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Technology Education in Japan

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An Overview of the Japanese Educational System

In recent years, Japanese industrial and educational practices have received worldwide attention. In spite of the interest in Japanese industry and education, there has been relatively little study of technology education in Japan. This paper describes the history, current status, and future challenges of technology education in Japan. Because of their close relationship, discussion of both technology education at the lower secondary level, *gijutsu ka*, and vocational technical education at the upper secondary and post-secondary level, *shokugyo kyoiku*, are included in this paper.

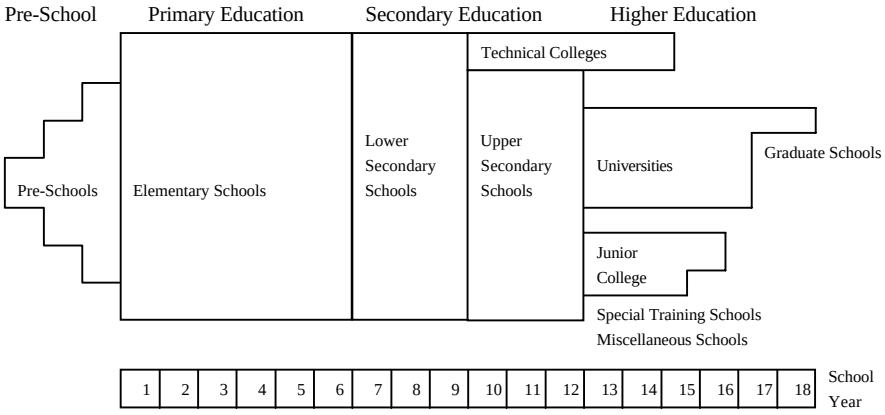

Figure 1. Organization of Japanese School System

The structure of public education in Japan is largely based on the American model of education which was adopted after World War II. Figure 1 shows the major types of publicly supported schools. The foundation of the modern Japanese educational system is the nine-year compulsory education core, *gimu kyoiku*. Included in the compulsory core is a six-year elementary school, *shogakko*, and a three-year lower secondary school, *chugakko*.

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Practically all (almost 100%) of Japanese students complete compulsory education. After completing compulsory education, about 95% enter upper secondary school. Of those who enter upper secondary schools, less than two percent drop out before graduating. (Ministry of Education, Science, and Culture, 1991).

With one of the highest literacy rates in the world, it is common to overlook the dramatic increase in educational attainment since World War II. Young Japanese are entering the workforce with much higher levels of formal education than ever before. In 1950, 45.2% of Japanese lower secondary graduates began working at age 15 after completing compulsory education, while 43% entered upper secondary school. As a result, the current Japanese workforce is a mixture of older workers with relatively lower levels of formal education and younger workers with higher levels of formal education.

Curriculum in Transition

Unlike America, Japan has a strong national system of education. Curricula for elementary, lower secondary, and upper secondary education is promulgated by the Ministry of Education, *Mombusho*. About every ten years, the Ministry of Education issues a new Standard Course of Study, which is a set of detailed, written guidelines for each subject taught in elementary and secondary schools. Suggestions for curricular revisions are made by various committees that include curriculum specialists, university professors, classroom teachers, members of local boards of education, and others.

Changes in Japanese technology education programs following World War II can be viewed in the context of four eras: 1) Economic Reconstruction Era, 2) High Economic Growth Era, 3) Stabilized Economic Era, and 4) International Era (Murata, 1990). Table 1 shows the socio-economic conditions that were characteristic of each era, and upper secondary and post-secondary enrollment percentages.

