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# AN IMPORTANT ROLE OF ASTRONOMY: TO EDUCATE ABOUT GLOBAL ENVIRONMENTAL PROBLEMS

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## ABSTRACT

There is a question, 'Which is beautiful, a flower or a star?'. Its answer is different from one person to another. It is only a matter of what one is interested in. It is very difficult for most school pupils, who will have non-scientific jobs, to understand science courses taught currently in school, because each science (physics, chemistry, biology, and earth science) is independently taught from the other sciences. Therefore, their knowledge of sciences obtained during their school period does not significantly help their understanding of global environmental problems. I am proposing that several scientific stories should be prepared to connect all the related scientific phenomena in order to give those pupils ideas in understanding global environmental problems. I believe that astronomy is able to play an important role in this context.

## I. TO TEACH TOO MUCH OR TO SHOW ONLY BEAUTIFUL NIGHT STARS

Items which it is desirable to teach at school increase with time. However, while items of language courses, mathematics courses, art courses and gymnastics courses increase only a little in number, and those of social science courses gradually, the development of science and technology is causing the number of items that may be taught in science courses to increase drastically these decades. Therefore, it becomes much more difficult to teach all the necessary pupils. Pupils at the lower level of an elementary school have an interest in science, especially in astronomy. Their interest, though, is not in motions of the sun, moon, planets, and stars on the celestial sphere, but in black holes, big bang, star formation, comets, and so on. Since in an elementary school and a junior high school, they are taught only about objects inside the solar system, they are gradually losing their interest in astronomy and also in science.

I heard many times that schoolteachers, planetarians, and amateur astronomers working actively to popularize astronomy, say the following: One should watch stars at night-time since they are so beautiful. I ask them, 'Which is beautiful, a flower or a star?', and show pictures of the Rosetta Nebula and of a rose blooming in a time sequence. The answer is different from one person to another, but I prefer the rose showing a delicate change of its shape from time to time. It is certainly only a matter of what one in interested in.

To make astronomy and also science attractive for school pupils, we have to find some other ways. I will present an idea in this paper.

## II. AN INCREASE OF PEOPLE HAVING A HIGHER LEVEL OF EDUCATION

In Japan, it has been said in this decade that there are two main problems, which are dislike of science and bullying. I believe these two problems have some connection with each other. Figure 1 shows percentages of children getting into a senior high school, into a college, and into a university, and these equivalences depending on time. Before 1960, only 10% of children went on to university level, and therefore, lectures in a class at the lower level were not targeted at the pupils going to the university level. Teachers did not pay much attention to text books, and had the possibility to make an attractive lecture.

Then, most of the pupils could be stimulated to enjoy science and tried by themselves to collect and identify, in some cases, insects, stones, flowers, and so on, and to watch and identify clouds, celestial objects, and the like. Less than 10% of pupils entered universities and became scientists and engineers who contributed much to the Japanese economic development during the past 30 years.

Now, so many pupils as shown in Figure 1 go to senior high school, and universities have imposed the higher level entrance examination. Then, schoolteachers are busy teaching a very wide range of topics which may appear in a paper test for the entrance examination. I believe less than 10% of pupils have the ability to absorb so many fundamental science items even at the present time. The other 90% or more pupils lose their interest in science courses and probably also in the other courses. Then, some number of pupils cannot find any meaning in going to school and may do bullying. This last linkage is my speculation and is not statistically proven, but we can find some indirect evidence.

Here, it is clear that we should cut down scientific items taught at school to keep science attractive for the pupils.

