

# Participatory gaming simulation as a science communication arena

**Reiko Hishiyama**

*School of Creative Science and Engineering, Waseda University, Japan*  
reiko@waseda.jp

**Abstract:** Participatory gaming simulation that is used for science communication at the science café or science workshop is a powerful technique for understanding the specialized scientific knowledge. In general, there is a short talk by an invited speaker on a new or controversial science-related topic at the science café. And followed by a discussion, the audience gets the chance to ask any questions they may have. However, the audiences, who are ordinary citizens, don't have enough technical knowledge about the topics, so it is not easy to understand the complicated scientific issues. To help solve the problem, we have been working to develop participatory gaming simulation as educational communication tools. In this paper, we report the findings of an analysis of a science communication trial using participatory gaming simulation that deals with global warming.

**Keywords:** participatory gaming, science communication, citizenship education

## Introduction

Science and technology today has penetrated deeply into all parts of daily life, and the potential impacts of advances in technology are becoming much more significant. Recently, science communication events such as “science cafés” or “science workshops” are becoming increasingly common as a way of communication between scientists and ordinary citizens; however, after starting communication there, we soon face a big gap between the perspective of the specialist and that of the citizen. The aim of this study is to create a new communication space for science communication using participatory gaming simulation, sharing information about risk and benefit influences, and predicting the future. The rest of the paper is organized as follows. Next, in section 2, we give a brief introduction to science communication. Section 3 discusses some hints on how we may achieve better performance in sharing scientific understanding and proposes our communication model, which melds the science communication with participatory gaming simulation. In section 4, we detail the experiments carried out with the results obtained. Finally, in section 5, we present our conclusions and future lines of work.

## 1. The method of science communications

Science communication has been conducted through technical briefings or public education as a way of holding public lectures and symposia in various regions. Usually, communication in current science cafés consists essentially of two parts: presentation by a specialist and subsequent discussion by citizens. However, there are the following problems:

- The specialist is unused to speaking about scientific issues and their backgrounds in *plain words*, so it is difficult for citizens to understand clearly.
- Ordinary citizens have various backgrounds and knowledge, different ages, careers, and academic fields including humanities and sciences. Although there is a possibility to elicit various opinions or ideas, it is not easy to create a common platform for discussion.
- If citizens do not understand the issue sufficiently, they are likely to remain in the role of questioner, while the specialist as speaker is likely to remain the respondent. In this case, it is hard to discuss interactively. It is difficult to compile the collective opinions of all. The point of discussion might sometimes be off track, and it is difficult for both scientists and citizens to digest information about the problem.

In order to solve these problems, we need a new communication method to enable interactive talk on a common platform and easy understanding of the topics or issues.

## 2. Proposal of a communication model

### 2.1 *The aims of the proposal*

In this section, we propose introducing participatory gaming simulation in order to solve these problems. We integrate participatory gaming simulation into the science café or workshop as a communication interface, an *interpreter*, so to speak. Viewpoints of evaluation of communication effects using participatory gaming simulation are as follows:

- Boosting explanation capability  
We handle the simulation by modeling the problem. This enables representation of the problem structure from a scientific perspective and its expression mechanism. This will help reveal the heart of the problematic intersection of scientific problems and social problems easily.
- Sharing the situation of the problem, sharing common understanding  
The backgrounds of the ordinary citizens who attend science cafés or workshops are diverse, so it is difficult to find what can commonly be discussed. Participatory gaming simulation provides *a common base* for understanding and solving problems as scenarios.
- Creation of interactive communication  
The citizens who come to science cafés or workshops meet new people in almost every case, so it is not easy to create opportunities for communication among them. Participatory simulation is expected to play an important role in sharing the structure of a problem, even though it is a pseudo-situation in computational virtual space, and it provides a chance to share the communication base to discuss the problem commonly faced. It enables creation of opportunities for communication among participants.

The aims of this paper are to integrate the method of science communication with participatory gaming simulation, and to realize a pluralistic communication space for both specialists and non-specialists to share problems, which cannot be provided just by traditional means such as science cafés or workshops.

### 2.2 *Related work: using participatory gaming simulation as an interpreter*

Participatory gaming simulation has been used for decision making[1,7], political planning[4], psychological analysis[2] and experiment for social or economic systems[3], educational training[5,6], etc. We have been using participatory gaming simulation for citizenship education[5,6].

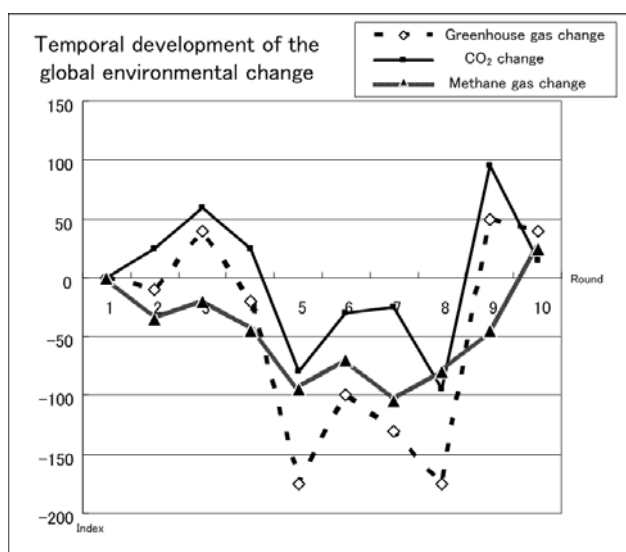
Our idea in this paper is to accomplish science communication by using participatory gaming simulation. This has different roles and ways from the previous simulation method. Our participatory gaming simulation method is used for creating a common understanding base. Business simulations[1,4] are used for understanding the structure of business or for decision making, or evacuation simulations[7] are used for grasping behavior in an evacuation situation and analyzing it. On the other hand, using participatory gaming simulation in science communication aims *to study scientific knowledge and to examine the best relationship between “human society” and “science and engineering” in the future.*

### 3. Trial of the new science café that integrates participatory gaming simulation

In this section, we report the results and discuss the implications of the proposed method. The participants in the trial were undergraduate students, and the topic was “the carbon cycling and global warming.”

