Effectiveness in Engineering Education by Participating in Model Contests in the Field of Civil Engineering

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In public works projects, it is crucial to effectively communicate the details of construction to local residents in order to build consensus and ensure smooth execution. However, explaining the mechanisms of natural disasters and their corresponding countermeasures often requires specialized knowledge, making it difficult to convey these concepts to the general public. Thus, it becomes necessary to devise communication strategies that make these complex ideas more accessible and comprehensible to a wider audience.

One such strategy involves the use of models constructed from readily available materials, such as those found in hardware stores. These models are designed to present specialized engineering concepts in a manner that is both approachable and engaging to the general public. Moreover, the process of creating these models also benefits engineers, as it encourages them to reconsider how they communicate their technical knowledge and to focus on the essential elements of their work.

This study explores the educational effects of a model competition in which civil engineering students from a technical college participate. In this competition, students work in teams to select a theme, build a model, and present their work, using the model to explain the mechanisms of natural disasters and corresponding countermeasures. A distinguishing feature of this contest is that, in addition to assessing the technical performance of the models, the evaluation criteria also include the clarity with which the models can be understood by the general public. Through participation in the contest, students not only deepen their understanding of specialized topics but also acquire valuable skills in model creation, presentation design, and project management, such as process planning and task delegation.

The results from a post-contest questionnaire survey of the participants indicate the significant educational benefits derived from the contest. Based on these findings and the guidance provided by instructors, the study proposes more effective methods for engineering education, particularly in the context of public communication and the dissemination of technical knowledge.

Keywords: *Model contests, Young employee development program in civil engineering, Presentation skill, Professional education*

Introduction

In public construction projects, explaining the details of the work to local residents and obtaining their consensus is extremely important for the smooth execution of the construction. However, explanations regarding the mechanisms of natural disasters and the countermeasure construction methods often involve specialized knowledge, making it necessary to devise ways to present the information in a manner that is easy for the general public to understand.

As one example of such efforts, a method using models has been implemented to convey specialized technical knowledge. The models use readily available materials that can be purchased at hardware stores, with the concept of making them familiar and interesting to a wider audience. On the other hand, creating these models also benefits the makers (engineers), as it prompts them to deeply consider how to communicate clearly to the general public and to identify the “core” aspects of the technology.

On the other hand, in recent years, higher education institutions such as technical colleges and universities have been placing increased emphasis on education related to project management. In the Project Management Body of Knowledge (PMBOK), which is a systematically organized resource on project management, stakeholder management and communication management are identified as important elements for the successful completion of a project.

This paper reports on the educational effects in engineering of students specializing in civil engineering at a technical college participating in a model contest, where they compete by explaining the mechanisms of natural disasters and corresponding countermeasure construction methods using models. Through the process of participating in the contest, students deepen their understanding of specialized knowledge, acquire skills in creating models and presentation materials, and gain

experience in project management aspects such as scheduling and task delegation.

At National Institute of technology, Matsue, where the author is affiliated, a practical initiative for learning project management has been conducted in the form of a DX Recurrent Course, providing education on human resource development through collaboration between working professionals and students (e.g.Ohya,2019. ;) . This initiative focused on the theme of conveying the appeal of construction work to elementary school students using ICT technology. According to a survey of participating students, the project enhanced their motivation to learn, teamwork, and communication skills. In this study, an investigation was conducted based on the idea that participation in the contest would provide project management experience, which would result in similar engineering educational effects.

Materials and Methods or Pedagogy

The contest in which the students participated was a model contest hosted by Fujii Foundation Design Office Co., Ltd., involving university and technical college students studying civil engineering in the Chugoku region of Japan. A total of five teams from universities and technical colleges participated in the competition. Participation was solicited by the organizer, who gathered the participants. The contest was covered by various media outlets, and the results have been publicly announced (Xtech.nikkei, 2024.).

