

# Learn from past Japanese national strategy for education to produce scientists around the end of World War II



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## Abstract

The special science education that produces leading scientists was provided by Japanese government around the end of World War II. Part of reality of this special science education was revealed by research and study of the research group that was formed during 1992-1993 and 2002-2004 by S. Iwatsubo and associate researchers. This education featured 1) early education, 2) to cultivate perspective that draw deductions from phenomenon and derives results, 3) to get an ability to rapidly understand advanced contents. The target was primary school students and lower secondary students who have good talent for science and the curriculum was based on science with experiment of science. The education for character formation is remarkable one. School teachers and teachers of teacher's college and professors of University participated this education. Especially professor's lectures have good affected to students. To promote this education required super teachers who convey the vastness of academy's compendium with passion. The super teacher was not only educator but also researcher. It is remarkable that many students who have been educated this system succeeded not only natural science field but also humanity. This education method suggests a beneficial way of resolving the problem of modern education, *e.g.* hands-on policy, cultivate perspective for positivism, organization for creative research work. Recent Japanese strategic science education "grade-skipping system for university entrance examination", "super science high school: SSH", "core science teacher: CST" are partly similar to the special science education. We can apply the special science education to modern science education as a verified education model.

**Keywords:** Experimental class for science education, Grade-skipping system for university entrance examination, Early stage educations for gifted students, Experimental education of science, Education of science.

## Resumen

La educación de la ciencia especial que producen los científicos más destacados fue proporcionada por el gobierno japonés a finales de la Segunda Guerra Mundial. Parte de la realidad de esta ciencia especial fue revelada por la investigación y el estudio del grupo de investigación que se formó durante 1992-1993 y 2002-2004 por S. Iwatsubo y los investigadores asociados. Esta educación destacó 1) educación temprana, 2) cultivar la perspectiva que elabora deducciones del fenómeno y obtiene resultados, 3) para tener una capacidad de entender rápidamente contenidos avanzados. El objetivo era los estudiantes de primaria y más bajos estudiantes de secundaria que tienen buen talento para la ciencia y el plan de estudios fue basado en la ciencia con el experimento de la ciencia. La educación para la formación del carácter es un notable. Los maestros de escuela y profesores de la Universidad participaron en esta educación. Especialmente conferencias de profesores tienen un buen efecto para los estudiantes. Para promover esta educación se requiere de super profesores que transmitan la inmensidad del compendio académico con pasión. El super profesor no era solo un educador sino también investigador. Es notable que muchos estudiantes que han sido educados en este sistema tengan éxito no sólo en el campo de la ciencia natural, sino también en la humanidad. Este método de educación sugiere una forma benéfica para resolver el problema de la educación moderna, por ejemplo, manos-sobre política, cultivar perspectiva para el positivismo, la organización de los trabajos de investigación creativa. Recientes estrategias japonesas en educación de la ciencia "grado-de omisión de sistema para la prueba de acceso a la universidad", "super ciencia de la secundaria: SSH", "maestro de la ciencia básica: CST" son en parte similares a la enseñanza de las ciencias especiales. Podemos aplicar la enseñanza de las ciencias especiales a la educación la ciencia moderna como un modelo de educación verificado.

**Palabras clave:** Clase experimental para las ciencias de la educación, Grado-de omisión de sistema para la prueba de acceso a la universidad, Educación en etapa inicial para los estudiantes superdotados, Educación experimental de la ciencia, Educación de la ciencia.

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## I. INTRODUCTION

Former Japanese government under the world war II has needed special scientists and engineers. Especially, the fight with United States of America was required scientific strategy and modern weapons. But Japan had a problem of lack of scientist and engineer to win the war. The government required to cultivate them from youth who had a good talent as one of a policy. The special science education was executed from January 1944 to March 1947 for the above purpose by Japanese government. The fact of that this special science education was implemented was hidden from the Japanese education history because many of materials that was related to this education was destroyed after losing in the war. Recently, this education was revealed by researchers and the parties concerned this education. One of the significant results was issued as research reports by the research group that was formed during 1992-1993 and 2002-2004 by S. Iwatsubo and associate researchers [1, 2]. Data of related researches, interview with experienced peoples, news papers, questionnaire survey on experienced people were included in these reports.

We explain the reality of the education, implementation system, curriculum, contents of experiment, career of students and discuss how to apply the experience of the special education to modern science education.

## II. BEGINNING OF THE SPECIAL SCIENCE EDUCATION

Almost of Japanese had following mind and thought at the last stage of the world war II.

