

# **Beginning Engineering Education at Age 15 - A Japanese Perspective**

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## **ABSTRACT**

Japan has recently joined the countries participating in the CDIO Initiative with concerns related to the effects of an impending population crisis and increasing demands for internationalization from the Japanese government. Kanazawa Technical College (KTC) is a unique CDIO collaborator school with regards to its place within the educational structure of Japan. As a college of technology, KTC is a vocational school that students attend after graduating at the age of 15 from a lower-secondary junior high school. This vocational education includes standard subjects required of secondary schools in Japan in addition to the specialized subjects of a chosen field. Students graduate at the age of 20 with the equivalent of a two-year college degree in addition to completing their secondary education. This puts KTC in a key position as a preparatory school for young people seeking entrance into an engineering career. This report provides an introduction to vocational education in Japan within the context of the education system. Japan's educational history and culture are discussed with an emphasis on students joining and graduating from colleges of technology. A look at the traditional views of secondary and higher education are presented as a precursor to modern educational reforms established within the last decade. This discussion elaborates the differences in preconceptions of higher education between Japan and Western culture. Presented in light of major economic and demographic changes, these differences are driving factors in modern educational reform. Finally, the preparatory education provided by KTC is described through concrete examples of courses in the Global Information Technology department. Students are introduced to engineering concepts in their first three years that are then built upon in their later years. These engineering courses are mapped to the preparatory proficiencies added to the CDIO Initiative in 2009. Discussion will focus on the implementation of project-based hands-on activities that provide introductory engineering activities for students aged 15 to 18 years old.

## **KEYWORDS**

Japanese Education System, Preparatory Engineering Education

## **INTRODUCTION**

The CDIO framework outlines a comprehensive syllabus of required skills and standards for best practices in engineering education. These were developed to meet various challenges facing educators around the world including the reduced satisfaction of industry with

university graduates and declining populations of students entering engineering disciplines [1]. Although the CDIO framework was formed by educators in the western world, evidence of Asian countries also paying closer attention to the qualities of students entering and graduating from their tertiary education systems can be seen [2]. Japan especially is faced with issues concerning a reduced number of students to attend its universities and an industry that is placing greater emphasis on the skills of the individuals being hired.

Institutions of higher education throughout the world have turned their sights to outreach programs and secondary education as a source for sustaining interest in and increasing the quality of their engineering programs [3][4][5]. In many Western cultures, educators are simultaneously faced with concerns related to inadequate preparation in math and science [6][7]. Japan, however, has demonstrated in a long history of international assessments an ability to meet outstanding compulsory education standards for these subjects. Coupled with a highly practical vocational education system included in the nationwide tier of higher education, Japan provides a well-conditioned environment for training technically skilled workers much earlier than would be allowed on a traditional university track system. The “college of technology” system in which students enter at the age of 15 takes advantage of the opportunity to prepare young technicians for a career of lifelong learning. Kanazawa Technical College (KTC) is one such school that has also embraced the CDIO framework for quality assurance of engineering education at a pre-tertiary level.

Given that KTC is the first Japanese school to join a worldwide initiative such as CDIO, it can be assumed that the Japanese education system must be in a state of major reform. One must first understand the context in which Japan has arrived at this current state in order to fully appreciate the motivations and details of vocational education in the pre-tertiary tier. The environment of compulsory education in which students prepare for university, college, or other further education as well as the higher education itself has a deep history and distinctive characteristics to be discussed in the following section. The chronological pertinence of each feature described is accurate up to the turn of the century. Shortly thereafter various policy reforms dated as early as 1998 and cultural shifts in perspective following the deflation of Japan’s economic boom began to take effect.

For the purposes of making global comparisons throughout this report, the list of OECD (Organization for Economic Co-operation and Development) member countries are used as the frame of reference where applicable.

## **JAPANESE HIGHER EDUCATION**

The National Institute for Educational Policy Research within the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan provides a number of detailed reports on Japanese education. The reports describing a historical overview [8] and distinctive features [9] are summarized below with supplemental information and key notes pertaining to colleges of technology and engineering education.

