

Improvement of mutual understanding in risk communication by application of a debate support system

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Abstract: Given the recent problem of climate change, nuclear power has become perhaps the world's most important energy source. In Japan, however, it is difficult to build new nuclear facilities. One of the reasons for such difficulty lies in problems in risk communication. In this study, a support method has been proposed to improve mutual understanding in risk communication. The authors paid especial attention at the learning effect of debating and the benefits of employing a debate support system. A laboratory experiment including 30 university students was conducted in order to evaluate the proposed method. Results showed that the use of the system could improve mutual understanding especially with respect to the factors of risk 'reduction measures' and 'accident management'. In addition, it was found that using the system and debating from 'opposite positions' could improve subjective mutual understanding; however, this practice showed no effectiveness in terms of improving objective mutual understanding.

Keyword: risk communication, mutual understanding, debate

1 Introduction

Recently, nuclear power has become perhaps the world's most important energy source, since it is a realistic alternative in the face of climate change. In Japan, however, it is difficult to build not only new nuclear power plants but also disposal facilities for high level radioactive waste (HLW)^[1, 2], which is a product of the nuclear fuel cycle. Part of such difficulty is due to the fact that recent accidents and scandals in nuclear related facilities have made the nuclear industry a source of social dispute. Hence, a key factor to be addressed is the successful communication between the nuclear facility (risk manager) and its neighbors or the general public (risk taker), so called, risk communication.

Risk communication has been a focus of attention and numerous approaches have been developed in a variety of fields^[3]. For example, in issues relating to HLW several risk communication approaches utilizing information technologies have been studied until now^[4,5]. Based on a review of risk communication studies, LEISS, W. has identified three phases in the evolution of risk communication practices^[6]. From phase 1, based on conveying probabilistic thinking to

the general public and phase 2, based on persuasion to change overcautious attitudes, we have arrived at the current phase 3, which emphasizes a two-way communication, sharing of risk information, exchange of opinions among stakeholders and the creation of mutual trust^[7-9]. On the other hand, RENN, O. classifies risk debates into the three levels of conflicts: (i)technical expertise, (ii)experience, trustworthiness and performance, and (iii)social values and world views^[10]. In the third level social disputes of high complexity such as HLW disposal facilities, risk communication is said to need dialogue among stakeholders and the public. In other words, in terms of risk communication, social disputes are supposed to be the result of the lack of dialogue and mutual understanding between the risk manager side and the risk taker side. In most cases of unsuccessful risk communication, risk managers only insist on the merits of their proposal and do not try to understand why do risk takers refuse their plans and oppose to the construction of their facility. In the same way, risk takers only refuse the proposal of risk managers and do not try to understand the reasons for the proponents' plans and the need of such facilities.

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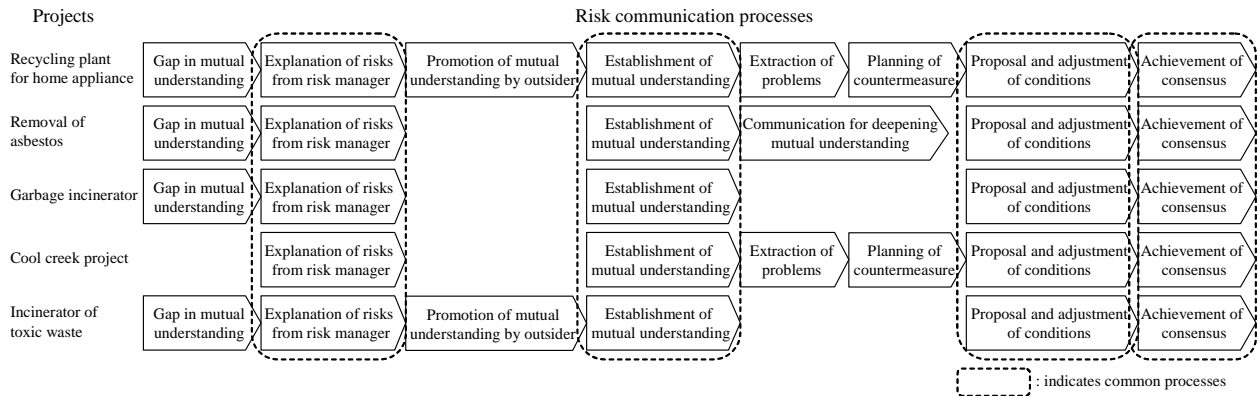


Fig.1 Detail processes of successful risk communications.