- (1) The heightening of nation's expectation of applying scientific technique to military forces
- (2) The sense of crisis about lose of scientists  
Mobilize of youth labor under the war
- (3) The expectation of changing the complexion of the war  
Lose information that Japan was outnumbered by United States of America  
Japanese thought the long war
- (4) The expectation of breaking uniformed education  
Explore good science education

Japanese government decided to start the special science education by the letter of transmittal from the ministry of education at 26/Dec/1944 -Implementation guidance about the special science education-

The policy is "Give a special science education to pupils who have a high talent for science and make a rapidly developing plan for our science and technology. For this purpose, study realistic way" The target pupils are from ten to fifteen years old pupils who have great talent of science. Implementation educational institutes were Tokyo higher teacher's school, Hiroshima higher teacher's school, Tokyo women's higher teacher's school, Kanazawa higher teacher's school, Kyoto-fu first middle school, Hyogo first Kobe middle school, Junior school of Kyoto teacher's

school. Total enrolment of the special science education was over 700, see Table I.

**TABLE I.** Enrollment of the special science education at its start time.

Implementation educational institute	Implemented school	School year(grade)	boy	girl
Tokyo higher teacher's school	Attached elementary school	4	16	0
		5	16	0
		6	16	0
	Attached middle school	1	18	0
Hiroshima higher teacher's school	Attached elementary school	4	15	0
		5	16	0
		6	12	0
	Attached middle school	1	34	0
		2	32	0
3	31	0		
Kanazawa higher teacher's school	Elementary school of Ishikawa teacher's school	4	16	0
	Kanazawa middle school	1	16	0
Tokyo women's higher teacher's school	Attached elementary school	3	11	11
		4	10	4
		5	7	8
	Attached middle girls school	1	0	30
		2	0	20
Kyoto University	Elementary school	4	15*	0
		5	15*	0
		6	15*	0
	Middle school	1	30*	0
		2	30*	0
		3	30*	0

\* Number of recruitment

Teachers of elementary school, middle school, teacher's school and university have taught and/or supported these special science schools. They were teachers in science but there were some teacher sin arts include English.

The selection method for students was different from each school. Kyoto-fu required following conditions to student;

- (1) Has an excellent qualification for all the subjects.
- (2) Get a good grade in science and technology.
- (3) Be physically fit.
- (4) Has strong mind and good cast of mind.
- (5) His/her parent has enough understanding and passion for the special science education, family environment befits the special education.
- (6) Has a guardian in Kyoto city.

The entrance examination consisted two parts. The first part was a written examination, its subjects were physics and chemistry, biology, mathematics. The second part was a physical checkup, oral examination, psychological test [1].

### III. CURRICULUM

Each school made their own curriculum because of no directive from the ministry of education. Mathematics and science were major subject and its number of hours were lather then typical school in common with these schools. The contents of lecture was high level, *e.g.* the curriculum was made to take 2nd or 3rd grade of middle school's academic ability in 6 grade of junior school. Also, students were imposed free investigation to cultivate their inquiring mind and originality.

An example of practical class for 4th grade of junior school: Case of Kanazawa

- (1) Comparative study about flight ability between animal and airplane.  
Study and device airplane's wing by focusing attention of animal wing.
- (2) Study of form, size of propeller and its speed  
Study relationship between power of propulsion, speed and form of propeller as source of flight power
- (3) Study of cryogen  
Thermal change by the blend ratio of snow and salt.
- (4) Study of freezing speed of materials  
freezing temperature and speed of some liquid.
- (5) Study of mirror  
study of optical low by plane mirror
- (6) Study of design by color glasses  
study of design as application of plane mirror
- (7) Study of hardness  
study of hardness gauge as basic research of mineral
- (8) Test of starch  
discovery things that has starch using tincture of iodine
- (9) Study of temperature of around of our life
- (10) Study of viewing method in a large  
study of viewing method for small things without hand glass
- (11) Study of pendulum  
isochronism of pendulum and relationship between length and number of frequency
- (12) Study of measurement of small things that are can't measured by weight scale or ruler
- (13) Study of measuring method of aria of map  
study and device measuring method of city and town using map
- (14) Making angle mater  
study and devise angle mater as application of glass craft.

Students were exempted from work for war and study all day. Students hated teachers of teacher's school who forced memorize knowledge [p. 17]. Students liked experimental class and lecture of university's professor. Especially, students had good effect from professors [p. 24].

After graduate the special science education, almost students have gone on university [Table II]. They became professor of university, medical doctor, executive of company, politician.

**TABLE II.** Case Tokyo high teacher's school, 32 graduates.

University	number
Tokyo University	25
Tokyo University of education	2
Nagoya University	1
Osaka University	1
Tokyo Institute of Technology	1
Tokyo University of Pharmacy and Life Science	1

### IV. OPPOSITION TO THE SPECIAL SCIENCE EDUCATION

There were oppositions under planning and beginning operation, and reflective opinions after closing the special education in intellectuals.