### ***Historical Overview***

The modern university model of Japan began in 1868 as an institution originally based on the European model at the time. Founding of the university occurred during the Meiji Restoration, a major political revolution that ended Japan’s isolationist state and marked the beginning of a national consciousness through equal opportunity education. The engineering and agriculture disciplines later reached university status in 1891 when faculties were added to the Imperial University (now the University of Tokyo). This university in Tokyo was the first of many imperial universities founded across Japan. As such, it had the highest status at the top of a hierarchy that established precedence for the status-based ranking system of

institutions still in use at the turn of the 21<sup>st</sup> century. Below these imperial universities in descending order of status were national universities, local public universities, private universities, vocational colleges, and finally women's colleges.

During Japan's occupation by the Allied Forces following its defeat in World War II in 1945, Japan replaced its multi-track educational system with the American model of a single track with 6-3-3-4 progression. All previous universities were grouped together into a single hierarchical level and vocational colleges were upgraded or combined with universities where possible. Those that could not meet the requirements were temporarily granted status as two- or three-year junior colleges.

In the 1950s, a period of high economic growth spurred on in part by the Korean War created the necessity for a highly qualified workforce and research base to drive industrialization. The desired labor force of the time was defined in three layers: a small number of talented individuals to perform administration and management duties; a large number of mid-level technical specialists; and an even greater number of support technicians. Adopting a policy of educational diversity, the Japanese government began expanding engineering and natural science programs in national universities and gave more freedom to the private sector to help meet the large demand by establishing private universities. Junior colleges were recognized as a permanent aspect of the system and primarily developed courses of general and specialized education for women.

In 1962, the first colleges of technology were founded to provide a 5-year technically intensive education to students entering from lower secondary schools. The purpose of this new type of institution was to quickly and efficiently produce the large number of support technicians right out of school with the potential to grow into the roles of managers and administrators later in their careers. Kanazawa Technical College was founded in the same year, aiming to provide students with the necessary mechanical engineering skills to begin a technical career in the rapidly industrializing society.

Despite enjoying rapid expansion and diversification for the next 20 or so years, institutions of higher education were bound to the status hierarchy that began with the University of Tokyo. With enrollment into universities being based on an individual's performance on entrance examinations, schools with greater prestige were able to set higher standards without suffering a decline in demand. This practice continued into the 21<sup>st</sup> century and has given reason to believe that the administration of these institutions has become complacent in terms of striving for quality modern education in a changing world. Before the major educational reforms put forth by MEXT in 2004, few schools were actively seeking quality assurance measures that would make them competitive at the international level.

### ***Distinctive Features***

The rich culture and history of Japan has given rise to some unique characteristics in its education system. The most distinctive of which is the prominence of school entrance exams and the weight they have on a young person's life. General high schools have adopted a curriculum meant to prepare students for university entrance exams and many students spend much of their time outside of school attending cram schools for supplemental or makeup lessons. For the student, this high-pressure system of education begins even before upper secondary school as high schools and sometimes middle schools also follow an enrollment policy based on entrance examinations. High schools are thus also subject to status rankings much like the universities and students who get into prestigious high schools have a greater chance of being accepted to top universities. Whereas other countries may determine student progression from lower to upper secondary schools by district allocation or personal preferences, Japanese students must begin studying for entrance exams and attending cram schools as early as age 12.

Relative to other developed countries, Japanese schools play a large role in the lives of Japanese children. While Japan does not vary much from other countries in terms of teaching hours, students are encouraged to spend time in extracurricular activities and engagements that require additional time in the evenings and over the weekends. Students also have considerable amounts of homework on top of various out-of-school learning activities such as cram school and private tutoring. An example of the extent to which schools play a role in a student's life can be seen in the significance given to the school uniforms worn at all year levels in primary and secondary schools. Students must wear these uniforms to school every day as well as around town while school is in session. These uniforms indicate the school to which the student belongs and so students are told to act with the most upstanding behavior while wearing them. Faculty members are instructed to stress the importance of properly wearing uniforms with tucked in shirts and straightened ties, as well as giving cheerful greetings to teachers outside of class. In this way, schools assume the responsibility to teach moral and ethical behavior to Japanese youth on top of the standard academic curriculum, although anecdotal evidence would suggest teachers don't take this too seriously [10].

