

What Should We Teach in Science Education?

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Introduction

Science has developed remarkably in this century. Particularly, after the second world war, science and technology have taken rapid strides. Such development of science and technology has brought the elevation of productivity, economic growth, the raising of culture and rescue of humankind from disasters and diseases. But, on the other hand, the human activity laying stress on their production has had a bad effect on the equilibrium in nature, and the problems of environment surrounding the earth have aroused the interest as an issue of international importance. Such transition of society and environment is reflected in science education also.

This paper will discuss what should be taught in science education under the fast advance of social conditions, adding my opinion referring to the Japanese situation. Especially, I would like to focus on the secondary school science education.

1. Traditional idea of education

Generally, it is said that education has two functions. one of them is the inheritance and the conveyance of cultural heritage, and the other function is the creation of a new culture.

These functions are necessarily alike, but, functions, which occupy much weight, differ with the educational idea and social influence of each age. For example, it might be enough only to master individual knowledge and skill at the undeveloped age of culture. But, in a rapidly advancing modern society

natural science develops remarkably and information increases markedly, the knowledge and the skill of today maybe become antiquated in the near future. Therefore, only to impart individual knowledge and skill in accordance with today's academic system, can't be said that education has achieved its purpose. For the pupils who will live in the future, the important role of today's education is the elicitation of creative ability and correct judgement. Moreover, under the present social situation humaneness is lacking, so the upbringing of a man with human relation is a most important problem.

2. What is the scholastic ability in science education today?

Originally, the character of natural science is to recognize the rule in nature by research natural phenomena, and moreover, to consider how human beings rationally and comfortably live in this rule of nature. On the other hand, science education must possess the educational system which affords understanding of the students' knowledge, ability and attitude. Then, what should we expect as the scholastic ability in science education?

It is needless to say that subject of study in science education is nature. Therefore, first of all, it is important to take an interest in nature and approach it with a positive attitude in the process of recognition of nature. But, if pupils have a positive attitude, they can't attain their object without the acquirement of inquiry method of nature, scientific thinking faculty and experimental skill. And furthermore, it is necessary to have varied knowledge about nature as much as possible, but there are unbounded things and phenomena in nature. So, it is a matter of course that pupils can't acquire all of them. Then, what sort of knowledge should be mastered?

The view of knowledge and comprehension in science education has changed with the times. Namely, in former days, it was the object to acquire the individual knowledge which was good for daily life, but nowadays, it is rather important to find the regularity underlying nature and moreover to understand fundamental conceptual knowledge which is abstracted from the various natural phenomena. Then, if pupils meet the new problems, they apply this knowledge and may be able to solve the problems.

What the experiment should be in science education also has changed.

Before, the character of experiment in the elementary and secondary school was apt to be thought for the identification of result which is described in textbooks. But, today it should have the following characters.

- i. To obtain the data from unknown phenomena.
- ii. To identify a hypothesis which is set forth based on the collected data by themselves.

Therefore, it is not too much to say that the scholastic ability from the view point of science is as follows:

- i. Scientific attitude which include an interest in nature.
- ii. Scientific knowledge and comprehension which mean the fundamental and conceptual ones.
- iii. Scientific skill.

But, in light of the present situation in which humaneness is lacking, it is a more important problem to bring up intellectual humility and a sense of gratitude through science education.

For that purpose, science education should be taught as a fundamental idea that mankind was created in the mighty nature, so he has a responsibility as a member of creation under the natural rule.

This is the reason that environmental education is emphasized in the science education recently.

After the war, the Japanese Ministry of Education revised the course of study several times, in order to improve and to develop science education to meet the needs of the times.

There are the following changes in the process of these revisions.

i.e.

Life science, the problem solving instruction



Systematic instruction



Instruction, emphasized the process of inquiry



and it is no exaggeration to say that in the course of study now¹⁾²⁾ which was proclaimed in 1977 (lower secondary school), 1978 (upper secondary school) placed great importance on the role of science education for the upbringing of

humanity through the elicitation of scientific outlook on nature.