The effort to explain disaster mechanisms and countermeasure construction methods using models has been led by Fujii Foundation Design Office Co., Ltd. for many years, demonstrating high effectiveness in communicating with local residents. Additionally, this initiative and the model explanations have been documented in several articles and books. While students participating in the model contest refer to these materials, creating models that differ from existing ones based on their own original ideas remains a challenging aspect.

In the contest format, students formed teams of two to three members, selected their own themes from various ground disaster types, and created models along with presentations using those models. A distinctive feature of this contest is that the evaluation criteria equally emphasize the model's performance and the ability to communicate the content clearly to the general public through presentations.

Overview of the Contest

Table 1 shows an overview of the contest. Five teams participated in the contest and six students fromNational Institute of technology, Matsue, participated in two teams (Team A and Team B). The themes focused on the mechanisms of disasters and countermeasure construction methods, with participants selecting one from landslides, slope failures, debris flows, floods, or earthquakes.The concept for the models to be created was to "use materials from 100-yen shops or hardware stores to clearly communicate to the general public." By using familiar materials that people commonly see around them, this approach aims to foster a sense of familiarity and enhance the understanding of the presentation among the general audience.

Table 1 Contest overview

Date of the event	October 27, 2024
Number of participating teams	5 teams
Theme	Disaster generation mechanisms and countermeasure methods Cliffslides, landslides, Mudslides, Floods, Earthquakes
Concepts	Communicate to the public in an easy-to-understand manner using materials from 100-yen stores and home centers.

Schedule of Student Activities

Table 2 shows the schedule of student activities. Students were given a rough schedule as shown in the table in advance, and they were instructed to manage the detailed schedule themselves while holding regular meetings with instructors to discuss their progress. Students were encouraged to make appointments with instructors as needed to hold meetings and receive feedback on their work. Additionally, during the course of their progress, adjustments were made such as advancing certain tasks or conducting tasks concurrently, focusing more time on items that students deemed necessary.

Table 2 Submission Day

1st week of Sep.	Participant's declaration of intent
3rd week of Sep.	Study of materials and selection of topics
4th week of Sep.	Meeting with the organizer
2nd week of Oct.	Model making
3rd week of Oct.	Creation of presentation materials,Submission of Entry Sheet
October 27	Contest Implementation

Division of Roles

Both participating Team A and Team B consisted of three members each. Within each team, three roles were assigned: a leader responsible for schedule and budget management as well as team coordination, a person in charge of model production, and a person responsible for preparing the presentation materials. By assigning each member a specific role with clear responsibilities, it is expected that members will participate more proactively, work will proceed smoothly, and individual understanding will deepen.

Results and Discussion

In the contest, team A won the Grand Prize, and Team B received the Excellent Model Award.

Figure 1 shows the results of a self-assessment survey on various skills conducted after the contest for the six participants. The items evaluated in the self-assessment were Scheduling, Teamwork, Presentation, Problem-solving, and Goal Setting. The figure indicates that the self-evaluations were high across all items.

Figures 2 and 3 show the survey results for the three members belonging to Team A and Team B, respectively. Table 3 summarizes the results from Figures 1 to 3. From the figures and table, it can be seen that overall, Team A had higher self-assessment scores both before and after the contest. Additionally, the difference of Teams A was increasing. Team A was the team that won the Grand Prize. This suggests that Team A was composed of members who initially had relatively high self-assessment scores, and their self-assessments further improved through participation in the contest. In particular, the increase in self-assessment related to problem-solving was significant for Team A. This indicates that participation in the contest can be expected to enhance problem-solving abilities, or that experiencing the problem-solving process extensively contributed to producing good results.

On the other hand, the item that showed the greatest improvement for Team B before and after the contest was teamwork. The improvement in teamwork can also be considered an effect of participating in the contest. However, Team A's teamwork scores were already high before participation. This suggests that engaging in a project can lead to a certain level of improvement in teamwork skills, and furthermore, that once teamwork reaches a certain threshold, other abilities such as problem-solving tend to improve as well. Therefore, enhancing individual teamwork skills can be considered an effective means to improve overall project management skills.

