Handicraft of 3D cardboard models derived from high-definition topographic data for enhancing geographic imagination

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Promoting theoretical and empirical considerations in the understanding of natural phenomena is essential for education at an early age. However, not all the knowledge taught in textbooks is necessarily accepted, and some supplementary ways to guide children to a deeper understanding of natural phenomena are often further required. For this purpose, fieldwork experiences in the outdoors have an impact on children's sensitivity and memory and are considered important as a method of environmental education. However, it is not always easy to provide opportunities for outdoor training within the scope of the daily educational curriculum. Besides, various methods to acquire 3D topographic data, including UAV (Unmanned Aerial Vehicle), SfM Multi-View Stereo photogrammetry, and laser scanning, have been widely applied, but it is still difficult for children to experience the operation of these devices and acquire data. Here in this study, we propose the use of 3D topographic data acquired in the field by researchers as a means to promote understanding of natural geography in indoor activities for children and verify its effectiveness as a teaching material that appeals to children's sensibilities.

High-definition 3D topographic data (point clouds and mesh models) of natural landforms can be displayed on a computer as digital data, but it is also easy to output them as analog 3D models thanks to the spread of 3D printers. In addition, it is possible to make a 3D model by dividing 3D data into equal intervals like contour lines, printing them on 2D papers, and then overlapping them with cardboard or other thick material. We developed a teaching material that can be used to fabricate a 3D cardboard model of a small island where the erosion of sea cliffs is progressing based on the 3D point cloud data obtained by researchers. Using this material, we held workshops to make a 3D model of the island as special events during the summer vacation (part of the "Hirameki-Tokimeki Science" program). The target group was about 20 fifth- and sixth-grade elementary school students. Multiple 3D models were made using data acquired at different times so that students could see the changes in the shape of the island due to erosion. The workshop was preceded by a lecture on the data acquisition process and the physical geography approach to understanding natural phenomena based on the survey. After the workshop, we conducted a questionnaire for the participants and their parents. The results of the questionnaire revealed the following findings. The participants felt that the lecture was "somewhat difficult" at the beginning. However, they were able to deepen their understanding of natural phenomena with stronger interest by making 3D models with their own hands, and by seeing, touching, and comparing the completed models of different time periods. In addition, through this workshop, the advantages of 3D models that stimulate not only the sense of sight but also the sense of touch were demonstrated.

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