

The Next Course of Study from 2022 and a History of the Subject “Informatics” in Japanese High Schools

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Abstract. In Japan, all senior high schools have had the subject “Informatics” since 2003. Before that, there were not any regular classes for informatics in Japanese senior high schools. Japanese Course of Study is revised approximately every ten years. The current one was implemented in 2013; the next one, published on March 2018, will be implemented in 2022. The authors outline the history as well as the prospect from 2022 on of the information studies education in Japanese senior high schools.

Keywords: general subject “Informatics”, course of study, scientific understanding of information.

1. The Japanese Course of Study

The Japanese Course of Study is published by Japanese Ministry of Education. With all the controversies of its legal binding power, it has tremendous influence on school education.

In Japan, all senior high schools have had the general subject “Informatics” since 2003, before which there were not any classes of information studies as the general education in Japanese senior high schools. Japanese Course of Study has been revised approximately every ten years and the current one has been implemented since 2013. The next Course of Study, which will be implemented from 2022, was published on March 2018.

2. Three Objectives of Information Studies Education in Primary and Secondary Education

The information studies education in Japanese primary and secondary education encourages pupils and students to develop their “Practical skills in using information actively”, “Scientific understanding of information” and “Positive attitudes towards today’s information-laden society”. **The three objectives were defined in the first report of “the Researchers Conference for Promotion of K-12 Information Studies Education”, published in October 1997.** Based on the report, the previous Course of Study launched its version of information studies education. (MEXT, 1997)

The three objectives are defined as follows:

- “Practical skills in using information actively”: The ability to use information means to collect, evaluate, express, process, and/or create the information needed, and to dispatch and communicate it in consideration of the receiver.
- “Scientific understanding of information”: Understanding the **characteristics of information** means to use information actively and to understand basic theories and methods for handling information appropriately and for evaluating and improving one’s own use of information.
- “Positive attitudes towards today’s information-laden society”: **The positive attitude that should be accompanied by the intention to understand the role and influence of information in our life, to consider the importance of information ethics and one’s own responsibility for information, and to participate actively in creating a desirable society.**

3. Information Studies Education in Elementary Schools

Elementary schools do not provide any specific subject of information studies but encourages pupils to develop their skills in using information actively by means of information devices like personal computers in class activities centered around the subject “Integrated Studies” (Nakano and Izutsu, 2013).

The next Course of Study for Elementary Schools describes what needs to be taken into account when making teaching plans in its Chapter 1, the general provisions (MEXT, 2017a):

In order to foster the ability to utilize information, each school should prepare the necessary environment to utilize information devices such as computer and networks, and enrich learning activities appropriately utilizing them.

To implement the next learning activity systematically.

- 1) Basic operations of computer such as keyboard operation.
- 2) Logical thinking skills by experience of computer programming.

What makes a great difference from the current Course of Study is “experience of computer programming”.

Moreover, the next Course of Study states on “Integrated Studies”:

It comprises the process of explorative learning, in which pupils participate in activities such as collecting information, processing and sending out information, utilizing computers and networks properly and effectively. In doing so, pupils learn about the basic operation of the computer to obtain the information needed and how to make a subjective or spontaneous choice among different information means.

4. Information Studies Education in Junior High Schools

In junior high schools, the subject of Technology and Home Economics generally covers information studies. The next Course of Study classifies the field of Technology as follows (MEXT, 2017b):

- A. Technology of materials and their processing.
- B. Technology of animal and plant growth.
- C. Technology of energy conversion.
- D. Technology of information.

The content of D “Technology of information” is defined as:

- (1) Information technology to support our life and society.
- (2) Interactive content by computer programs.
- (3) Measurement and control by computer programs.
- (4) Development of society with information technology.

Half of the 175 hours of the subject Technology and Home Economics are allotted to the content of Technology. The learning of information used to take up half the content, but now takes up only a quarter of it. Thus the time period for information studies that formerly reached 44 hours currently amounts to only 22 hours. This means a significant change in quantity as well as quality.

