, motion picture films are recorded at 24 frames per second (fps), and TV systems employ at 25 or 30 fps, depending on the TV standards. Therefore, we have to use optical devices (e.g. digital camera), in order to observe the events

taking place within 20 ms or less. Since the first consumer digital camera was produced in 1995, the digital camera technology has kept developing, and high-speed movies have become to be used easily for lectures. There is no doubt that visual aids help students gain a better understanding. In addition, nowadays, most students are familiar with digital movies on the Web and enjoy learning from it.
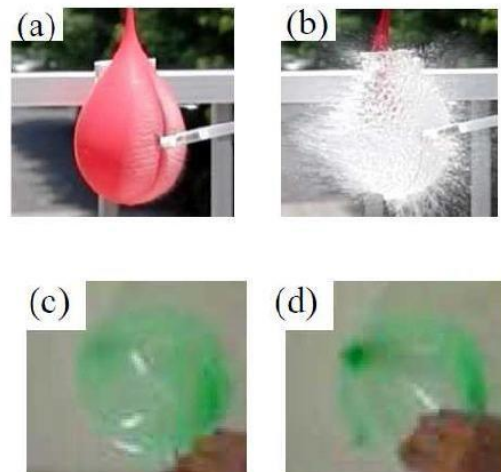

Fig. 1 Rupture of balloons: (a), (b) water-filled balloon and (c), (d) air-filled balloon.

The high-speed movies can be easily used to reveal the details of high speed events. It is obvious that teaching materials of this kind, digital movies, have a great potential for the science and technology education. As mentioned above the high speed movie is a powerful teaching tool. However, it should be noted that this new technology brings new questions in the class room. Figure 2 shows a picture of a blinking red light emitting diode (LED) as an example. Although the color of light is pure red, purple light was observed by the high speed camera, when the LED started to be illuminated. Of course, this is a typical false photo caused by optical properties of the camera sensor and its filters. Digital image sensors possess high sensitivity for infrared lights of which wavelength is longer than visible lights. Actually, infrared lights passing through the optical filters are detected as purple light. It should be noticed

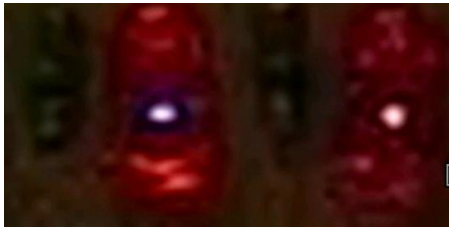that we have to prepare for newly developed questions when new technology is introduced in education.

Fig. 2   False light captured by a digital camera.

Analogy between "seeing" and "understanding"

When we learn about the human eye system, we realize conceptual analogy between seeing and cognitive process "understanding." Figure 3 shows a schematic structure of vertebrate eye. Although the resolution of human eye is equivalent to a 576 megapixel digital camera, the highest visual acuity is only limited to the central 2 degrees of the visual field: approximately twice the width of thumbnail at arm's length. The fovea that gives the highest visual acuity is less than 1% of retinal size, but it occupies over 50% of the optic nerve fibers.
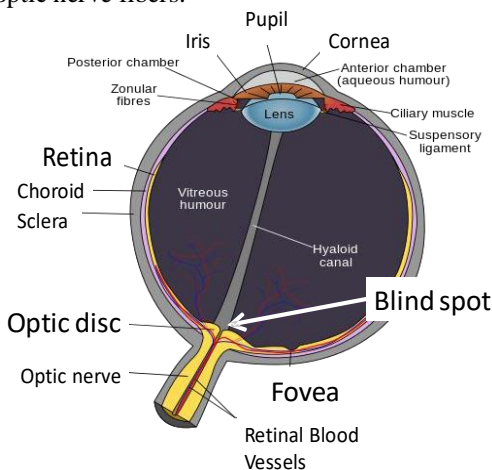
Fig. 3   A schematic structure of vertebrate eye.