Establishment of Vocational Technical Education as a Required Subject

National support for vocational education in Japan has a long history. In his address to to the Diet (the popularly elected national legislature) in 1894, the Minister of Education said,

> It is clear that competition in the world is essentially industrial, rather than military. Our science has advanced satisfactorily, but not our technical training at the lower levels. This condition is like an army with plenty of good generals, but not enough noncoms. (Passin, 1982, p. 97)

His reference to the military was made in the context of the Sino-Japanese War. Later that year, the first national Vocational Education Law was passed. By 1899, agriculture, fishery, forestry, and industrial programs were established at the lower secondary level. Until 1958, vocational education was offered in

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Table 1

Socio-economic development and educational enrollments

Era	Socio-Economic Conditions	Enrollment Percentage* Upper Secondary	College/ University
Economic Reconstruction	Shortage of housing and food.	43.0% (1950) 51.5% (1955)	10.1% (1955)
High Economic Growth	Promotion of science & technology.	57.7% (1960)	10.3% (1960)
		70.7% (1965)	17.1% (1965)
	Rapid economic growth (about 10%).	82.1% (1970)	24.0% (1970)
Stablized Economy	Oil crisis (1971 & 74).	91.9% (1975)	34.2% (1975)
	Economic growth slows and stablizes (3-5%).	94.0% (1980)	31.9% (1980)
International	Growth of microelectronics & service industry.	94.1% (1985)	30.5% (1985)
	Internationalization of economy.	94.7% (1989)	30.6% (1989)

*Ministry of Education, Science, and Culture, 1991

lower secondary schools. Since 1958, vocational education has been offered in both comprehensive high schools and in separate vocational secondary schools. Although the concept of the comprehensive high school was an objective of the American Occupation education reform, it never became the dominant pattern in Japan. About half of Japanese upper secondary schools provide only an academic program, with the remainder almost evenly divided between comprehensive and vocational schools (U.S. Department of Education, 1987). In other words, most Japanese upper secondary schools offer academic programs that prepare students for higher education, and do not offer vocational courses. Therefore most of the Japanese students who participate in vocational courses do so in vocational schools. During the 1990 school year, about 26% of upper secondary school students were enrolled in vocational education classes.

As shown in Table 1, during the Economic Reconstruction Era about half of lower secondary school graduates began work immediately after graduating. At that time, vocational education was a required subject in lower secondary schools for all boys and girls, consisting of courses related to agriculture, industry, business, and home economics. The curriculum varied from school to school depending on the school's location. One of the main goals of vocational education was career education through experiential learning.

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Introduction of Technology Education

Following the successful launching of the Soviet satellite "Sputnik," Japan, like many other countries around the world, tried to improve their science and technology education programs. One of the policies adopted by the Japanese government in late 1957 was the introduction of technology education, *gijutsu ka*, as a required subject in all lower secondary schools beginning in 1958[1]. With the introduction of technology education in the lower secondary schools, vocational education was moved to the upper secondary level as an elective course.

In 1958, the major objectives of technology education at the lower secondary school were: 1) to help students learn basic skills through creative/-productive experience, to understand modern technology, and foster fundamental attitudes for practice; 2) through experience of design and realization, to foster skills for presentation, creation, and rational attitudes for problem solving; and 3) through experience in manufacturing/operation of machines/devices, to understand the relation between technology and life and to foster attitudes for improving technology and daily life. Major content areas included design and drawing; woodworking and metal working; machinery; electricity; and cultivation. A total of 105 hours in each of the three grades of lower secondary school was allocated for technology education.

In 1960, the Japanese government set out to double the number of technical high schools. During this era, five-year technical colleges for the graduates of lower secondary schools were established by the Ministry of Education. To respond to the shortage of skilled technical teachers, three-year teachers' colleges for technical education were established. These colleges were attached to Faculties of Technology at Japanese national universities. During the 1960's these colleges enrolled about 900 students each year. These policies were all related to Japan's "Doubling the National Income Program." At the beginning of this era, the *Ministry of Education* sent a curriculum specialist in technical education to the U.S. to gather information about technical-related subjects (Suzuki and Murata, 1990).

Introduction of Fundamental Subjects and Equal Opportunity in Education

Throughout the High Economic Growth Era, the percentage of Japanese students enrolled in upper secondary schools and higher education institutions continued to increase. However, the knowledge and skills needed in the workplace changed dramatically. In industry-related sectors, employers wanted workers to have greater flexibility and trainability. During this era, Ministry of

[1]The same term, *gijutsu ka*, has been consistently used to describe industrial arts/technology education classes in Japanese lower secondary school since its introduction in 1958. Gijutsu means technology and ka means subject.