In this study, a method to improve mutual understanding in risk communication, which employs a debate game as means to allow logical discussion, has been proposed. In addition, a laboratory experiment was conducted in order to evaluate the fundamental effect of the proposed method.

2 Risk communication and mutual understanding

2.1 Analysis of risk communication cases

For this study, various cases of risk communication were collected and reviewed. Five successful cases^[2,11-14] were chosen, in which various kinds of stakeholders participated. Such cases involved typical social disputes, not only related to the nuclear field. Then, the processes that lead to consensus in each of the cases were analyzed in detail. Fig. 1 shows the analyzed cases and their processes. Based on Fig.1, common processes among them were identified, as shown in Fig.2. It was found that important processes for successful risk communication are:

- (1) Explanation of risks from the risk manager side,
- (2) Establishment of mutual understanding between the risk manager side and the risk taker side,
- (3) Proposal and adjustment of conditions for consensus and
- (4) Achievement of consensus.

Whereas, unsuccessful cases also included the process of explanation of risks by risk managers, they failed at the stage of establishment of mutual understanding. ‘Mutual understanding’ here means that each side recognizes and comprehends the position and opinions of its counterpart. Hence, the reasons behind their failure lay on the lack of understanding between sides

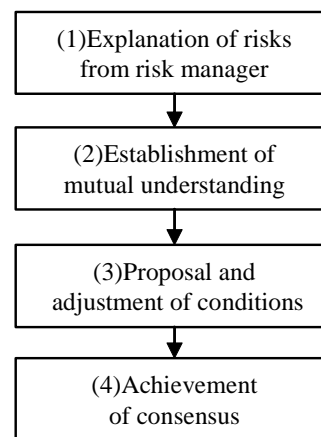


Fig.2 Common processes of successful risk communication.

and/or on the fact that their views and opinions were not conveyed in an adequate or sufficient way. The common phenomena seen in the failed cases is:

- (a) A side does not understand completely why the opposite side takes a given position,
- (b) People cannot express their opinion adequately enough during the discussion,
- (c) The discussion cannot be expedited because of high excitement and
- (d) The discussion heats up and deviates from the point of issue.

The solution to the above problem (a) comes from enhancing the comprehension of the counterpart’s viewpoint. Whereas, for problems (b), (c) and (d), the existence of a mechanism that allows a smooth argument among stakeholders is necessary.

2.2 Mutual understanding

The authors of this study have aimed at constructing a mechanism that achieves mutual understanding, solving the problems mentioned above.

Firstly from the viewpoint of understanding the opposite side, it is necessary not only (i) to understand the position of the opposite side but also (ii) to understand that the opposite side thinks what kind of risk information should be shared. Mutual understanding is indispensable for the latter process of (3) proposal and adjustment of consensus conditions. Successful cases of risk communication indicate that consensus conditions could be roughly categorized into (iii) risk reduction measures and (iv) measures to be taken in cases where there is an external hazard or an accident occurs. Consequently, to achieve mutual understanding:

- (i) Risk managers and risk takers must comprehend the reason why their counterpart takes a given position,
- (ii) They mutually acknowledge what kind of risk information their counterpart thinks must be provided,
- (iii) They mutually understand what kind of risk reduction measures their counterpart thinks are necessary, and
- (iv) They mutually understand what kind of measures their counterpart thinks must be taken if an accident occurs.

These four conditions are therefore considered to be necessary for a successful risk communication.