Thus, our vision consists of high resolution central vision (foveal vision) and peripheral vision with low resolution. In addition, there are blind spots in our eyes. Due to the structure of eye, there are no light-sensitive cells on the retina as shown in Fig, 3. A part of the vision cannot be perceived at that point. Figure 4 is a chart for demonstration of the blind spot. To find the blind spot, close one eye and focus on the other side symbol ("x" for the right eye or "•" for the left one). Move your eye closer or away from the chart until the symbol disappears. It is important to note that the vertical line or the black background still can be seen even though the symbol at the blind spot disappears. It is shown that our brain always interpolates the vision with blind spots using details of vision without the blind spot and/or information from the other eye. This is the reason why the blind spot is not perceived in daily life. As shown in this demonstration, what we are seeing is

not a direct visual image from the eyes. The detected visual information is always being processed and modified by the brain.
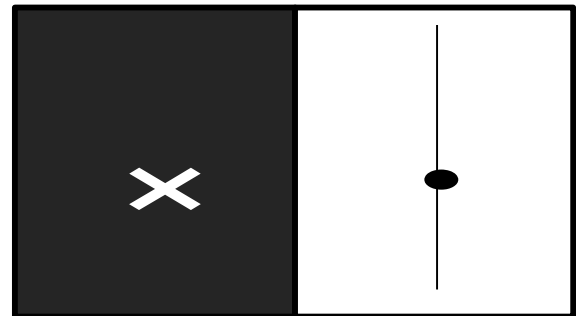

Fig. 4   A blind spot test chart.

These processes of seeing seem to be similar to the processes of understanding that students experience in the classroom. When the students face new concepts, ideas, and/or topics, they have to recognize whole image of these as well as to understand in detail. However, like the foveal vision and the peripheral vision, they cannot well understand these all at the same time. Some contents are highly comprehended, others remain in ambiguity. They try improving and increasing their understanding using their highly comprehended

concepts/ideas, as the eye movement in the reading. There may also be blind spots of understanding, but the students compensate the missing part and form their own comprehension of what they have learned. We should know that ability to understand is similar to the "vision" in which information is always being processed, modified, and compensated. Thus, these processes are good examples to consider the students' behavior of understanding.
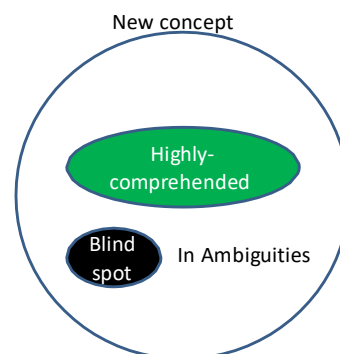

Fig. 3   A schematic structure of understanding.

Motion Induced Blindness

Motion-induced blindness (MIB) is an interesting phenomenon of visual awareness in which stationary visual stimuli disappear. MIB was originally discovered in 1991and rediscovered in 2001. Figure 5 shows a still picture of a typical MIB demonstration movie. High-contrast static yellow letters (ISATE) are among a pattern of blue x rotating around the letter "T" on black background. When the pattern of blue x rotates, one or more of the yellow letters are found to disappear and reappear randomly. It shows us that we cannot see what we are seeing; the brain ignoring or discarding

visual information that is less stimulus. When this illusion is demonstrated to the students, they realize the limitation of human awareness. It also shows the difficulty of keeping attention focused on an entire field of vision. This phenomenon is a good example for explanation of the limitation of awareness to the students.
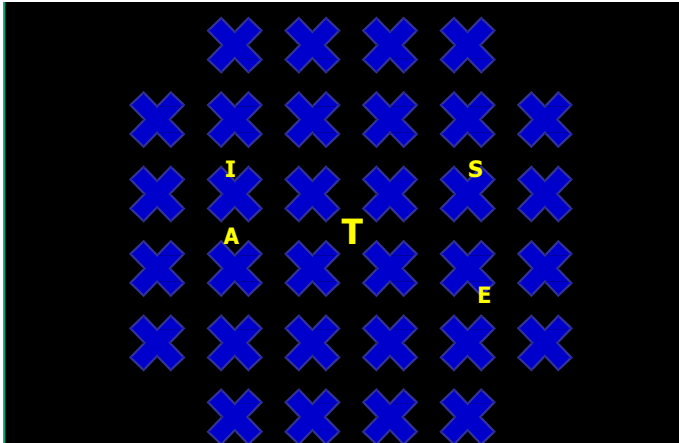

Fig. 5   A still picture of a typical MIB movie.
(Fixating on the central "T")