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Education introduced fundamental subjects to vocational technical courses and also introduced work experience activities to general courses.

In this era, issues related to equal educational opportunity in secondary education began to emerge. Until then, all male students participated in technology education classes and all female students participated in home economics classes. To provide equal educational opportunity, beginning in 1977, the Ministry of Education required all male students to take at least one home economics class and all female students to take at least one technology education class.

In upper secondary schools, students enrolled in vocational technical education were required to take fundamental subjects such as "Fundamentals of Industry," "Mathematics in Technology," and "Practice." The goal of these subjects was to improve students' fundamental knowledge and skills, as well as accommodate new teaching materials and methods (Tamura, Arai, and Murata, 1985). At that time, work experience activities were introduced into general courses for all students.

Introduction of "Fundamentals of Information" into Lower Secondary School and "Independent Study Project" into Upper Secondary School

To respond to changes in the workplace and society, the Ministry of Education initiated several changes in the late 1980's. One of the major changes was the inclusion of a new computer literacy course in technology education programs in lower secondary schools. The primary objective of the new course is to help students understand the roles and functions of computers, and develop capability for the use of computers and information. Major content areas include computers and society, computer hardware, computer software, and application of computer software.

Although the new computer literacy course is not one of the four required courses (woodworking, electronics, home life, and food), it is one of the most popular elective courses. According to a study by the Ministry of Education (1991) 76% of all students want to take the new computer literacy course.

In the upper secondary school level, the Ministry of Education revised technical courses to encourage the development of basic skills and flexibility. In general subjects, the Ministry of Education encouraged the use of computers in science and mathematics. All vocational students are required to take a new information technology subject related to their major course, such as agricultural information processing and home economics information processing. One of the most significant revisions in upper secondary technical courses is the introduction of integrated problem solving courses, such as "mechatronics," "applied mechatronics," and independent/assignment project study.

The primary objective of the new mechatronics course is to promote the understanding of fundamental knowledge and skills related to mechatronics (a

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combination of mechanics and electronics). As shown in Table 2, content areas include basic machines and devices, sensors, A/D conversion, logic circuits, actuators, mechanics, and power transmission devices.

Table 2
National Course of Study Example

Objective	Contents
Mechatronics. To understand fundamental knowledge and develop skills related to mechatronics, and to foster the ability to apply them in a practical setting.	1) Integration of electronics and mechanics in machines and devices. 2) Principles and characteristics of sensors. 3) Sensors and computers; analog digital conversion, logic circuits, and signals. 4) Types and characteristics of actuators. 5) Actuator control. 6) Mechanics and power transmission devices.

In general, there has been a movement toward a broader view of technology education and vocational education in Japan. However, a broader and less "subject-specific" approach can result in a relatively shallow educational experience. The primary objective of independent project study is for students to deepen and integrate knowledge and skills through problem solving and industrial projects. Major content areas include design, manufacture, research, experimentation, the study of workplace practice, and acquisition of professional/vocational certificates. Examples of projects include the design and manufacture of robots and remote control models (Murata, 1990).

Technology Education Teaching Methods

From the beginnings of technology education in Japan, the primary teaching methodology was experiential, based on the project method. Technology education classes in Japan are typically organized into lecture and practice classes. Practice classes (laboratory work) usually have less students than lecture classes. The average class size in Japan is approximately 40 students. More recently, new types of project activities have been introduced that attempt to integrate different technical areas and lecture content.

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Support for Technology Education

The Vocational Education Promotion Law was enacted in 1951. As a result the national government, through the Ministry of Education, was obligated to promote vocational technical education and encourage local governments to support facilities for vocational technical education. After the development of each Standard Curriculum, the Ministry of Education promulgated technology education and vocational technical education equipment standards. The national government provided subsidies to upper secondary schools that amount to approximately one third of the budget for vocational technical education facilities and equipment. As authorized by Vocational Education Allowance Act of 1957, upper secondary vocational teachers at national and public schools receive a special monthly allowance equal to 10% of their monthly salary.