First, we handed out materials “*Eco-experiment scenario: Let’s protect our Earth from global warming!*” before conducting the science café. The role of the carbon cycling and photosynthetic microorganisms is described in the handout as an easy scenario. Participatory gaming simulation is used for formulating a common understanding regarding fundamental scientific assumptions. After reading the scenario, we conducted participatory gaming simulation based on the handout. The participants played the role of government regulator, controlled the utilization volume of following three energies: fossil fuel, natural gas (biogas), and biomass energy. The participants planned to grow forest resources and rejuvenate the livestock industry, reconciling economic growth and environmental policies by collaborating with other participants. The participants went through the pseudo-situation of the global warming problem in the participatory simulation. Once every four years (=four game rounds), all participants attended a virtual world meeting to discuss the global warming problem. After the simulation, the facilitator conducted a brief debriefing.

The simulation program can be controlled by interfacing a web page with the Perl & CGI server program that runs on the web server. It sends the participants feedback on the situation data of global warming. Figure 1 shows the transitional changes in the simulated global warming on the earth at the trial. The first round data are taken as the criterion. This shows the change as a corollary of all participants’ activities on the simulated earth.



**Figure 1.** Participatory gaming simulation result (left); Photo of the simulation space (upper right); Photo of the small tetrahedral eco-dice are made by the participants (lower right)

The details of the result are as follows: In the early simulation rounds, global warming was disappearing because of the positive use of the energies. The meeting was held two times; after the 4th round and after the 8th round. In the meeting held after the 4th round, they reached a deal on a joint statement about the greenhouse gas emission target. After that, each participant made a reduction target and cooperated with each other. Therefore, the gas decreased after the 5th round; however, they faced a heavy slump in economic activities. In the meeting held after the 5th round, they reached a deal on a joint statement about the greenhouse gas emission target. However, it was a decision in which each country considered achievement of an economic goal. As a result, the level of warning gas fell.

In the course of the simulation, they discussed the reduction of methane gas, which has a high greenhouse impact. They also made a prediction about the future of the greenhouse gas effect under rejuvenation of the livestock industry. One participant analyzed the data of the simulation using MS-Excel. Active data analysis by the participants seemed to help in understanding the problem's structure and relationship between economic activities and greenhouse gas effects.

After the participatory simulation, the specialists explained not only the role of fossil fuel energy and biofuel but also the role of photosynthetic microorganisms. In this explanation, the specialist introduced the fact that photosynthetic microorganisms with plants who immobilize the CO<sub>2</sub> cycle have the function of heat insulation, and specialists believe that analyzing this role of microorganisms would help prevent global warming.

At the end of the workshop, the participants made a small tetrahedral eco-dice (Figure 1. lower right). The purpose is to promote face-to-face conversation among participants away from the serious environmental situation of the global warming problem. They casually talked about daily environmental awareness and environmental improvements.

We asked the participants for feedback regarding the science café using participatory gaming simulation. Their comments were as follows:

- In the real world, the people usually only focus on the CO<sub>2</sub> level. One of the lessons we learned from the participatory gaming simulation and science communication today was that we have to focus more on the methane gas level.
- Though scientists may be familiar with the greenhouse effect of methane gas due to their scientific background, we are less than familiar with it. We could understand the control structures of the environmental situation easily.
- Careless policy making in one country has considerable influence over other foreign policy decisions. In particular, the overlapping of policy making has a significant impact on global warming problems.
- The international conference held once every four years gave a chance to prevent political abuses in this problem. It also gave a chance to come to grips with environmental problems.
- We could understand the difficulties of policy making and the complexity of taking environmental measures.
- It is not only necessary to reduce the CO<sub>2</sub> level. The global warming problem may be more of a challenge than I thought it would be.

From the results of simulation and previous comments, the following are shown as findings:

- (1) As typified by the understanding of methane gas effects, participatory gaming simulation plays an effective role in gaining a correct understanding of the scientific structure.
- (2) Participatory gaming simulation creates the opportunity for interaction among participants.

- (3) Participatory gaming simulation establishes a comprehensive understanding of the framework of problems. The scope of the problem is addressed not only scientific understanding but also social or political understanding.
- (4) Describing a dynamically reconfigured situation is easy with participatory gaming simulation on a computer. This provides an opportunity for participants to create a conflict or collaborate in policymaking.

The participants' comments range from scientific understanding to social problems. We assume that participatory gaming simulation based on conversation among participants including specialists is excellent in terms of providing diversified viewpoints that at a science café one cannot give. In particular, problems as complex as global warming need multidimensional understanding based on social and political viewpoints. By using participatory simulation, participants try to seek what's going on in the simulation. A fusion of the science café and participatory gaming simulation leads participants to diverse yet profound discussion.

#### 4. Conclusions

We propose a fusion of the science communication method and participatory simulation as a new methodology to share scientific and social problems with specialists and non-specialists. The new methodology has the advantage of not only providing diversified viewpoints but also leading participants to experiential situations that include conflict and collaboration. As a future work, we hope to examine the effects of communication in participatory gaming simulation that gathers many participants, citizens. And we rely on statistics to analyze the effects of the new methodology. At the same time, we hope to explore a more effective way of using the communication model to bridge the gap between science and society.

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