Object permanence and understanding

Figures 6 (a) to (c) show letters "ISATE" with or without modifications. Fig 6(a) can be categorized as a blotted letter type illusion. The letters are concealed with white circles without border. It is worthy of notice that the remaining parts seems to be a random pattern that has no meaning for us. However, when the borders of circles are shown, we can read the letters easily as "ISATE" using image compensation.
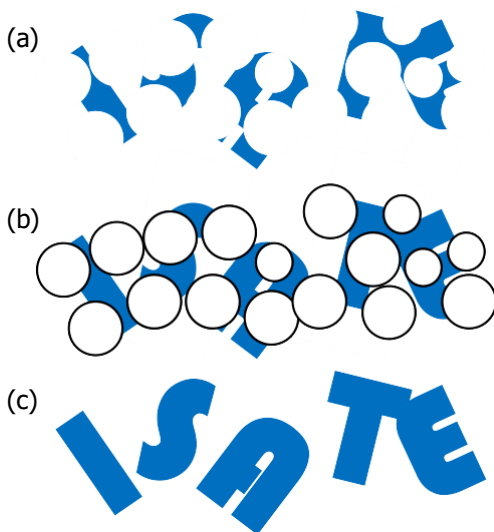

Fig. 6   Letters of "ISATE" concealed with (a) white circles without border, (b) white circles with border, and (c) without modifications.

This effect is an example of our ability of understanding the continuity of existence of objects (i.e. objects permanence) even when they cannot be seen. Object permanence is an important cognitive ability developed with growth and Peek-a-boo is thought to be an example of infant's inability to understand object permanence. In this illusion, the indistinguishable borders among letters, background, and blot are important.

This demonstration of seeing suggests us following ideas of learning and understanding: Students' image of not-understanding is like blotted letters (ideas/concepts). Figure7 shows a class survey result for the question "which figure represents your not-understanding idea/concept most likely?" (Note that the survey was conducted using Japanese letters and the same letter configurations are allotted in the figure.). It is shown that more than half of students (67%) selected the blotted letters type that is quite different from the other types of not-understanding. In the other images (#1 to 4), the students are sure about that somehow they form their own understanding, even though those are partially wrong or missing. So, if wrong or missing parts are shown to them, they can improve their understanding. However, there is no formed understanding and meaning in the blotted letters type. In this case, internal processes of understanding are required for the improvement of their understanding. It should be also noted that their actual not-understanding is supposed to be a combination of all of these.

Fig. 7   A class survey result of students' image of "not-understanding."

As shown in Fig 6(b), it is suggested that understanding is similar to be a variety of processes in which various circles are placed on the blots to clarify the letters: understanding the continuity of existence of idea/concept. The blot patterns are different for each student and the various circles which may be in different shapes represent lecturer's teaching, teaching materials, references, and/or learning by themselves.
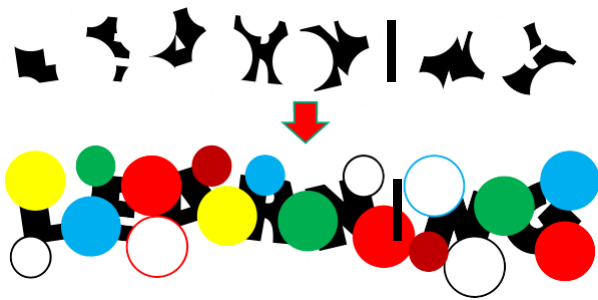
Fig. 8 Image of "Learning" with blot patterns and various circles which represent lecturer's teaching, teaching materials, references, and/or learning by themselves.

Conclusions

In this paper, use of high-speed digital movies and the cognitive processes of seeing for teaching are discussed. In addition to the use of digital high-speed movies and the facts about human vision, several optical illusions are introduced to understand the cognitive process of seeing. Galileo Galilei said that "You cannot teach a man anything; you can only help him discover it within himself." Thus, the understanding is the internal process within the students. It is difficult to let the students consider the process of understanding without guiding. The concepts mentioned in this paper, the cognitive processes and facts about seeing can be used to demonstrate this internal process and to provide enough materials for their consideration. Combinations of new technology in education (e.g. high performance digital cameras and ICT) and the cognitive process possess a great potential in improving students' understanding. Therefore, it is suggested that this International Symposium for Advances in Technology Education (ISATE) should play significant role to develop this kind of teaching materials and methods as international collaborations among educational institutes.

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