World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:12, No:05, 2018

Modeling Curriculum for High School Students to Learn about Electric Circuits

Authors : Meng-Fei Cheng, Wei-Lun Chen, Han-Chang Ma, Chi-Che Tsai

Abstract : Recent K–12 Taiwan Science Education Curriculum Guideline emphasize the essential role of modeling curriculum in science learning; however, few modeling curricula have been designed and adopted in current science teaching. Therefore, this study aims to develop modeling curriculum on electric circuits to investigate any learning difficulties students have with modeling curriculum and further enhance modeling teaching. This study was conducted with 44 10th-grade students in Central Taiwan. Data collection included a students' understanding of models in science (SUMS) survey that explored the students' epistemology of scientific models and modeling and a complex circuit problem to investigate the students' modeling abilities. Data analysis included the following: (1) Paired sample t-tests were used to examine the improvement of students' modeling abilities and conceptual understanding before and after the curriculum was taught. (2) Paired sample t-tests were also utilized to determine the students' modeling abilities before and after the modeling activities, and a Pearson correlation was used to understand the relationship between students' modeling abilities during the activities and on the posttest. (3) ANOVA analysis was used during different stages of the modeling curriculum to investigate the differences between the students' who developed microscopic models and macroscopic models after the modeling curriculum was taught. (4) Independent sample t-tests were employed to determine whether the students who changed their models had significantly different understandings of scientific models than the students who did not change their models. The results revealed the following: (1) After the modeling curriculum was taught, the students had made significant progress in both their understanding of the science concept and their modeling abilities. In terms of science concepts, this modeling curriculum helped the students overcome the misconception that electric currents reduce after flowing through light bulbs. In terms of modeling abilities, this modeling curriculum helped students employ macroscopic or microscopic models to explain their observed phenomena. (2) Encouraging the students to explain scientific phenomena in different context prompts during the modeling process allowed them to convert their models to microscopic models, but it did not help them continuously employ microscopic models throughout the whole curriculum. The students finally consistently employed microscopic models when they had help visualizing the microscopic models. (3) During the modeling process, the students who revised their own models better understood that models can be changed than the students who did not revise their own models. Also, the students who revised their models to explain different scientific phenomena tended to regard models as explanatory tools. In short, this study explored different strategies to facilitate students' modeling processes as well as their difficulties with the modeling process. The findings can be used to design and teach modeling curricula and help students enhance their modeling abilities.

Keywords : electric circuits, modeling curriculum, science learning, scientific model
Conference Title : ICPSELS 2018 : International Conference on Pedagogical Sciences and Effective Learning Strategies
Conference Location : Singapore, Singapore
Conference Dates : May 03-04, 2018