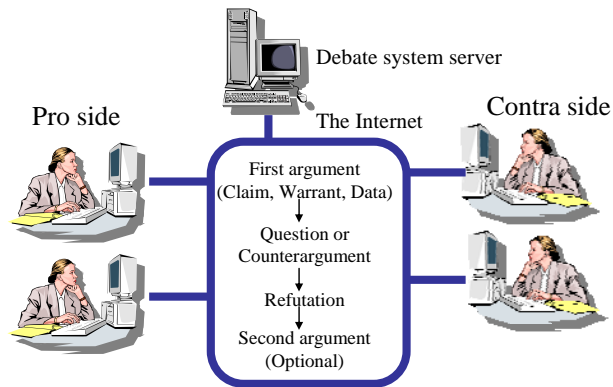
3 Promotion of mutual understanding by a debate support system

In order to promote a logical and smooth discussion in risk communication, the authors explored the possibility of using a PC-based debate support system.

3.1 Original purpose of the debate support system

The debate game format has been widely used as a powerful teaching tool to attract students' interest and let them take an active role in their learning process^[15]. Online debate systems have been introduced in the education field^[16]. The debate support system employed in this study^[17] provides the same type of environment needed to hold a debate through the Internet, as shown in Fig. 3. This system was originally

developed as a tool to complement the knowledge-given type lectures in higher education and to foster students' abilities, such as logical and critical thinking, ability to deal with multiple viewpoints, information ordering and communication.



One to one argument on a given theme

Fig.3 Outline of debate support system.

3.2 Outline of the debate support system

The discussion using the debate support system (from now on referred as 'system debate') is based on two different positions, one of approval (pro side) and one of opposition (contra side) on a given theme. The debate is held by four to six people. Differently from an ordinary face-to-face debate, the participants discuss among each other through an internet browser, such as Microsoft Internet Explorer. The system debate consists of four opportunities to express one's opinion: a first argument, a question or counterargument, a refutation and a second counterargument. In each opportunity, the participants must type their opinions into the browser, in text format.

This system has been used by more than 2,000 students in Kyoto University and in local high schools, and its effectiveness (for education purposes) has been confirmed^[17].

3.3 Promotion of Mutual Understanding

The utilization of this debate support system is proposed as means to promote mutual understanding in situations of risk communication. In such cases, the debate theme is to be set from the main topic of the risk communication, and risk managers and risk takers are set to take pro and contra sides.

Previous experiences with the debate support system have revealed the following effects:

- (1) Gathering the information posted by the counterpart and constructing a counterargument from this information helps one side to better understand the position of the opposite side.
- (2) Not having to state their opinion face-to-face helps some people to express themselves in an easier way.
- (3) The use of a text-based message communication promotes a cool and logical debate; preventing agitated discussions.

Considering the above effects and the four problems of risk communication mentioned in 2.1, it can be seen that problem (a) can be solved by the above effect (1), (b) by (2) and problems (c) and (d) can be solved by (3).

4 Basic evaluation experiment

4.1 Purpose of experiment

Before introducing the debate support system into an actual situation of risk communication, it is necessary to examine the fundamental effect of the proposed method. Therefore, a basic evaluation experiment was conducted so as to investigate the following effects:

- (1) Whether or not the system debate is effective in terms of improving mutual understanding, and
- (2) Whether making risk managers and risk takers to hold the debate from their counterpart's positions promotes mutual understanding further than by letting them debate from their original viewpoints.

4.2 Experimental method

4.2.1 Outline of experimental method

In order to investigate the effects mentioned in 4.1, the following three situations were compared:

- (A) A system debate held by risk managers and risk takers, each from their original positions,
- (B) A system debate held by risk managers and risk takers, each from the opposite position, and
- (C) An ordinary face-to-face debate held by risk managers and risk takers, each from their original positions,

Holding a debate 'from original positions' means that risk managers and risk takers claim their own opinions, while holding it 'from opposite positions' means that they are required to claim and defend the

other side's opinions against their own. The effect (1) mentioned in 4.1 can be examined by comparing the results of the above conditions (A) and (C), while the effect (2) can be determined by comparing the conditions (A) and (B).