5. Information Studies Education in Senior High Schools

In senior high schools, the subject “Informatics” chiefly serves for information studies education. It is comprised of General Informatics (Informatics as general subject) and Major Informatics (Informatics as major subject).

5.1. The Subject General Informatics

Introduction of the Subject General Informatics and Previous Course of Study

The subject “Informatics” was newly established in high schools in 2003. General Informatics and Major Informatics were set up, and General Informatics are composed by “Information A”, “Information B” and “Information C”. “Information A” teaches the practical skills in using information actively, “Information B” deals with the scien-

tific understanding of information, and “Information C” nurtures the positive attitudes towards today’s information-laden society. Students are supposed to select one of these three. It would have been ideal that students themselves could freely select the one suitable to their characteristics and their future career. However, the actual situation of most schools was that each school designated the subject with no regard to the students’ preference. The rate of “Information A” was 80% of high schools nationwide. On the other hand, “Information B” was only 5% and “Information C” was only 15%. Unfortunately, most of those subjects seems to have been subject to the preconception of “the practical skills in using information actively = the skills of using office software” (MEXT, 1999). The classes accordingly limited themselves to exercises in using word processors and presentation software.

Information A:

- (1) Devices for active use of information and information equipment.
- (2) Collection and transmission of information and utilization of information equipment.
- (3) Integrated processing of information and utilization of computers.
- (4) Development of information equipment and changes in our lives.

Information B:

- (1) Solving Problems and utilizing Computers.
- (2) Structure and function of computer.
- (3) Modeling problems and solving by computers.
- (4) Information technology supporting the information-laden society.

Information C:

- (1) Digitization of information.
- (2) The Internet and communication.
- (3) Collection and transmission of information and personal responsibility.
- (4) Progress of information technology and its impact on society.

The problems with information studies education in those days were primarily attributable to the inadequacy in the teacher training of the subjects. As such training, “Teachers’ license program of the new subject Informatics for in-service teachers” was implemented over the three years since 2000, and the teachers who completed a fifteen-day course acquired its certificate and were in charge of the pertinent subjects and classes. The authors have to say that it was extremely difficult for teachers to acquire the knowledge and skills necessary for teaching the appropriate contents of Informatics in no more than fifteen days.

Present Situation of Informatics Teaching and Current Course of Study

In spite of those problems, it was meaningful that Informatics was established as a new subject. It encouraged a lot of research groups of Informatics to be created in each prefecture, and they were eventually put together into **Japan Informatics Teachers' Association (JITA)**. Every year sees in its annual conference not only high school teachers but also university professors holding research presentations. Those active comprises a driving force for improving the lesson and creating new initiatives of Informatics.

The current Course of Study, being applied to the students who entered high schools in 2013 and later, reorganized General Informatics into two subjects: "Society and Information" and "Information Science". Their contents are as follows (MEXT, 2009):

Society and Information:

- (1) Active use of information and its expression.
- (2) The Internet and communication.
- (3) Issues of today’s information-laden society and information ethics.
- (4) Construction of desirable information societies.

Science of Information:

- (1) Personal computers and the Internet.
- (2) Problem solving and effective use of personal computers.
- (3) Information management and problem solving.
- (4) Progress of information technology and information ethics.

The subject corresponding to “Information A” disappeared, the “Society and Information” was substituted for “Information C”, and “Information B” developed into the “Information Science”. Nevertheless, these reformations did not change the situation in which each school designated which subject their students should take; the 80% of high schools assigned “Society and Information”, whereas only 20% designated “Information Science”.

Moreover, even though more than ten years have passed since Informatics was newly established, the situation of teaching Informatics is far from having been improved; rather it is in a much poorer condition. Of Informatics teachers nationwide, only 20% is dedicated, 50% teaches other subjects concurrently, and the remaining 30% do not have an Informatics teacher’s license, only with a temporary license.