Following the idea of a unified national consciousness, the single track system provides all children with the same general education through lower secondary school. In upper secondary school students have the options to enter into general, vocational, or specialized courses, but these do not differ significantly in terms of content. MEXT requires all upper secondary students to learn specific subjects and subsequently more than half of all teaching hours in vocational courses are spent teaching non-vocational material. While all Japanese students receive a similar general education in fundamental competencies, the training of more specialized skills is understood to be the responsibility of the specific industry in which the student will work following graduation.

This single track system is one aspect of a high degree of inclusiveness in the Japanese education system that is rooted in the cultural values of unified conformity. Another example is that most schools traditionally practice automatic promotion of students based on age rather than academic accomplishment. Regardless of their ability, students progress alongside their classmates and graduate together, making it a rare occurrence that a student would have to repeat a grade and even rarer still that one might skip ahead. This is not to say that student ability has no effect on academic success. Entrance exams for upper secondary and higher education effectively sort students based on ability on a broader institutional level. Students are only allowed to advance into a school for which they can pass the entrance exams, and the variation of standards between schools ensures that all students will be able to advance to some institution. As a result, over 97% of students continue into upper secondary school [11] and subsequently over 95% graduate compared to 89% in the United States during the last decade [10]. In 2009, accessibility to higher education in Japan was at an all-time high with 68.6% of high school graduates attending universities or colleges [11] compared to 70.1% in the United States [12].

Adding to the theme of uniformity, Japanese educators at the compulsory level follow a conviction to practice equality of learning conditions. They aim to treat all students fairly and impartially to the extent that they even refrain from praising talented students. Public schools across geographic areas share similar learning conditions with little deviation from the norm while private schools and tutoring centers have assumed the role of developing the aptitudes of students beyond what is deemed adequate by public institutions.

This reluctance to distinguish students based on ability or allow diversity in learning environments is one characteristic of Japanese culture that appears to be beneficial as indicated by international assessments. On the OECD PISA (Programme for International Student Assessment) and TIMMS (Trends in International Mathematics and Science Study)

Japan consistently scores among the top nations in math and science [13]. With evidence such as this, it is understandable why Japanese primary and secondary education is considered among the best in the world despite criticism regarding the stress incurred by cram schools and passive teaching methods in secondary schools [14][15].

Upon graduation from secondary education, Japanese students do not receive a certificate qualifying them for tertiary education as in Western countries. Instead, they must meet the terms set by the entrance exam specified by the desired institute of higher education. These exams often consist of selective written achievement tests and provide the function of distinguishing students who have advanced at equal rates throughout secondary education. The amount of stress caused for both parents and students competing for a place at high ranking universities has made the test-taking season a matter of great interest for the media.

At the end of the university track, students graduate and begin a career as in any other country. The main difference of job hunting and recruitment in Japan is the common understanding that educational institutes emphasize trainability in their graduates to prepare them for the training of specialized knowledge and skills they will receive in industry. An OECD review of the Japanese transition into working life describes the traditional practice of educational institutions forging relationships with a number of large employers. These employers implicitly trust the institution to judge a student's suitability for the company. Top ranking universities then have ties to high performing industries, creating a strong demand for admissions from college-bound students. The entrance exams allow for institutions to select students that match a specific profile of academic ability, guaranteeing their eligibility for a career with the school's industry partners. Because of this, variations in program offerings and student ability tend to be between institutions rather than within them, and young people must make important decisions about their futures as early as entrance to upper secondary schools [16]. For many Japanese students hoping to begin a prestigious career after attaining a degree of higher education, the last chance to prove themselves comes with the entrance exam for university.