- (1) There is a possibility that the education for gifted children makes disable persons.  
Shyuji Yagi said "Good scientist is not produced if we cultivate he/her ability of only science and technology. As a nation to produce specialists of science and technology is important even if other parts are wrong. Good scientist is produced by not only special science education but also arts and social science education" [1, 3].
- (2) It is difficult to select children who have good talent in science.  
Kiyoshi Tomitsuka said "The selection method of student is important element of the special science education. But they select students who have good result in school. A child who will be a good scientist at the future is not a brilliant student. We can found him/her in spoiled brat" [1, 4].
- (3) The ability of teachers who operate the special science education is not enough.  
Shin Nagata said "Many teachers who graduated from teacher's school cram knowledge into students and are not qualified to watch for student's self-motivated growth with patience" [1, 5].
- (4) Teaching method is not well known.
- (5) It is the most important to educate basic of science and technology to general students.  
Mineo Yamamoto requested to teach the importance of the fundamental of science. Reiji Ito said that the urgent task was a well-developed science and technology education of primary school [1].
- (6) The necessity of the special science education is a maturity of society that accepts a genius of science [1].

## V. BENEFICIAL IMPACT OF THE SPECIAL SCIENCE EDUCATION

Several studies suggest a beneficial impact of the special science education on modern science education. The situation that the special science education was executed under the world war II is different from current education. But the necessity of good scientists and to conquer uniformed education are common problems. The special science education that targeted pupils who had good talent for science was closed after only 26 months education. In spite of the short term, the tactic, making the translation from education for memorizing knowledge to education for using knowledge, and its effects was verified. Today, Japan are executing some plan to solve educational problems leading the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan., *e.g.*,

- (1) grade-skipping system for university entrance examination, enrolls 17 years student who has good talent for science and cultivate he/her talent  
MEXT issued this system in 1997. Chiba University implemented this system in physics in 1998, Meijo University implemented in mathematics in 2001.
- (2) super science high school: SSH,  
emphasis science education for high school students  
MEXT issued SSH in 2007. The subjects are development of curriculum that is focused on science and mathematics on high school, promote the study about cooperative policy with universities and/or research institutes then conducts a cultivation of human resources of beneficial scientific engineer at the future. SSH is partly similar to the special science education. MEXT designated 125 high schools as SSH. Meijo University Senior High School cooperates with Meijo University.
- (3) core science teacher: CST  
Japan Science and Technology Agency (JST) issued CST in 2009. The subjects are to step up a training skill of science and mathematics teacher of primary and secondary school.

These plan are partly similar to the special science education. The most important thing is how to produce highly capable science teachers, "Super teacher".

There are some lack of passion for science education, cooperative framework and sense of crisis in comparison to the past in Japan. But, the situation that Japan has to win the science competition in the world is same as the past. Japanese advantage for modern education is that we have an experience of the special science education and know its effects.

## VI. HOW TO APPLY EXPERIENCE OF THE SPECIAL SCIENCE EDUCATION TO OUR NEW EDUCATION

Taku Komai, the general director of the special science education in Kyoto and the dean of Faculty of Science

Kyoto University, have sent a following message to students of the education [2, 6].

Expectation for you

You are people who are educated with special facilities because of having good quality for future scientific technologists. In spite of this reason, you may change the your thought and interest. If you are the person then I think that you don't need to work in science as your life work. You may work in arts, law or economy. You have better brain than general people even if you work above field. Therefore, it's no surprise that you are lots expected.

The reason of the special class for you was to produce human resources to science and technology area of Japan. This necessity is not changed even if the state of affairs in a country is changed. Especially, recently Japanese are expected to contribute to mankind by cultural activities. I have to say that this requirement is increased than ever before.

(snip)

The most warning thing is that to only stuck motley much knowledge into brain gets good mark but he/her can't win against one encyclopedia. In short, your knowledge has to be of service to your brain's work. That is to say, you get not only knowledge but also sprit of science. If you get them, you can make suitable judgment when you meet new thing, you are not manipulate by provocator, you are not urged by tyranny, and you must be drive people to the correct direction with confidence.

His sprit was applicable to modern science education. Therefore, it is not so difficult to apply the special science education to modern science education with some modification.

Meijo University have started above grade-skipping system and started on the SOGOSURI Program that promoted cultivating leaders who lead science and technology at the comprehensive scientific education center in 2001 [7]. The program is closely related to produce super teachers who lead mathematics and science education. The program is introducing to developing countries as a SOGOSURI project. This project is faced with the difficulty of producing super teacher who supports SOGOSURI program. This difficulty is similar to the problem of how to produce super teacher. We need to train scientists as super teachers who have following skills as;

- 1) Science facilitator who interprets professor's talk to students and/or citizens,
- 2) Science teacher,
- 3) Researcher because he/her understands insight and the slits of investigation.

The grade-skipping system has same problems of above "the opposition to the special science education". SOGOSURI project is trying to solve these problems especially section IV (1, 3, 4, 5).

## VII. CONCLUSIONS

We explained 1) the special science education, 2) the challenge of the special science education were applicable to modern science education, 3) the experience of the special science education predicts a lack of super teacher. The special education for children who have good talent of science was discussed in this paper. But, special education should be not only for gifted children but also for all children.

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