COMMUNICATING SCIENCE AND TECHNOLOGY IN THE MAKING: A CASE STUDY OF "MANIA CONTEST"

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Abstract

"Science and Technology Mania Contest" is a public program organized to provide teenagers with opportunities to design high-technology-based artifacts and thereby to increase their interest in science and technology. The task given is to design a model ship propelled by the Lorentz force (Lorentz ship), which allows wide range of approaches and thus takes features of science and technology in-the-making. In this year, one hundred forty teams participated in the contest and presented their model ships. In this study, we attend to opportunities for communication that the artifact designing activity provides to the participants. Particularly, we analyze students' communicative interaction in the oral session in which they talked about their model ships to expert scientists and engineers. We show that students' concrete design practice constitutes referent the scientific language would direct toward and therefore resources for developing legitimate discourse of science and technology.

Keywords: Artifact designing, Science and technology in-the-making, Communication,

1. Introduction

Over the past decade, the technological artifact designing activity emerged as constituting authentic environment for learning science [1]. Design activities are reported to provide opportunities to develop scientific ideas and artifacts by drawing on cultural resources of science and technology [2]. The process of designing and its consequential products are not pre-determined but become what they are as concrete practice unfolds the activity [3]. Designers keep confronted with uncertainties in developing their design artifact, which brings forth opportunities for "learning-in-practice" [4]. In this study, we report about "Mania Contest," a nationwide technological design activity, and associated learning-in-practice. We draw on the notion of "in-the-making" suggested in a recent science study [5] and use it to describe two aspects of uncertainty involved in the "Mania Contest": "science and technology in-the-making" on the one hand and "communication in-the-making" on the other.

2. Mania contest: science and technology "in-the-making"

The purpose of the "Science Technology Mania Contest" is to provide teenagers with opportunities to design high-technology based artifacts and thereby to develop interest in science and technology, even toward a level of mania. In accordance with the first contest conducted in the previous year, the task was to design a model ship propelled by the Lorentz force (Figure 1). To participate in the contest, three students and one teacher constituted one team and competed with other teams for gaining high marks in activities of writing a report, giving a poster presentation, and racing.

Figure 1. Lorentz ship: a simplified model (left) and a force diagram (right)

The "Science Technology Mania Contest" proceeded through the following steps: First, the nationwide announcement was made through both on-line and off-line media. The information was available on the internet homepages of the host center (HYTIST) and other well-known science culture related organizations. The metropolitan and provincial offices of education of Korea assisted distributing the announcement to individual schools at their local areas. Second, one hundred sixty five teams (19 at middle school and 146 at high school level) submitted applications. Third, one hundred sixty teams participated in the workshop consisting of lecture and experiment (Figure 2, left). Two university professors gave lectures on the physics of the Lorentz force and an introduction to the naval architecture. Students made a simplified model “Lorentz ship” by using materials provided. Fourth, one hundred forty teams (a total of 500 students and teachers) submitted their final reports and participated in the final competition. A panel of judges consisting of fifteen university professors and engineering experts observed students’ poster presentations and tournament races (Figure 2, middle & right). Grand, Gold, Silver, and Bronze award were given to the seven high-rated high school teams and six middle school teams.

Figure 2. Mania contest: workshop (left), oral presentation (middle), and Lorentz ship race (right)

The “Science Technology Mania Contest” is evaluated as taking features of “science and technology in-the-making” in the following points: First, the task of designing a Lorentz ship allows diverse approaches and therefore does not come down to getting *a* right answer. Despite the simple basic principle of propelling, there are many empirical factors affecting the movement of the ship. Designing a model ship in relatively smaller scale gives different constraints. For example, students find out that using batteries are advantageous than using an electromagnet that weighs more; advantages of electromagnet are revealed not to cover up disadvantages of batteries. Second, because of the openness of the task, the hosting center did not have to change the task in the second contest. In this year, some students had experiences of participating in the previous year’s contest or attended the same schools as those of previous year’s participants. The same task gave students opportunities for conducting a long-term project both individually and collectively and proposing more elaborated artifacts than before. As the previous year’s awarded artifacts were available through the workshop, participants attempted to learn about them and propose improved artifacts. Some artifacts were equipped with newer technologies (e.g., wireless control panel). Third, the contest was organized to provide participants with opportunities to become part of a community. The host center opened the workshop and introduced science and engineering of Lorentz ship. During individual teamwork, internet homepage and email service of HYTIST afforded prompt interactions and relevant supports. In the final competition, students’ achievement was evaluated not only by race record but also by their performance of writing (report) and talking (poster presentation). The students, scientist, engineers, and the host center constituted a community of practice [6] and communicate with one another whenever there was an issue.