Recent trends in the expansion of a lifelong learning culture and the deflation of the lifetime employment system have resulted in more adults going back to school for post-graduate study and fewer companies giving preferential treatment to graduates based solely on the prestige of the university from which they graduated. This, in addition to policy reforms required by MEXT, has sparked changes in the entrance exam procedures to be more flexible and reduce overheated competition. Alternative methods for the admission procedure now include recommendations, interviews, essays, and a nationwide standardized test called the National Center Test for University Admissions.

### ***Modern Reform***

Japan's education system is currently undergoing its third major reform since its modernization in the middle of the 19<sup>th</sup> century. In compulsory education, a series of reforms meant to reduce the burdening workload of students went into effect in 2002. These reforms no longer required students to take classes on Saturdays, reduced teaching hours, and eased up the perceived high difficulty of many subjects by reducing content and postponing more advanced lessons to higher levels. These reforms were labeled "*yutori* education" or "education with breathing room" and have been subjected to criticisms claiming that the education system has lowered its standards below acceptable levels. Japan's drop in ranking on the 2006 OECD PISA fueled these concerns and has since motivated MEXT to increase teaching hours again to just above the OECD average. Nevertheless, the results in 2009 proved these changes to be statistically insignificant and actually showed improvements in higher-order thinking, one of the reform goals [14].

In higher education, the system is being threatened by a declining number of eligible students. A report by the University Council of Japan quotes numbers that have dropped from their highest of 810,000 entering university in 1993 to 690,000 in 2010. Estimates have claimed that by the end of the last decade the number of students entering university would have reached 100% of those applying. As of January 2011 however, that percentage remains in the 90s due to an unexpected surge in applicants. Furthermore, the nationwide population of 18-year olds is expected to remain stable for the foreseeable future [17].

The issue of demographics is one of the motivations for change cited by the OECD review back in 2000. Other major factors included economic restructuring, rising aspirations, and the changing attitudes of young people. In the period following the burst of the economic bubble in the early 1990s, industries were forced to adapt to a less affluent economy and began reducing their hiring rates. Many companies at the turn of the century were putting less emphasis on lifetime employment and had greater expectations for skill development from the educational system and individuals. The demand for higher education increased as more young people recognized the value placed on such credentials by industry and the relatively higher security in transitioning to the job market from tertiary education. These young people's attitudes also began changing after the bubble economy stagnated. The traditional values of lifetime commitment to a company and long work weeks were declining although individuals still considered work to be a social duty. They began expecting greater variation in their careers and demanding more from their schools in terms of choosing their job placement based on personal preferences rather than academic history [16].

These factors resulting in institutions beginning to compete for students among other issues related to employability of graduates, educational quality and innovation lead the Ministry of Education to introduce new reforms for higher education in 2004. While these reforms were primarily aimed at Japan's 87 national universities, the extent to which they require quality control and enhancement affects institutes of higher education as a whole, and thus colleges of technology as well. MEXT effectively removed itself as the governing body overseeing the operation of all national universities (with the exception of student enrollment caps, levels of fees, and academic program reorganization) and put in place a system of evaluation by certified agencies. Through allowing the national universities greater autonomy and removing the lifetime employment guarantee of their civil servant faculty members, these reforms aimed to provide incentives for greater agility, creativity, and responsiveness to society's needs in both teaching and research. This would effectively urge greater competition between schools and bring about the growth required for greater competitiveness in the global context.

A second measure for improving quality through competition requires the third-party evaluation of all institutions of higher education which had previously been responsible for self-monitoring and self-evaluation. The results of these evaluations are then released to the public, giving greater power to the consumer to affect the educational market. Since 2011, universities have had the additional requirement of providing public information on activities, faculty and fees. These reforms for transparency are most notable for introducing the historically unprecedented notion of institutions competing for student interest through performance rankings over all other factors.