4.2.2 Subjects

The subjects of this evaluation experiment were 30 university students (24 males and 6 females, ages from 19 to 23). None of them had experienced the system debate before.

4.2.3 Experimental conditions

Subjects were given some scenarios of risk communication and required to express their own opinions. Then, they were asked to hold a debate under one of the three situations (A), (B) and (C), mentioned in 4.2.1. In other words, the conditions (A), (B) and (C) were independent variables in this experiment.

4.2.4 Scenarios of risk communication

Several scenarios of risk communication, describing a dispute over a given problem, were prepared in advance. Each one included the following information;

- Characteristics and background of the dispute,
- Explanation of the dispute,
- Explanation of the position taken by the risk manager side and some of their reasons,
- Explanation of the position taken by the risk taker side and some of their reasons, and
- Assumed scene of the dispute between risk managers and risk takers.

Table 1 shows the eight different scenarios prepared for this experiment. In addition to the information provided in each of them (as mentioned above), the subjects were required to collect further information themselves, via the Internet. The main topic of each scenario was set as the debate theme.

4.2.5 Questionnaire

In order to examine how mutual understanding changes, before and after a debate and under the conditions mentioned in 4.2.3, three questionnaires were filled by the subjects, before and after each debate.

Table 1 Prepared Scenarios of Risk Communication

Scenario	Content
Disposal facility of HLW	Case of HLW disposal facility to Toyo-cho, Kochi Prefecture, Japan
Nuclear power plants	Promotion or reduction of nuclear power
Construction of wind mills	Installation of a new windmill facility into Shimane Prefecture, Japan
Import of foreign foods	Traceability of all imported food for safety concerns
Disposal facility of industrial waste	Construction of a disposal facility of industrial waste in Ontake-cho, Gifu Prefecture, Japan
Construction of a transmission line	Construction of a 500kV transmission line in Hazu-gun, Aichi Prefecture, Japan
Construction of an airport	Construction of a new airport in Shizuoka Prefecture, Japan
Building of a dam	Building of a new dam on the Kawanabe River in Kumamoto Prefecture, Japan

(1) Prior questionnaire

This questionnaire was prepared in order to examine the degree of mutual understanding before holding a debate. It consisted of the following questions:

- Why is the opposite side against us? (reason)
- What kind of risk information does the opposite side want to be provided with? (risk information)
- What kind of risk reduction measures does the opposite side want to be taken? (reduction measures)
- What kind of measures does the opposite side think must be taken if an accident occurs? (accident management).

The questions above correspond to the four conditions of mutual understanding discussed in 2.2.

(2) Posterior questionnaire

In order to determine if there was a change in mutual understanding after holding a debate, subjects were asked to fill a posterior questionnaire containing the same questions as the prior questionnaire plus the following question:

- After holding the debate, do you think that you have learnt any new points about the issue that you didn't know before the debate?

To answer this question subjects had to choose from a seven grade scale.

(3) Questionnaire of subjective understanding

After holding debates under all the experimental conditions, the subjects were asked to answer the following question for each experimental condition, also on a seven grade scale.

- Do you think that mutual understanding improved after the debate?

They were also asked to describe the reasons why they thought so.

4.2.6 Evaluation method

The improvement of mutual understanding was evaluated from the following two viewpoints:

(1) Objective evaluation

The debates in this experiment were held in groups of four people, two on each side. The answers of both prior and posterior questionnaires filled in by two people of one side were checked by the other two people of the opposite side (their opponents). They were asked to mark an 'X' on the answers that matched their own opinions. And if a matching answer coincided with their main believe, they were asked to mark it with a '1'. By calculating the average number of '1's in the responses to each questionnaire, an improvement in the degree of objective mutual understanding was evaluated.

(2) Subjective evaluation

By calculating the average of positive answers to the question 'Do you think that mutual understanding improved after the debate?' an improvement in the degree of subjective mutual understanding was evaluated.