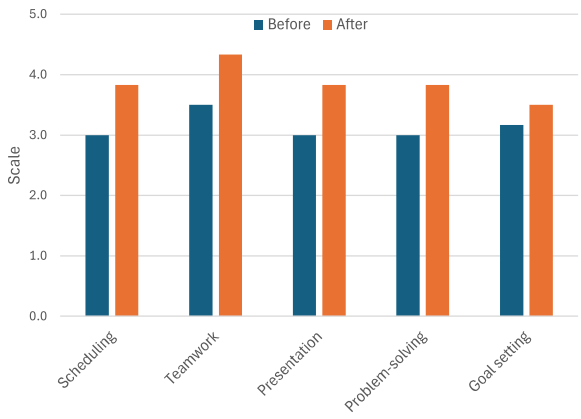

Figure 1 Summary of self-evaluation survey (All students)

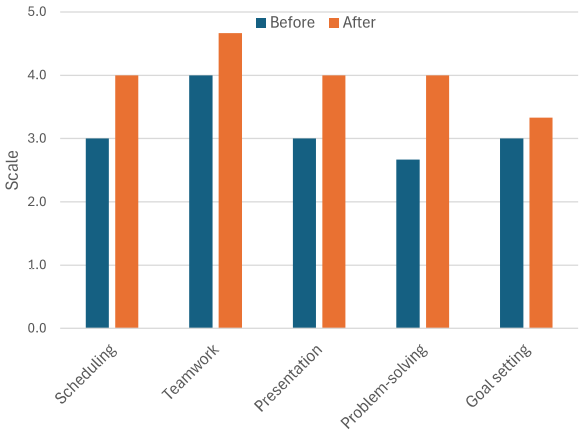

Figure 2 Summary of self-evaluation survey (TeamA students)

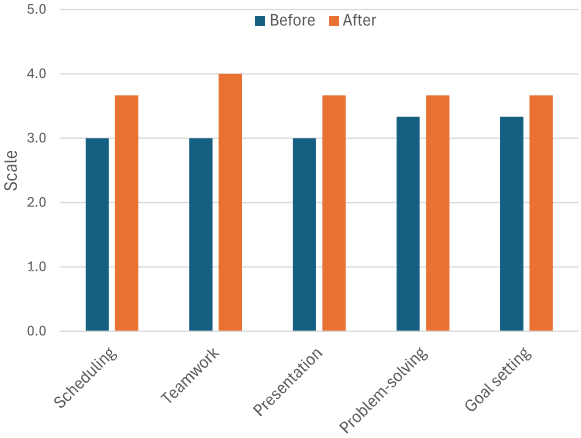

Figure 3 Summary of self-evaluation survey (TeamB students)

Table 3 Summary of self-evaluation survey

	All students			Team A students			Team B students		
	Before	After	Difference	Before	After	Difference	Before	After	Difference
Scheduling	3.0	3.8	0.8	3.0	4.0	1.0	3.0	3.7	0.7
Teamwork	3.5	4.3	0.8	4.0	4.7	0.7	3.0	4.0	1.0
Presentation	3.0	3.8	0.8	3.0	4.0	1.0	3.0	3.7	0.7
Problem-solving	3.0	3.8	0.8	2.7	4.0	1.3	3.3	3.7	0.3
Goal setting	3.2	3.5	0.3	3.0	3.3	0.3	3.3	3.7	0.3

Conclusions

Students specializing in civil engineering at a technical college participated in a model contest where they competed by explaining the mechanisms of natural disasters and corresponding countermeasure construction methods using models. Through this participation, the following educational effects in engineering were achieved.

The results of a self-assessment survey on skills before and after the contest confirmed improvements in project management skills such as teamwork, scheduling, and problem-solving. Members of the team that won the Grand Prize showed particularly significant improvement in problem-solving skills. On the other hand, for the team with initially low self-assessment scores, a marked improvement in teamwork was observed. It can be inferred that improving teamwork first may lead to enhancements in other skills.

Participation in the model contest was found to significantly enhance students' project management skills.

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