Initial and In-Service Teacher Training

Initial teacher training for technology education and vocational technical education primarily occurs in the Engineering Colleges or technical education departments of national universities. Because of rapid changes in technology it is often necessary for technology education and vocational technical education teachers to be retrained. After each major curriculum revision (usually a ten-year cycle), the Ministry of Education plans and implements in-service training programs. A good example is the major in-service effort to prepare the approximately 16,000 Japanese technology education teachers to teach the new course on computer literacy. In the first stage of the in-service program, about 160 technology teachers received two weeks of full-time in-service training. Over a three-year period, a total of 480 such “lead teachers” received similar training. In addition to the two weeks of intensive training, these teachers assume personal responsibility for self-study about computers. Each newly retrained teacher returned to their district and began training other technology teachers in their district. In-service training at the district level continued for four years (1988 through 1992) providing in-service training to all technology education teachers in Japan (Stern and Matsuda, 1988).

Educational Centers for Technology Education

Every one of the 47 prefectures (regional self governing bodies) in Japan has an education center that includes a department of technology/industry-related education (including information technology). Some of the large prefectures have independent centers for information technology or technical education. These educational institutions serve several functions including teacher retraining, development of teaching materials, and research on educational methods. In order to use prefectural educational budgets effectively, educational

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centers are equipped with expensive facilities such as large scale computer systems and machining centers.

Textbook Approval and Subsidies for Compulsory School Textbooks

All textbooks used in compulsory schools and most upper secondary schools are compiled and published by private publishing companies, and subject to approval by the Ministry of Education. All compulsory school textbooks, including technology education textbooks, are provided to students at no cost. The textbooks, which are typically softcover and well illustrated, are designed to be compatible with the Standard Course of Study as outlined by the Ministry of Education. By way of example, an approved mechatronics text would have material directly related to each of the content areas identified in Table 2.

Challenges Facing Technology Education in Japan

The following are four major challenges facing technology education in Japan. How well Japan is able to meet these challenges will determine the nature and effectiveness of technology education in the future.

Entrance Examination Pressure

Highly competitive entrance examinations are an important aspect of education in Japan. Especially important are the university entrance examinations which determine which students will be accepted at prestigious Japanese universities. Since admission to prestigious universities will result in various lifelong advantages, parents encourage their children to begin preparing for entrance examinations at an early age. The national university examinations cover five major areas: mathematics, Japanese, English, natural science, and the humanities. The entrance examination does not include content from technology education, home economics, fine arts, or health education. As a result, Japanese parents tend to regard these subjects as subordinate to subjects that are included in the entrance examinations. The influence of parents is strong, affecting the attitudes and actions of students and teachers.

Difficulty of Curriculum Change

The ten-year intervals between major curriculum change are too long to reflect changes in technology and in the workplace. This is an especially important challenge for technology education, since the content of technology education is closely related to the world of technology and the world of work.

Technology Education and Equal Opportunity in Education

Japan is beginning to experiment with a shorter work week and shorter school week. During the 1992-93 school year, Japanese schools will not have classes on one Saturday per month. As a result there will be less time available

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for instruction. There is widespread concern that in response to entrance examination pressure, many students will use the extra time to attend cram schools, *juku*. The reduction in school time poses an especially important challenge for technology education and home economics education. To provide equal access to boys and girls, the Ministry of Education decreased the time allocated to technology education and home economics by 50%. Although more students, both boys and girls, participate in technology education and home economics, they spend less time in each area.

Lack of Resources for Technology Education

As in other countries, technology education in Japan is constrained by a lack of resources, both financial and human. Technology education requires continuing financial investment in facilities, equipment, and materials. More importantly, it is becoming increasingly difficult to recruit good technology education teachers. Many engineering and technology graduates are recruited by companies, leaving relatively few available to work as technology education teachers.

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