Problems with Teaching Astronomy in Japan

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Abstract: By 1989 a new curriculum in Japanese elementary and secondary schools had been devised and started. I will report on the contents of the new curriculum and point out some problems in teaching astronomy in Japan identified from the results of recent research in science education. Recent research shows that it is important to know how children's ideas and misconceptions are constructed and what role the philosophy of science may play in shaping them.

1. Introduction
There are some innovative views for science education in elementary and secondary schools. One is the view that children's understanding of science learning is important. Another is the view that the philosophy of science contributes to how to learn scientific methods. Science education has been affected by the above two views for the past decade.

2. Astronomy in the New Curriculum
The new curriculum, drawn up by the Japanese Ministry of Education, has been revised after an interval of about ten years. There are some changes in contents and subject names. The largest modification in elementary schools is the inclusion of a subject 'seikatu-ka' (life study) instead of science and social studies in grades 1 and 2. Elementary is from grade 1 to 6 and science is taught in grades 3 to 6. Lower secondary is from grade 7 to 9. Astronomy is taught in grade 7 in the unit called the Earth and Solar System. Upper secondary is from grade 10 to 12. There are five divisions and 13 subjects. Students must select more than two divisions from five divisions and nine subjects. The astronomical content is in earth science IA, IB and II.

3. Some Problems in the New Curriculum
Many science teachers, including teachers of astronomy in elementary and secondary schools, have pointed out various problems in the new curriculum. There are three problems in the teaching of astronomy students. The first concerns the training of teachers, as discussed at many domestic and international conferences and in papers (e.g., Owaki and Isobe 1988; IAU Colloquium No. 105). These problems affect the selection of earth science in a previous curriculum. Earth science is only selected in about 7% of cases (Tubota 1990).

Secondly, there is a problem concerned with children's understanding of space-time. We need to know how children actually think when presented with astronomical material. However, we know little about the formation of children's concepts, especially what they think about the space-time concept. Though the curriculum considers the physical well-being of children in new courses of study, it mentions little about the cognitive process in children and why and how children make misconceptions.

Research into children's concepts of astronomical objects (e.g., Earth, Moon and Sun) suggests that children construct their own ideas and meanings for the events they observe in the natural world long before they receive any formal education. Nussbaum and Novak (1976), Nussbaum (1979), Sneider and Pulos (1983) and Baxter (1989) reveal and confirm this view. These concepts of children are seen in cross-cultural studies (Mali and Howe 1979; Klein 1982; Matumori 1986).

Thirdly, we must consider the philosophy of science which is being discussed in a number of studies of science education (e.g., Hodson 1985; Hills 1989), and education (Owaki 1987). In the new curriculum, however, astronomical content which includes the significance of the philosophy of science does not seem to be discussed sufficiently.

4. Conclusions
Many researchers have reported various problems of teaching astronomy, most of which are based on the views of how efficiently teachers teach astronomy to children by using good materials. What then are 'good' materials? Most of the so-called good materials are devised practically. Recent science education research reveals the importance of children's understanding. In this respect, we have to develop good materials.

It seems that there are some problems in the new curriculum from the point of view that studies of science education have tended to change in the next phase. Recent science education studies reveal the importance of children's understanding which is researched on methods of science, curriculum and materials through results of philosophy of science and cognitive psychology. It is time that we may again have to recognise a role for astronomy in schools among science education.

Nussbaum, J., 1979, Science Education, 63, 83.
Owaki, N. and Isobe, S., 1988, Vistas in Astronomy, 31, 863.