Development of Disaster Prevention Teaching Materials Using Digital Fabrication in Junior High School Technology Education

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Abstract

This study developed disaster-prevention teaching materials for junior high school technology classes using digital fabrication and low-melting-point metal casting. The goal was to shift the focus from "being cautious" to "creating safety." After presenting at a national education conference in July 2024, collaboration began with researchers from Chiba, Fukuoka, and Kagoshima Universities. In November, a four-session class series at Chiba University Junior High School allowed students to design, fabricate, and test their own sprinklers through trial and error, confirming the materials' value for active learning.

1. Aim of Research

To create materials that teach students to view safety as something they can produce, using hands-on fabrication rather than passive caution. The goal is to cultivate a proactive understanding of safety in junior high school students.

2. Method of Research & Progression

2-1 Research Method

The study used 3D printers, laser cutters, and alloy casting to create a sprinkler kit. The project followed three phases: development, classroom implementation, and analysis.

2-2 Research Report

After the July 2024 conference, partnerships were formed with Mr. Kinoshita (Chiba University), Mr. Nogata (Fukuoka University of Education), and Mr. Sakata (Kagoshima University). Kits and materials were shared to promote collaborative research. A summary was published in *Technology and Education*.

2-3 Practical Application

In November, a four-week lesson series at Chiba University's affiliated school covered CAD design, mold printing, casting, and testing. Students engaged in trial and error throughout, and data was analyzed to improve the material.

3. Results of Research

3-1 Educational Dissemination

The project introduced innovative safety education to teachers, researchers, and future educators, highlighting the value of creating safety through technology.

3-2 Active Learning

The four-lesson structure promoted trial and error, confirming students' ability to build functioning safety devices using digital tools.

4. Future Area to Take Note of, and Going Forward

To expand use of these materials, broader access to 3D printers in junior high schools is needed.

5. Means of Official Announcement of Research Results

Results will be shared through further implementation and through a new KAKENHI project (No. 25K06311) focused on 3D printing and alloy-based safety materials.

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This study aims to develop and implement teaching materials for junior high school technology classes that foster the mindset that "safety is something to be created." Utilizing digital fabrication tools and low-melting-point alloy casting, a disaster-prevention sprinkler was developed. Following its presentation at the 2024 National Conference of the Japan Association of Technology Education, collaborations were initiated with researchers from Chiba University, Fukuoka University of Education, and Kagoshima University. The teaching kit was provided to partner institutions, and in November 2024, a four-week series of classes was conducted at Chiba University Junior High School. Students experienced the entire process from design to casting and testing, actively engaging in trial and error. The effectiveness of the materials as an active learning tool was confirmed.