Finally, reforms aimed at the internationalization of Japan's primarily homogeneous classrooms have also received a lot of attention. Currently, less than 1% of the total number of students in compulsory education is not Japanese. In tertiary education, this number was around 3.5% in 2008 after a government program to attract 100,000 international students to Japanese universities reached its goal in 2003. The program is responsible for a rapid increase in the number of international students over the last two decades and a new goal has been set to reach 300,000 by 2020 [18]. Additionally, the Campus Asia program began in 2010 with the aim to encourage exchanges with China and Korea through establishing

common guidelines for transferring credits and grading. However, in an OECD report on these recent reforms, Jones emphasizes the point that schools should focus on attracting high-quality students from overseas whereas current programs only appear to be concerned with raising the overall number of international students [14].

While the numbers may be improving, it is important to note the effect on Japanese classrooms of a sparse international presence. Students experience limited development in terms of their multi-cultural perspective when compared to the students in Europe or North America. In response to this, Kanazawa Technical College (KTC) began a reform program in 2009 to become a school that trains global engineers by providing international experience within the classroom in addition to exchange and internships with partner schools in Singapore and New Zealand. Additionally, vocational classes taught by native English-speaking faculty members from overseas have also been available to students since 2008 [19]. Through a relationship with Singapore Polytechnic, KTC administrators learned about the CDIO framework for engineering education as a worldwide initiative for enhancing the quality of engineering schools all across the globe and saw the opportunity employ CDIO as a system of quality control. Since 2010, KTC has lead the colleges of technology in Japan as an international institution bringing best practices from overseas to improve the vocational training of young engineers in the making.

## **COLLEGES OF TECHNOLOGY AND KANAZAWA TECHNICAL COLLEGE**

Even today, 50 years after their establishment, colleges of technology continue to fulfill their original role of educating a workforce of young specialists that are ready to jump into industry and get their hands dirty. Through the alternative track provided by vocational schools, students are not required to attend university or junior college as a requisite for a career with the potential for advancement. Students who do not plan to attend university may instead acquire employable skills directly following lower secondary school at a college of technology. This vocational track offers a five-year course of general and specialized education while some schools within the system offer an additional two-year advanced course for a full degree.

Due to their divergent nature from the university track, vocational schools experience little to no status within the education system. Although colleges of technology are considered institutes of higher education for students in their fourth year and higher, it is often difficult for their graduates to transfer into a university. In this regard Kanazawa Technical College as a college of technology is at an advantage. KTC shares a campus with a four-year university and graduate school, the Kanazawa Institute of Technology and is run by the same board of directors. The intimacy of these two schools allows students graduating from KTC to enroll in KIT where they can complete the usual four-year university degree from their second or third year. As shown in Figure 1 below, KTC provides a more direct path to industry for most of its students while others opt to take the alternative route into university.

Since the founding of the first colleges of technology, these schools have always offered explicit training for young, skilled laborers in the fields of engineering. The vocational education provided by these schools is often praised for a high degree of practicality and responsiveness to the needs of industry [13][20]. KTC currently offers two-year degrees in Mechanical Engineering, Electrical and Electronic Engineering, and Global Information Technology. KTC's dedication to meeting the needs of industry is evidenced by its annual 100% success rate for students seeking employment after graduation [21]. The institution is able to accomplish this through acknowledging the skills students will need to begin their careers, teaching these skills during the first three years, and further developing these skills in the students' final two years.