Future of Informatics and Next Course of Study

Third stage of revision of the Course of Study changes General Informatics dynamically rather than remaining as a minor improvement of it. The previous Course of Study and the current one both presupposed a choice among the required subjects: "Information A", "Information B" and "Information C", or "Society and Information" and "Information Science" and did not provide any advanced subject in General Informatics. However, in the next Course of Study, the compulsory subject is unified into "Informatics I" and, furthermore, "Informatics II" has been set as an advanced subject (Fig. 1) (MEXT, 2018).

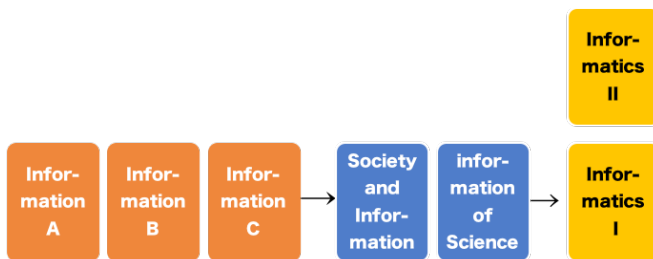


Fig. 1. Historical shift in the subjects and levels of General Informatics.

Aim of General Informatics

“Informatics I” and “Informatics II” provide high school students with learning activities in which they can make use of scientific viewpoints and ways of thinking about information to discover and solve various problems by utilizing information technology appropriately and effectively. The subject aims to nurture the propensity and ability to participate actively in society as follows:

- (1) To understand more about information and information technology and methods to discover and solve various problems by using them, to acquire the skills needed and to deepen their understanding of the relationship between the information society and people therein.
- (2) To understand various events in terms of information and its connection to them, cultivate the ability to appropriately and effectively utilize information and information technology toward finding and solving problems with the events.
- (3) To appropriately utilize information and information technology and cultivate an attitude to participate actively in the information society.

Contents of “Informatics I” and “Informatics II”

The contents of the relevant two subjects are as follows:

Informatics I:

- (1) Problem solving of information society:
characteristics of information and media, utilization of information technology, problem discovery, problem solving, legal system, information security, personal responsibility, information ethics, and impact on society
- (2) Communication and information design:
characteristics of media, communication means, effective communication, and information design
- (3) Computer and programming:
computer mechanism, algorithm, modeling, simulation, evaluation, and programming
- (4) Utilization of information communication network and data:
Internet structure, protocol, database, and information system

Informatics II:

- (1) Progress of information society and information technology:
development of information technology, future information technology, and information society
- (2) Communication and contents:
type of communication, characteristics of media, multimedia contents production, and information design
- (3) Information and data science:
data science, database, modeling, and data processing
- (4) Information system and programming:
information system, information service, information security, software development process, and project management

- (5) Exploration of problem solving using information and information technology:
 - imagination of new values, and effective utilization of information technology

As we noted above, “Informatics II” is positioned above “Informatics I”. The correspondence between the contents of the two subjects (“Informatics I” -> “Informatics II”) is fairly clear: (1) -> (1), (2) -> (2), (3) -> (4), (4) -> (3). (Fig. 2) (5) of “Informatics II” amounts to exploring comprehensive tasks utilizing the knowledge and skills acquired in “Informatics I” and “Informatics II”. We can see it as corresponding to project research in Major Informatics, which we will see below.

Although the standard unit number of each subject remains two, the flat organization of Informatics teaching has now grown into a “two-story structure” with one based on the other. The compulsory subjects one of which students were required to choose are unified in Informatics I, and Informatics II opens the door to further and deeper learning. This structural change is likely to improve the presence of Informatics at high school.

A slightly more concrete look at the contents will show that information design, programming, networking, information security, and databases are dealt with in “Informatics I”. In addition, “Informatics II” enriches the contents related to data science and information systems. Placing emphasis on the scientific understanding of information, it adopts further contents being dealt with in the current Major Informatics.

There may arise a concern about the teachers, whose specialties are other subjects or who don’t have an Informatics teacher’s license: can they appropriately teach these contents? It can be a relieving fact that more and more university professors are actively incorporating practical training, while an increasing number of Boards of Education are employing Informatics teachers. Additional in-service training is also supporting Informatics teachers and improving their teaching environment. Educational equipment such as computers and networks must also be improved for their active and effective practices.