3. Communication “in-the-making”: a case from oral presentation

Three main activities constituted the main program of “Mania Contest”: writing a report, giving an oral presentation, and taking part in racing. In the oral presentation session, students were debriefed by expert scientist and engineers—how they approached the problem, what they learned in the process, and what was their final result. The session was intended not only to evaluate students’ achievement but also to provide opportunities to participate in scientific discourse. The oral presentation session was revealed to be very instructive in two points. First, students talked about their concrete practice in front of the scientists and engineers, which already constituted a real context that their discourse is grounded. That is, students had to speak in a way that they suppose would be reasonable to scientists. Second, because the topic of conversation was *students’* practice for designing Lorentz ship—not that of scientists, students made use of scientists’ utterances as resources for participating in legitimate discourse of science. We exemplify communication “in-the-making” with an analysis of the following episode.

Episode

01 Scientist: you said current affects more than voltage, how did you increase current while keeping a same voltage?
02 Student 1: we used voltage-apparatus in the experiment
03 Scientist: I mean, how could you make current bigger at the same voltage?
04 Student 1: used the voltage-apparatus
05 Scientist: voltage apparatus [(???)
06 Student 2: [((he stretches his left hand))
07 Student 3: [increased the number of batteries
08 Scientist: then, the voltage increases
09 Student 1: using the voltage-apparatus, keeping voltage same, and current (???)
10 Scientist: you mean, a parallel connection?
11 Student 1: we connected in series
12 Scientist: then the voltage (will change?)

13 Student 1: we did not use [batteries but the [voltage apparatus
[((she gestures a line with her right hand))
[((She gestures a rectangle with her hands))
14 Scientist: what is the voltage apparatus?
15 Student 1: (???)
16 Student 3: power [supply
17 Student 1: [power supply
18 Scientist: did you put a power supply here?
19 Student 1: no, we experimented with a power supply

a. b. c. d. e.

Figure 3. Oral presentation: Student 1 is a girl standing right next to the screen, Student 2 is a boy beside her, and Student 3 is a girl standing the other end of the screen.

In this situation, the scientist and the three students talk about research results presented on slides. On one of the slide projected to the screen, it said “the strength of current affects more the magnitude of the Lorentz’ force rather than that of voltage” (Figure 3a). The scientist asks how they could keep the voltage same and change only the current (turn 01). Student 1 says that they used “voltage apparatus” and thereby completes the scientist’s question as the one about experimental setting (turn 02). However, the scientist asks the question again that is literally same with the previous one (turn 03). The student gives a same answer (turn 04). The scientist makes an utterance beginning with “voltage apparatus” (turn 05). Immediately, Student 2 gestures with his left hand (Figure 3b) and intervenes with it (turn 06). He seems to want to talk something. At the same time, Student 3 takes a turn and says that they increased the number of batteries (turn 07) (Figure 3c). The scientist points out that the voltage increases, that is, cannot be same (turn 08). Student 1 talks again about voltage apparatus; that is, their voltage apparatus can keep the voltage same (turn 09). Scientist asks if they made connection in parallel (turn 10). Student 1 negates that they made connection in series (turn 11). As the scientist begins to talk about voltage again (turn 12), Student 1 specifies that they used voltage apparatus, not batteries (turn 13). She gestures a series connection by moving her right hand horizontally (Figure 3d) and then a rectangle shape with both hands (Figure 3e). Finally, the scientist asks what she refers to in terms of voltage apparatus (turn 14). She makes some inaudible utterances (turn 15). Student 3 articulates that it refers to power supply (turn 16). Immediately, Student 1 joins and repeats power supply (turn 17). The scientist points out the ship and asks if they put a power supply inside (turn 18). Now Student 1 articulates that they experimented with a power supply.

One of the issues in this conversation from the perspective of Scientist is to understand experimental settings that produced the result. In the former part of the episode, the scientist repeated questions, but each time, the scientist’s question is responded by the same term “voltage apparatus” that did not seem to give an answer relevant to his question—it does not make sense to him to keep the voltage same with “voltage apparatus.” However, the scientist in this situation attempt to understand what the students did in their experiment. The scientist changes the question. He specifies by asking whether they made a parallel connection. He implies that it makes sense to keep the same voltage if batteries are connected in parallel. This question provides an opportunity for the student to specify. Student 1 points out, not only with utterances but also gestures, the voltage apparatus does not refer to batteries. The scientist asks directly what the voltage apparatus is—it becomes apparent that the word, “voltage apparatus” refers to different kinds of practices. Students 3 mentions a power supply in his utterance and Student 1 confirms by repeating it. Now Scientist asks a question, an utterance including the word “power supply.” His action exemplifies a legitimate way in which the term power supply is used by a scientist. It leads to Student 1’s utterance including the term “power supply.” Finally the three students arrived at a legitimate scientific description of their practice that is understandable to not only to the particular scientist but also within the scientific community in general.

4. Conclusion

In this study we intended to understand aspects of “learning-in-practice” brought forth by “Mania Context” and described it by drawing on the notion of “in-the-making” in two ways. First, uncertainties inherent in the process and outcome of the artifact design activity produced opportunities for conducting a project-type task in the long term and learning through it within a scientific community (“science and technology in-the-making”). Second, interaction with expert scientists and engineers provided opportunities to communicate students’ practice in scientific terms. In communication, students’ concrete design practice constitutes referents the scientific language would direct toward and therefore resources for developing legitimate discourse of science and technology.

5. References

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