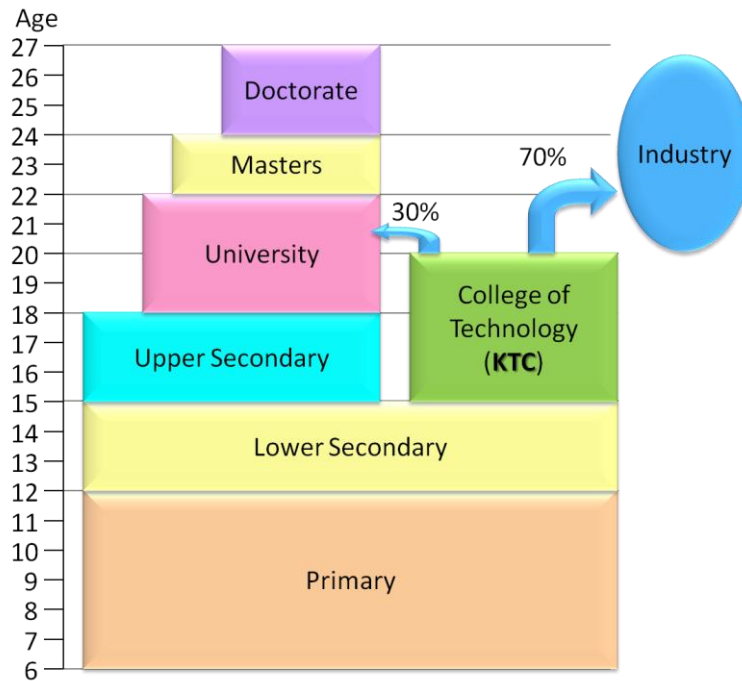


Figure 1. Colleges of technology in the education system with tracks for KTC graduates

### ***Preparatory Education at Kanazawa Technical College***

The position and role of the college of technology within the education system makes it an appropriate institution for fostering the preparatory skills needed to enter various engineering fields. The accomplishment of this preparatory education can be observed by looking at specific courses and proficiencies taught therein. With the adoption of the CDIO framework to guide the development of engineering education at KTC, the target proficiencies for each course have been categorized accordingly. The extended CDIO framework with preparatory proficiencies presented by Campbell et al. at the 5<sup>th</sup> International CDIO Conference in 2009 is used for the basis of this study. These proficiencies are described as follows:

- Prep1: To have elementary knowledge and basic awareness of ...
- Prep2: To be able to participate in and contribute in controlled situations
- Prep3: To be able to understand and explain elementary principles
- Prep4: To have preparatory skills in the practice and implementation of ...

In addition, Campbell et al. associated each of the proficiencies with Bloom's Educational Objectives of Knowledge (Prep1 and Prep2), Comprehension (Prep3), and Application/Analysis (Prep4) [22]. Although the proficiencies for upper secondary level education are limited by scope, context, and depth of coverage, linking them to Bloom's Educational Objectives allows for a clearer depiction of the learning activities and expected abilities to be demonstrated by the students. The discussion to follow uses the courses of the Global Information Technology department as a concrete example of such comparisons. The preparatory proficiencies are indicated in each course by the inclusion of specific types of assessments such as knowledge-based tests for Prep1, instructional assignments for Prep2, presentations for Prep3, and problem solving assignments for Prep4.

In the 1<sup>st</sup> through 3<sup>rd</sup> years at KTC, the preparatory proficiencies are taught in advance of the high-level vocational education of the 4<sup>th</sup> and 5<sup>th</sup> years. The Global Information Technology department specifically designs course content to support the acquisition of elementary



knowledge and increase the motivation of students to study with a strong interest in engineering.

Table 1 below shows the current Global Information Technology department curriculum mapped to the extended CDIO framework for preparatory proficiencies. The sections that follow outline the course activities designed to foster these proficiencies in students.

Table 1  
Vocational Courses of the KTC Global IT Department with Preparatory Proficiencies

Year Level	Course	Prep1	Prep2	Prep3	Prep4
1 <sup>st</sup>	Creative Experiments I		■	■	■
	Data Processing I	■	■		■
2 <sup>nd</sup>	Computer Lab I	■	■		
	Computer Systems I	■			
	Creative Experiments II		■		■
	Data Processing II	■	■		
3 <sup>rd</sup>	Business Systems	■	■	■	
	Computer Lab II	■	■		
	Creative Experiments III		■	■	■
	Data Processing III	■	■	■	

*Prep1: Elementary Knowledge and Basic Awareness*

In the first three years of the Global Information Technology department curriculum, an emphasis is placed on instructional knowledge for information literacy, computer literacy, and programming.

Students in the Data Processing I, II & III courses study fundamental computer and information literacy required for putting computers to practical use. In Data Processing I they learn the basic operation of a computer, touch typing, connecting to a network, and application install methods. In Data Processing II they learn the fundamentals of computer science (data expressions, binary numbers, computer architecture, etc.), how to use office applications and electronic mail, and the creation of simple HTML pages. Finally, in Data Processing III students learn the basic operation of UNIX and UNIX-based systems.

