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International Comparison of Weather and Climate Education for Primary Schools

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Abstract
The objective of this research is to compare primary schools' weather and climate curricula and their associated textbooks in the of Japan with their counterparts in the United Kingdom and the United States; and to find a way to incorporate the same climate-change education within the primary schools of Japan. Japan's weather and climate education is distinctly different from their UK and USA counterparts. These differences act as a barrier against incorporating a universal climate-change course within Japan's curriculum. We propose a remedy to this problem.

Keywords
Primary School, Weather, Climate, Climate Change, International Comparison

1. Introduction

There are so many dissemination and outreach activities in recent years on climate change including "Global Warming". In Japan, the Challenge 25 Committee of the Ministry of the Environment operates a web site on global warming. Since weather influences our daily lives, it is taught in primary schools throughout the world. However, climate change and its consequences are not taught in many schools, including Japan.

The Fundamental Law of Education and the School Education Law in Japan have clearly stipulated the need to foster an environment-preservation attitude. The course of study as defined by the Ministry of Education, Culture, Sports, Science and Technology in Japan (CSJ) supports the value of a natural environment and contributes to environment preservation; and hence, has formed the foundation of climate-change education within a school's science education.

The objective of this research is to compare primary schools' weather and climate curricula and their associated textbooks in the of Japan with their counterparts in the United Kingdom and the United States; and to find a way to incorporate the same climate-change education within the primary schools of Japan.

2. Research Data

School curriculums and textbooks were the means of comparing weather and climate education. The CSJ and the national curriculum were used for Japan and UK, respectively.

Since the USA does not have a national curriculum, the New York state curriculum, which is accessible via web, is used as a model. The conceptual understanding of the New York state curriculum is consistent with the approaches of the National Science Standards, as established by the National Research Council in 1996, and the benchmarks for science literacy: Project 2061 of AAAS in 1993. Therefore, it was considered as being comparable to Japan's and UK's national curricula. The textbooks used in this study are listed in Table 1.

Table 1. Textbooks used in this research
Tokyo Shoseki, New Science 3, 2011
Tokyo Shoseki, New Science 4, 2011
Tokyo Shoseki, New Science 5, 2011
Tokyo Shoseki, New Science 6, 2011
Tokyo Shoseki, New Social Study 5 Part 1, 2011
Dainippon Tosho, Pleasant Science 3, 2011
Dainippon Tosho, Pleasant Science 4, 2011

Dainippon Tosho, Pleasant Science 5, 2011
Dainippon Tosho, Pleasant Science 6, 2011
Houghton Mifflin, Science Grade 3, 2010
Houghton Mifflin, Science Grade 4, 2010
Houghton Mifflin, Science Grade 5, 2010
Houghton Mifflin, Science Grade 6, 2010
Oxford Univ. Press, Geography Success 1, 2011
Oxford Univ. Press, Geography Success 2, 2011
Oxford Univ. Press, Geography Success 3, 2011
Oxford Univ. Press, Geography Success 4, 2011

3. Weather and Climate Education

3.1. Weather and Climate Education in Japan

Weather is a primary science in the CJS. The fourth grade introduces temperature measurement, the relation between weather and temperature, the daily variation of temperature, and water circulation.

The fifth grade introduces the various clouds of weather, cloud movement and weather change, general weather information with emphasizing typhoons and weather related natural disasters. Weather information includes weather charts and satellite images. Climate is taught within social studies rather than as a science.

The authorized textbooks from different publishers are examined. These textbooks have similar content and story. The materials covered in these textbooks are as follows:

- Weather only;
- Observation of weather and cloud;
- Measurement of temperature;
- Weather is changed from the west.

The term "climate" is missing from these textbooks. The other weather elements such as humidity, wind and air pressure are not measured in any weather observation. These elements don't explain why weather changes from the west. Social Studies introduces climate but not from a scientific point of view. A sixth-grade science textbook offers a description about the global environment in the section of "Living things and Environment".

3.2. Weather and Climate Education in United Kingdom

The UK government introduced a national curriculum in 1989. The key-stages 1 and 2 correspond to Japan's primary school. Here, weather and climate are taught within a geography course versus science.

Key-stage 1 introduces the concept of climate in contrast to changing weather. Pupils are taught to make observations about where things are located; for example, seasonal changes in weather. Also, pupils are taught to recognize changes in physical and human features; for example, heavy rain & flooding fields.

Key-stage 2 introduces the appropriate vocabulary and the proper use of appropriate fieldwork techniques and instruments; e.g., a rain gauge. Pupils are expected to use the INTERNET to access comparative weather information of different locations.

Third-grade textbooks introduce weather and climate in the context of selecting travel destinations. Weather and climate are clearly defined in the textbook, which states that climate depends on the latitude. And latitude determines solar altitude and hence, insolation. Also, it is stated that elevation and distance from the sea determine climate. The seasonal change of weather and climate is explained by the evolution and rotation of the earth. Weather information and weather forecasting required by the national curriculum are also explored.

Fifth-grade textbooks introduce water via both social and scientific points of view. For example, arid deserts versus water-rich tropical-rain forests are studied in relation to human-induced climate change. The study of coastal region covers the motion of the sea such as tide, warm and cold oceanic-currents and waves. The study of the sea relates to the climate that was introduced in the third grade via the effects of oceans. Moreover, the mechanism of a sea breeze and hence wind, is explained scientifically. Then wind is studied as a renewable-energy source.

3.3. Weather and Climate Education in United States of America

By the forth grade, pupils should understand how weather changes daily and seasonally. Also, pupils should understand that weather is by definition, the condition of the outside air at any particular moment. Pupils should know that weather could be described and measured by: temperature, wind speed and direction, type and amounts of precipitation, and general sky conditions via the science of cloud, rain. Pupils should understand the science behind cloud, rain and water cycle. And extreme natural events such as floods, forest fire, earthquake, volcanic eruption, hurricanes, tornado and other severe storm in relation to the human impacts should be understood.

The New York curriculum defines the education content of various grade ranges rather than for an individual grade. Therefore, we find a chapter on weather and climate for each grade-level textbook. The contents are weather observation, constituent of the air, structure of atmosphere, and the mechanism of wind, such as sea breeze, cloud classification; and air mass and frontal systems. We can find nearly everything in meteorology, even in a primary science-textbook. The content in the American textbook is the real science of weather; such as meteorology instead of the preparation of for an advanced study.

The New York curriculum for the fifth grade and above is defined for grades 5 through 8. The seventh and eighth grades are within the secondary school in Japan so they are excluded in this study.

4. Conclusion

Weather and climate education in Japan differs from its counterpart in the UK and USA. In the UK and USA, weather and climate is studied within the framework of atmospheric science. For example, cloud formation and the cause of wind are explained in the UK and USA. In Japan, the term "climate" is missing in the science curriculum. Moreover, pupils are taught only to describe a cloud and wind without any scientific explanation.

Also, the sea and ocean are covered with the weather and climate in the UK. Sea and ocean studies are very important for both the UK and Japan, for they are both islands. However, such studies are not included in the science curriculum of the CSJ. This is another big difference. The New York curriculum has the sea and ocean covered in the fifth through eighth grades.

In order to introduce the climate-change education into the primary schools of Japan, it is required to include the study of climate and ocean within its science curriculum. If we define ‘primary education’ as a part of the informed-citizenship education, we should teach weather and climate scientifically and/or logically.

Weather and climate education in the framework of science is possible; based on the UK and USA’s school curricula. We consider climate-science education from the scientific point of view to be very import for the education of future citizens who care about the preservation of the natural environment of a sustainable society.

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