## III. NEW RECOMMENDATION OF GOVERNMENTAL CONSULTING COMMITTEE FOR EDUCATION

In 1947 after the second world war, a completely

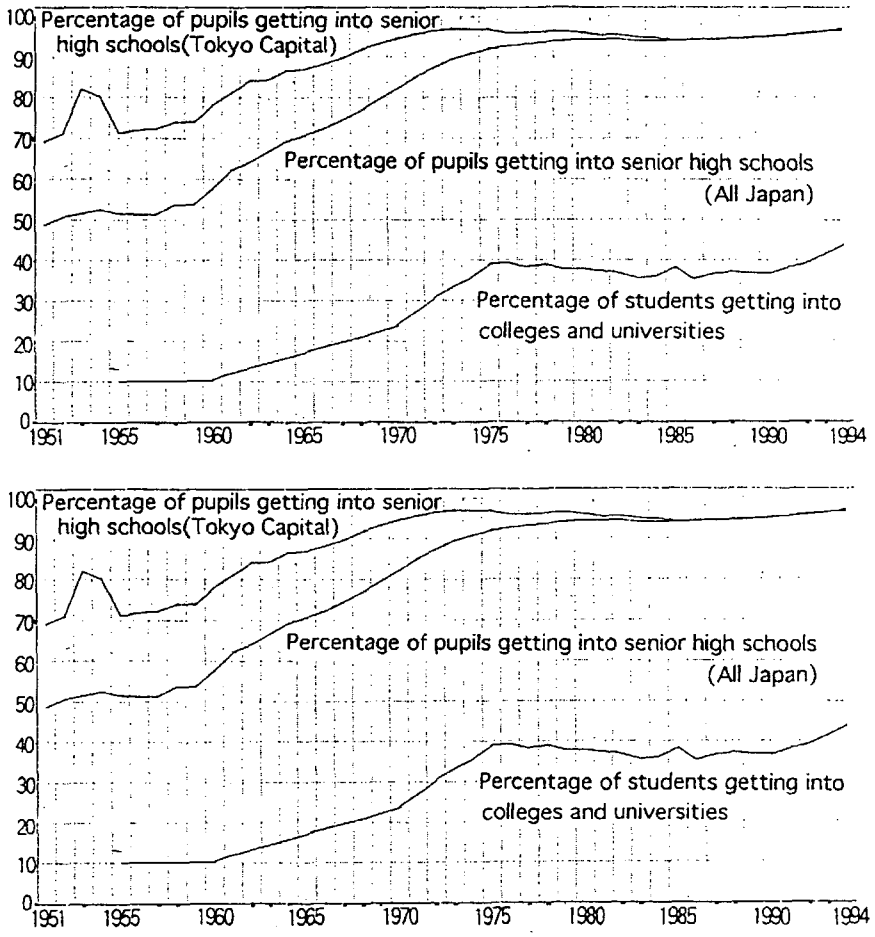


Fig. 1.— Numbers of pupils reaching given academic levels.

new education system was introduced under the US occupation. Therefore, this system imitated the US education system. Since then, there have been 6 minor revisions as shown in Table 1. In all the cases, the number of school hours for science courses was gradually reduced. At the first stage, the science course was divided into 4 parts, namely, physics, chemistry, biology and earth science. To set up earth science, there were deep discussions, and a conclusion was reached whereby astronomy was included in it instead of in physics. In 1969, a new part was set up, dundamental science, which was changed to science I and II in 1988, and to integrated science in 1994. All the efforts to combine all the science parts into one part were not successful. From 1980, our government has requested companies to introduce 5 working days per week. The number of companies having accepted this system is now over 80%. To follow this up, the Japanese government set up a committee in spring of 1995 to study a re-organization of our school system to have 5 rather than 6 school days per week, and the committee made a final recommendation to reduce school hours for science and introduce new areas such as practical computers (internet etc.) and environmental science this July. Although a final decision of school hours for each course will be made by a committee for school hour

Table 1. Change of Science Education

| | • Physical Science • Natural Science |
|---|---|
| 1947 | Introduction of US System under US Occupation |
| 1951 | Minor change |
| 1956 | Minor change |
| 1958 | A discussion on disintegration of Earth Science |
| 1968 | Introduction of **Fundamental Science** |
| 1987 | Introduction of **Science I and II** |
| 1994 | Introduction of **Integrated Science** |
| | 3 hours/week junior high school |
| | 2 hours/week senior high school |
| 2000? | 6→5 school days per week |

allocation, it will certainly start with school hours for science courses being reduced because of two effects, reduction of the total school hours and an addition of new courses. It will not be possible to teach the science being carried out as the present 4 parts of the science course, such as physivs, chemistry, biology, and earth science, with such reduced school hours. We need a drastic change of science course to mathc this recommendation and to take into account matters in section 2.