4.2.7 Experimental procedure

Eight groups of four people were formed from 30 subjects and two experiment assistants. The experiment was conducted over two days, as shown in Fig. 4. On the first day, the groups were given the risk communication scenarios and held a system debate under experimental conditions (A) and (B). These debates were held just as a practice in order for the subjects to get familiarized with the system; so, the results from such debates were not evaluated. On the

second day, debates under conditions (A), (B) and (C) were conducted and prior and posterior questionnaires were answered. Groups 1, 3, 5 and 7 held debates under conditions (A), (B) and (C), in this order; while groups 2, 4, 6 and 8 held them in the following order (B), (A) and (C). This was made so as to cancel ordering effects.

After all the debates were held, the questionnaire for subjective mutual understanding was answered. The details of the procedure under each experimental condition are also shown in Fig. 4.

4.3 Experimental results

(1) Improvement of objective mutual understanding

Figure 5 shows the change of objective mutual understanding before and after the three experimental conditions mentioned in 4.2.6 (1). The graph illustrates a subtraction of the number of most important factors of mutual understanding, before and after the debates, for the answers of all 30 subjects, excluding those of the 2 experiment assistants.

As it can be seen in this figure, for ‘reason’ and ‘risk information’ factors, mutual understanding under condition (C) is higher than under (A) and (B). These

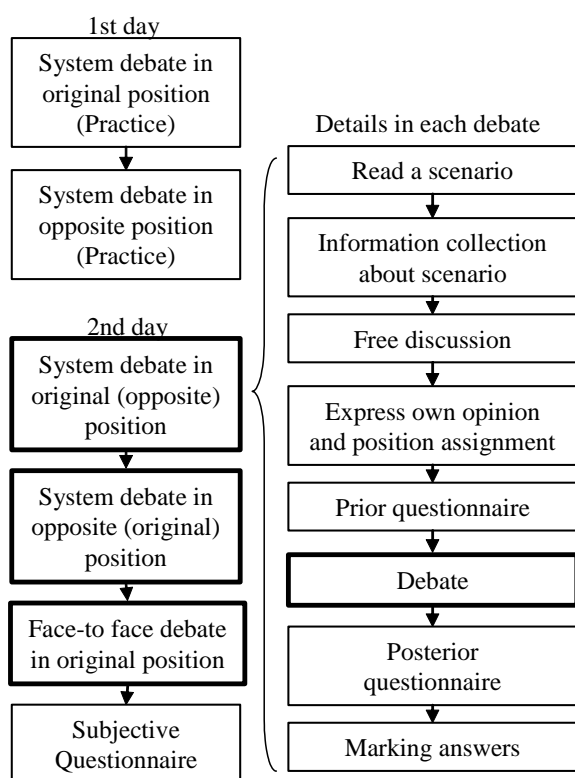


Fig.4 Experimental procedure.

two factors, ‘reason’ and ‘risk information’, were the main topics of the debates held under all the conditions. The reason for this result is thought to be that in an oral face-to-face debate more information can be communicated than in the text-based system debate, and also because the face-to-face style of debate allows for non-verbal communication, such as facial expressions and gestures. On the other hand, ‘reduction measures’ and ‘accident management’ were rarely main topics, especially in the face-to-face debates. It is supposed that the risk taker side tended to avoid these topics because they may imply the acceptance of the risk by the risk taker side.

(2) Improvement of subjective mutual understanding

Figure 6 shows the subjective mutual understanding of the three experimental conditions. The graph shows the average of each experimental condition, as mentioned in 4.2.6 (2).

4.4 Discussion

First, in order to examine the improvement effect of the system debate, the results of experimental

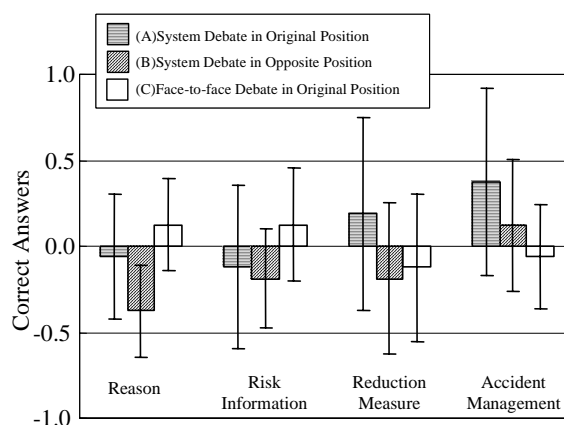


Fig.5 Results of objective mutual understanding.