I would like to mention about the Japanese social background at that time in which the present course of study has been revised. In the '60s and the '70s, industrial production activities developed remarkably and brought the growth of economy in Japan. But, with the advance of these activities, occurred various pollution problems and brought about the social troubles. On the other hand, in the '70s, more than 93% of lower secondary school graduates entered upper secondary school. So, the quality of students in upper secondary school is declining and diversifying. As a result, various problems were caused. For example, the increasing of poor scholarship students, juvenile delinquency and so on. Under such a situation, the Japanese Central Education Council had submitted a report to the Minister of Education in 1976. In conformity with this report, on the occasion of the revision of the course of study, the Ministry of Education had taken up the following points as the important matters.

- i. To bring up a man rich in humanity.
- ii. To plan a comfortable and substantial school life.
- iii. To acquire the fundamental contents of study and education to meet pupils' individuality and ability.

Originally, the purpose of science education was building up character through recognition of nature, but, the lesson tends to aim at preparation for entrance examination, which is far from the real object of science education. Under such a situation, pupils can't experience the marvelous, mighty, interest of nature.

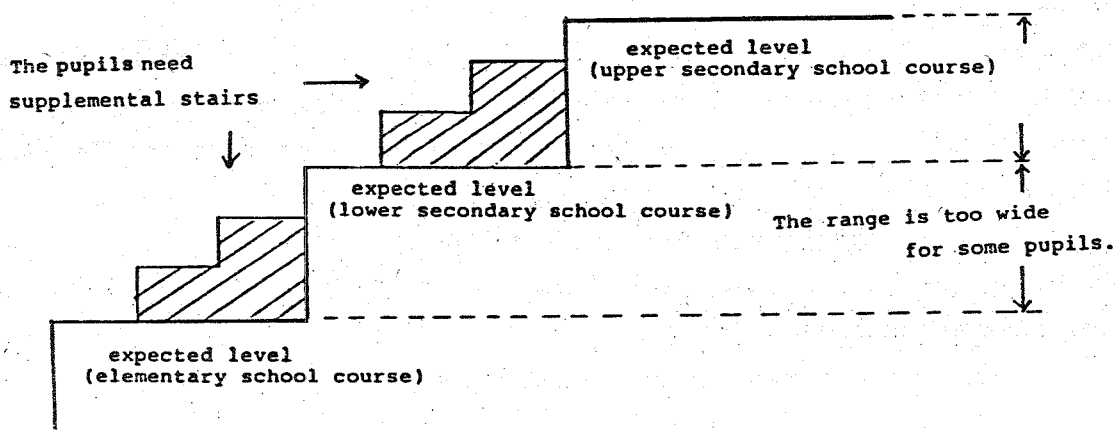
And furthermore, it causes a tendency to increase the number of students who dislike science.

3. The problems of instruction in science education

The author surveyed the students' attitude toward science education by questionnaires in 1983. According to this result³⁾, the number of students who came to dislike science increased as the course went on. About the principal reason which makes them dislike science learning, they answered abstruse instruction.

Students are expected to master the contents of each course, but actually they

learn too high level subjects, even when they can't digest the lower ones and such failure accumulation makes them unable to get on with the next process in any way. They need supplemental stairs to go up. The intensity of entrance examination accelerates cramming. Under such a situation, if they can memorize momentary problems without understanding, they may forget them in the near future. Therefore, the teachers should design the method of instruction in which students are able to advance step by step.



Moreover, from their answers, we can see that they stumble at the understanding of the relation between concrete phenomena and abstract concepts. Therefore, thoughtful consideration about this point is an important matter. It is effective to help student's understanding that the teachers take teaching materials from daily life or explain the phenomena in relation to their life as much as possible. For example, in the case of learning about Rault's Law, it is more effective for the student's understanding to talk about the antifreezing solutions which are used in car radiator than to explain the theory directly. And have the students make as many experiments as possible.

People say that the development of science today is caused by the following points:

- i. A man has always mental curiosity about strange things and makes an effort to satisfy his curiosity.
- ii. A man makes an effort to enhance the level of his life.

So, I think this essential character should be applied in science education. That is to say, the key to success of the lesson exists in how to stimulate a

pupil to learn, to promote his interest and how to introduce him to solving the problems.

4. Conclusion

Contemporary educational thought shows a tendency to respect scientific humanism, emphasizing curriculum. Therefore, how to mold the character through science education is a most important problem now.

Many of the countries in the world make an effort for the improvement and development of science education. It is no exaggeration to say that the success of science education depends not only on administrative countermeasures but also on the effort of the individual teacher who teach the pupils directly.

I pay my special respect to the Republic of China for making such great efforts in science education, and I wish you a continued success and development in this field.

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