## IV. PROPOSED CHANGE FOR SCIENCE COURSE

It is very difficult for most school pupils, who will have non-scientific jobs, to understand science courses currently taught in school. As seen in Figure 1, only 10% of all the pupils in a period of 1960 went to university and about 5% of them became natural scientists and engineers. This ratio is probably not different between periods or 1960 and the present. When one consdiers our scientific curriculum, school pupils are able to develop very high ability in science if they absorb all the scientific matter taught in a school class. Furthermore, physical, chemical, biological, and earth scientific phenomena are taught independently. However, since scientific phenomena which puils see in their daily life are combinations of those phenomena, and there is practically no case of purely physical, chemical, biological and earth scientific phenomena, school pupils feel that their knowledge of sciences obtained during their school period does not greatly help their understanding of daily life sciences. For example, since an electric microwave overn is used to heat up food, it may sometimes happen that one tried to dry the wet hair of a cat using this oven. There is no ability to combine the two pieces of knowledge of microwave and heating despite being taught both items at school. These years, there are many discussions and also activities on environmental problems by so-called environmental groups. However, because of their shortage of ability to combine different areas of scientific knowledge, it happens many times that they take out garbage from their area (e.g., their own houses) but move it to another (e.g., their neighbor's house). That is, we are not able, these days, to escape from global environmental problems: one should always consider whether an action to solve an environmental problem does or does not affect the global environmental problems. To solve these matters, I will propose a way in which 20 to 50 stories to connect all the related sciences should be prepared in order to give those pupils ideas in understanding global environmental problems. As examples, we can prepare the stories shown in Table 2.

Each story should contain physical, chemical, biological and earth scientific items, mixing items from each part. Astronomy is able to play an important role in this context. In example 1 of Table 2, water was collected on the earth when it was formed from asteroid and comet collisions during its early history, and those collisions are seen in this day as meteors, fireballs, and asteroid collisions forming craters. For the other examples, we are also able to include astronomical items. It is not necessary for pupils to learn all the stories. They can choose several stories for each grade. One can increase slightly difficult items for each story depending on the grade and also include new topical items such as the event of the Shoemaker-Levy 9 comet. Then, pupils can enjoy interesting scientific items and also learn the interrelation of 4 parts of the sciences. We should also prepare a curriculum for pupils who have good scientific ability and a high possibility to be scientists or engineers. This type of pupil should learn fundamental items and methods of 4 parts of the sciences. Amounts of fundamental items increase up to 30% depending on grade during a period of elementary school, but at a grade of junior and senior high school we should prepare a different curriculum for those two types of pupils.

**Table 2.** Stories to connect all the relating Sciences

| | | |
|---|---|---|
| 1. | The cycle of water | **Comet. Interstellar.** |
| 2. | Solar light | **Atomic energy. Starlight.** |
| 3. | Rise and decline of the dinosaurs | **Collision of asteroid** |
| 4. | Shape of the Earth | **Planets** |
| 5. | . . . . . | |
| . | | |
| . | | |
| . | | |
| 50. | . . . . . | |

## V. CONCLUSION

Pupils who have the ability to be scientists and engineers can enjoy the current curriculum. Therefore, we should prepare this fundamental scientific curriculum with enough school hours for each of physics, chemistry, biology and earth science. For each, 5 hours per week over one year are needed. The total (the equivalent of 20 hours/week for one year) can be spread over the three years of senior high school. Pupils who will have non-scientific jobs can also enjoy a new curriculum with stories described above, and get an understanding of the importance of science, both in everyday life and as applied to global environmental problems.