In the Computer Lab I & II courses students learn the fundamentals of computer programming using Java as the standard programming language of the Global Information Technology department. The primary reasons for adopting Java are 1) the available standards for writing programs with a graphical user interface (GUI), 2) the available standards for networked programming, and 3) the available standards for handling multimedia content. Growing accustomed to programming through the familiar medium of a GUI is especially effective for young learners. These Computer Lab courses begin in the second year where students learn about data and variables, control structures, functions and arrays. In their third year, students then learn about the class construct and study the concepts of object-oriented thinking. Third-year students also study the fundamentals of the client-server computer networking architecture in the Business Systems course.

### *Prep2: Controlled Participation and Contribution*

KTC provides a significant number of courses for students to experience hands-on learning. Each student is given a laptop computer to use in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> year courses. They are allowed to use these personal laptops outside of class as well so the completion of assignments is not restricted to the time spent in class. In addition, the Global Information Technology department has many laboratory classrooms for performing various hands-on exercises, which are done primarily in teams.

Students in the Creative Experiments I & II courses assemble robots using LEGO® MINDSTORMS® kits and program them to accomplish certain tasks. In the Creative Experiments III course, students divide into teams and build radio controlled robots to compete in a class tournament. These Creative Experiments courses in all departments are the distinguishing feature of the KTC curricula as they aim to foster intellectual curiosity, inquisitiveness and faculties of reason in the students.

In the Computer Systems I course, second-year students build a PC and set up a networking environment. In their third year, students create a web server to host their own website and practice troubleshooting in the Business Systems course.

### *Prep3: Elementary Understanding and Explanation of Principles*

In order to deepen their understanding of elementary principles and acquire public speaking skills, students give demonstrations and present on various topics throughout their first three years at KTC.

Students in Creative Experiments I present a robot of their own design (built as an activity discussed under Prep4 below) and demonstrate its features. These presentations are assessed by classmates as well as teachers.

In the Data Processing III course, the teacher runs a contest in which the students compete by writing and presenting about an original shell command for Linux.

### *Prep4: Preparatory Skills for Practical Implementation*

Finally, assignments that require some degree of problem solving skills are used to determine the acquisition of skills for practical implementation.

In the Data Processing I course, students create their own original Christmas and New Year cards. They must use their skills in photography and Photoshop to process images and create 3D graphics for the card designs.

In the first half of the Creative Experiments I course students think up their own storyboard for a short film. Then they record, edit and publish a video that follows their story. During the other half of the course, students go beyond simply using LEGO® MINDSTORMS® to create robots that accomplish certain tasks. They work with a partner to conceive of an original idea for a robot, design it using the limited resources of their assigned kits, and then build it. Students are expected to program the robot using the fundamental programming skills they picked up from previous assignments. These assignments also introduce the students to engineering concepts such as designing solutions, configuring them through trial and error, and improving upon them for better performance.

The radio controlled robotics competition in the Creative Experiments III course is held according to predefined rules while the students must examine the source of defects and fix their robots in real-time if a problem arises during the competition.

## CONCLUSION

In closing, Kanazawa Technical College plays a role in the historically rich culture of compulsory and higher education within Japan. Japanese people have borrowed from both Europe and the United States to build an education system while staying true to the core cultural differences between the East and the West. The inclusiveness of Japanese society provides the benefit of high educational standards reaching a broader population base. However, this system also has disadvantages that are being intensified by the economic and demographic changes of the recent decades. The college of technology vocational track within Japan's education system once struggled to meet the demands from industry for trained technicians but now finds itself competing for students with the increasingly popular university track. Kanazawa Technical College has come to recognize the benefits of the internationally renowned CDIO framework being applied in the context of preparatory engineering education. Using the preparatory proficiencies outlined by Campbell et al., KTC provides a model of engineering education for putting young, technically apt individuals on a course to contribute to society through a technical profession from the early age of 15.

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### ***Biographical Information***

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