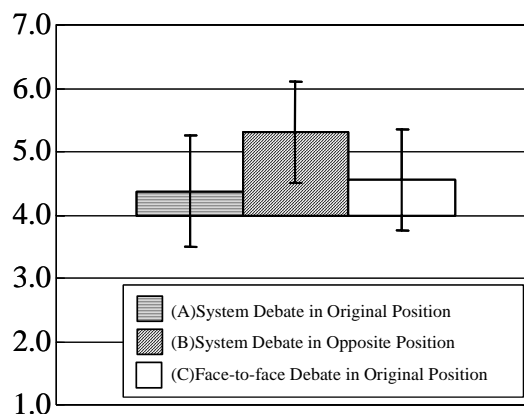


Fig.6 Results of subjective mutual understanding.

conditions (A) and (C) were compared. Results showed an improvement in objective mutual understanding for the factors of ‘reduction measures’ and ‘accident management’. Here, the system debate seems more effective than the face-to-face debate. However, the opposite occurs for the factors of ‘reason’ and ‘risk information’. An analysis of the debate records showed that arguments based on scientific information were more abundant in system debates than in face-to-face debates. Also, arguments regarding the factors of ‘reason’ and ‘risk information’ appeared less in system debates.

In terms of improvement of subjective mutual understanding, there was no significant difference between the system debate (A) and the face-to-face debate (C), as shown in Fig. 6.

In order to examine the improvement effect of holding the system debate from different standpoints, the results of experimental conditions (A) and (B) were compared. It was found that all the factors of mutual understanding were higher when the sides held the debate from their original positions (condition A), than when they did it from opposite positions (condition B). Furthermore, the degree of objective mutual understanding when debating from opposite positions sometimes decreased after the debate. The reason is supposed that, under this form of debate, each side had no chance to know directly the opinions of the opposite side.

However, the degree of subjective mutual understanding when debating from opposite positions (condition B) was higher than from original positions (condition A). The reason of this is supposed that each side might have erroneously thought that they understood the opposite side’s viewpoint.

5 Concluding remarks

In this study, a method to improve mutual understanding for a successful risk communication has been proposed. This method employs a debate support system as a discussion tool. In the laboratory experiment, conducted to evaluate the fundamental effect of the proposed method, three debate conditions were compared: (A)holding a debate using the debate support system and with each side debating from their

original positions, (B)holding a debate using the debate support system and with each side debating from opposite positions, and (C)holding an ordinary face-to-face debate, with each side debating from original positions. Results showed that holding a debate under condition (B) did not improve objective mutual understanding but did improve subjective mutual understanding, whereas holding it under condition (A) improved objective mutual understanding.

Lastly, there will be three issues described below, from the presented works of the authors for further study of risk communications.

(1) It is said that a successful risk communication needs to establish mutual trust^[7-9]. For this purpose, it is important to foster a positive disposition to understand the reasons of the opposite side. Given that holding a debate under condition (B) improved subjective mutual understanding, this practice might be helpful in terms of generating an attitude that leads to the establishment of mutual trust.

(2) This study also showed that a debate involving several stakeholders improves mutual understanding. Since in cases of risk communication in real social disputes the number of stakeholders is normally high, in order to apply this proposal to such cases, either (i)opinion leaders as representatives must conduct a system debate and the content of such discussion is open to the stakeholders via Internet, or (ii)plural groups are arranged and they conduct system debates among them.

(3) From a psychological viewpoint, “understanding” has not only a logical side but also an emotional side. This means that the emotional factor should also be considered in an actual situation of risk communication. Since this study mainly focuses on the logical side, the emotional side should be treated in a further study.

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