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Development and Evaluation of High School Science-Camp Using EdGCM

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1. Introduction
We have planned and executed three-day science camps during the 2009, 2010 and 2011 summer vacations of senior high-school students and collaborated with the center for climate systems research, the research consortium of NASA/GISS and Columbia University. The main title of our camp is "Global Warming Computer Simulation" with the sub-title: "Let's try NASA's Global Climate Mode, EdGCM".

Our science camps are executed under the Science-Partnership Project (SPP) of the Japan Science and Technology Agency (JST). The purpose of the SPP is to enhance children's interest in science, technology and mathematics and to encourage children to develop their inquiring minds. Our participants are supported with food and logging by the JST. The JST also offers funds to hire teaching assistants and consumables.

We had more than twenty applicants each year from many parts of Japan. We accepted ten for 2009 and twelve for 2010 and 2011, respectively; based on essays written in their application forms that demonstrated their motivation and intelligence.

2. Objectives
Our science camp is part of our climate-change education. The purpose of the science-camp project is to enhance high-school students' interest in science and technology; and to foster intellectual interests in general. Our concrete objectives are:
to understand the climate system;
to understand the Global Climate Model (GCM) and its use;
to experience the scientific process and to acquire scientific strategy; and
to develop an attitude toward global environmental-issues.

3. Contents of our science camp
Our science camp consists of observation, experiments, simulation and presentation. Observation consists of participants visiting our meteorological observatory and making their observations at various locations to verify a meteorology theory. It can be used to confirm climate change and experience the result of climate prediction and hence, underscores the importance of observation in climate science. In our laboratory, participants perform basic experiments in order to deepen their understanding the climate science. For example, they confirm thermal expansion of water, the various properties of carbon dioxide, cloud formation and so forth.

Participants are lectured about global climate-models such as EdGCM and then instructed how to use them. They also practice how to visualize computer-simulation results. Learning the structure of a global-climate model is one of the easiest ways to learn the climate system. Then, they are divided into three groups. Each group sets up a specific simulation scenario and run it during the night after discussing the factors and awareness of global warming, and determining a final theme for the simulation.

Each group is expected to present their results at the discussion session in the afternoon of the final day. The morning of the final day shall be allocated for the analysis of the results within a group and for the preparation of presentations. They shall exchange their ideas with other participants and instructors in the discussion session. Participants are expected to deepen their understanding on the theme through the process of presentation.

4. Science-Camp Performance

The overall performance of our science camp is evaluated by questionnaires given before the closing session. 60 % of the participants answered "I'm very much interested in science." to the question of "Did science interest you?". Then 40 % answered "I'm interested in science." The 90% of participants answered "Yes" to the question of "Did you participate in a science camp and have some influence in an attitude to environmental problem?"

The effects of our science camp are assessed via pre- and post- questionnaires that are used by the United Kingdom's Risky Business climate-change project. In the questionnaires, statements such as "Climate change is happening now" are presented to assess the participants' conviction.

We focus our attention to the change of a participant's conviction versus any particular question and answer. For example, the number of those that chose "Strongly agree" rose from 14 to 22. Also, their answers supported an environmental policy such as "Invest more money in science and technology". Decisive answers are becoming more common; such as "Definitely against" rose from 9 to 11 and "Definitely for" rose from 18 to 26. They tend to express their idea strongly after participating in our science camp. We naturally confirmed that participants have acquired scientific knowledge. For example, after completing our camp they correctly recognize that water vapor and methane are greenhouse-causing gases.

For the EdGCM simulation, 80% of participants answered "very interesting" and 20% answered "interesting". For experiments and observations, 70% of the participants answered "very interesting" and 30% answered "interesting". For the answer to the "Most favorite activity in the science camp", 50% of participants selected EdGCM simulation, 30% selected experiments and observations, 20% selected communication with researchers.

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