Informatics I		Informatics II
(1) Problem solving of information society	→	(1) Progress of information society and information technology
(2) Communication and information design	→	(2) Communication and contents
(3) Computer and programming	↘	(3) Information and data science
(4) Utilization of information communication network and data	↗	(4) Information system and programming
		(5) Exploration of problem solving using information and information technology

Fig. 2. Content correspondence between Informatics I and II.

5.2. The Subject Major Informatics

Current situation

Alongside of “General Informatics”, the current Course of Study has provided 13 subjects of Major Informatics with senior high schools.

However, only a very small number of schools teach subjects of Major Informatics. Japan does not have more than 20 senior high schools that offer the course Major Informatics.

Aim

Major Informatics provides high school students with the practical and experiential learning activities necessary for the acquisition of scientific viewpoints and ways of thinking on information. This is because students will need these to realize a healthy and sustainable development of local society and information society, including the information industry. The subject aims to help students to acquire abilities as follows:

- (1) To understand each field of information systematically, and to obtain related skills.
- (2) To discover issues relating to the information industry and cultivate the ability to solve reasonably and creatively based on the ethical sense required of workers.
- (3) To nurture the rich human nature necessary for professionals, learn by themselves to build a better society, and cultivate an attitude to actively and cooperatively work on the creation and development of the information industry.

The difference in objectives between General Informatics and Major Informatics is that this latter focuses on "practical and experiential learning activities", "a sound and sustainable development of information society by the information industry", and "professional ethics".

New Subjects of Major Informatics and their Characteristics

The new Course of Study reorganizes subjects of Major Informatics by introducing some new subjects as well as revising the overall content of the subjects. This reorganization is expected to help foster qualified young people who have the creative capability of solving various problems in addition to understanding occupational ethics.

The new Course of Study divides Major Informatics into 12 different subjects in reference to four characteristics: basic, system design and management, creation and production of information content, and synthetic.

- Basic subjects:
 - “Information Industry and Society”, “Expression and Management of Information”, “Information Technology”, and “Information Security”
- System design and management subjects:
 - “Programming for Information Systems”, “Network System”, and “Database”
- Creation and production of information content subjects:
 - “Information Design”, “Production and Dissemination of Contents”, and “Media and Services”

- Synthetic subject:
“Informatics Practice” and “Project Research”

5.3. Other Subjects Related to Informatics in Special High Schools

The Course of Study notified in 1979 provided some major subjects of industry and commerce, which by and large corresponded to the present-day information studies. Subsequently, the ministry of education established the course of information technology in high schools of industry and **that of information processing in high schools of commerce**, which have played a central role of information studies education in the nation.

Other special high schools teach some other subjects of information: “Agriculture and Information” in agricultural schools, “Maritime Information Technology” in fishery schools, “Nursing Information” in nursing schools, and “Welfare Information” in welfare schools.

Likewise, the new Course of Study provides “Industrial Information Mathematics”, “Programming Technology”, “Hardware Technology”, “Software Technology” and “Computer Systems Technology” for high schools of industry and “Information Processing”, “Software Application”, “Programming”, “Network Application” and “Network Management” for high schools of commerce. The subjects will be learned by a lot of students in a wide range of high schools.

6. Trends in General Informatics

The characteristics of General Informatics in the three sets of Course of Study can be summarized with respect to the three objectives as in Table 2.

The third revision of Course of Study will hopefully allow us finally to start ideal information studies education in Japanese senior high schools. However, further monitoring and support will be necessary to see if it will really be realized. The authors would also like to participate continuously in the practice, observation, and support of this new endeavor of information studies education in Japan.

Table 2
Specific gravity of the three objectives in General Informatics

	Previous	Current	Next
Practical skills in actively using information	****	**	*
Positive attitude toward participation in today’s information-laden society	**	****	**
Scientific understanding of information	*	*	****

The number of asterisks in the table indicates that the objective is pursued actively (****), moderately (**), or barely (*).

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* MEXT – Ministry of Education, Culture, Sports, Science & Technology