

OUTREACH ACTIVITIES FOR SCHOOL EDUCATION BY SCIENCE MUSEUM

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Abstract

National Museum of Emerging Science and Innovation (Miraikan) has studied on achievements and problems of on-site lectures as conventional outreach activities especially concerning cutting-edge science and technology by researchers and museums, to develop a new model of outreach activity. A new type of on-site lecture has been developed and implemented by collaboration of the staff from Miraikan and junior high school teachers. This reveals some problems to be considered for more effective outreach activities.

Keywords: Science communicator, Outreach activity, On-site lecture, Science museum, School education

1. Introduction

Science and technology is essential in every scene in modern societies, however, on the other hand, there have been strong indications that younger generation is moving away from the sciences in Japan. This is recognized as a serious educational issue, and the Government puts an emphasis on science education at schools as well as the training of science communicators and the improvement of science literacy.

At the same time, the decrease of interest in science and technology has been recognized as a serious problem in education, and the improvement of science literacy in society, as well as the necessity of human resources development in science and technology, became one of the most important policies. In particular, science education in schools has been focused on as the significant first step in stopping young people moving away from the science. Schools are socially and politically required to perform unique educational activities for this purpose. Visiting museums and research institutes including fieldworks is considered as an effective activity to attract students' interest in science, but its financial and time constraints also often prevent schools from such activities.

In addition, the importance of outreach activities to convey scientific information to society by those who are involved in science and technology, such as researchers and museum staff, has been emphasized, and many universities and research institutes give extension lectures and open campus, and science museums organize science events. Under the circumstances, schools have been increasingly having the opportunities for invited lectures by researchers from universities and research institutes. However, such invited lectures are often too difficult for students to understand, which is useful to show them the profiles of researchers and their jobs, but is not necessarily give them scientific experiences.

This paper introduces the new model of outreach activity contributory to school education by Miraikan as a center of science communication activity, including its practice and problems to be found.

2. On-site Lectures as Outreach Activity

In Japan, Ministry of Education, Culture, Sports, Science and Technology (MEXT) has launched the new curriculum guideline for junior high schools in 2003, where various special plans are also introduced to enhance the students' intellectual curiosity and inquiring mind and to bring them scientific aspects. These plans put emphasis on observations and experiments, including development of new teaching methods and educational materials, on-site lectures researchers from universities, and collaboration with schools and local museums. This requires schools to be more enthusiastic for utilizing new teaching methods and materials.

Based on such social and political context, many organizations, including universities, research institutes, academic societies, museums, companies and NPOs, have been working on providing on-site lectures at schools to achieve some positive results. But in some cases, these lectures are used as opportunities to introduce their organizations.

Looking at on-site lectures focusing on motivating students' interests in science, most organizations provide their specialized subject as packaged lectures. These packaged lectures often have characteristics as science events given as special lectures out of regular educational curriculum. Such on-site lectures can offer students good opportunities to increase their interests in sciences by seeing lectures and experiments by specialists, however, some problems are also pointed out as below;

- 1) Most on-site lectures are already packaged as an isolated event with less direct links with regular science classes, so that it is difficult for students to see the connection between lectures and their daily lives.
- 2) The packaged lectures are hard to include demands from school teachers, so that they cannot take useful information for the regular classes from the lectures.

Miraikan has been playing an important role as a base for PUR (public understanding of research) activities since its establishment in 2001, and working on science communication activities, including on-site lectures, linking with various groups in society such as researchers and engineers, the media, museum visitors, government offices, schools, and museums. Also, Miraikan has been engaged in training science communicators who practice science communication activities, offering training programs for internal staff including those who develop and interpret scientific exhibits and events, and external personnel such as researchers, graduate students, school teachers, and museum staff. In particular, we took four school science teachers in and give them a training program through a year, to increase their skills as science communicators and return it to their educational activities.

With the above background, Miraikan has developed and practiced a new style of on-site lecture as one of our outreach activities aiming to rebuild conventional on-site lectures with teachers' aspect, and to improve it to have a closer relation to regular school class by collaboration with our staff and school teachers.

3. On-site Lecture as New Model of Outreach Activity

We have positioned this new style of on-site lecture as a Miraikan's new model of outreach activity. In this lecture, a staff science communicator of Miraikan plays a role as a bridge between researchers and students, and the school teachers proactively participate in designing the lecture as a part of their regular curriculum, so that students can see science and researchers to be familiar to their lives. For this purpose, following points were particularly focused on;

- 1) To increase students' interests in sciences with wider view for society and people, by showing them the fascination and potential applications of research activities from the scientists engaged in cutting-edge researches,
- 2) To suggest students the practical connections between research activities and science classes at school by using on-site lectures as the introduction of a specific subject, and
- 3) To provide school teachers the opportunities to rediscover the fascination of science and the information on latest research trend to be utilized in regular classes.

One of the features of this lecture is the collaboration of Miraikan, school teachers and researchers. Miraikan has staff called 'Interpreters' who are trained science communicators specialized in oral presentation for the exhibits and communication with visitors, and an Interpreter plays a role as a lecturer at the on-site lecture which is one of the features of this collaboration. Another feature is the presence of a coordinator as intermediary between an interpreter and teachers to share information and organize classes at school. A science teacher of junior high school sent to Miraikan for one year by the school board to take a training program for science communicators participated as a coordinator, and earth science was chosen as the subject of the on-site lecture in this case.

The preparation of the on-site lecture took three months according to the following procedure; Firstly, the Interpreter studied on the cutting-edge researches in earth science focusing on volcano and lava by interviewing researchers at universities and research institutes. Then based on the information from the study by the Interpreter, including latest topics and messages from researchers, the structure of the lecture was planned by a school teacher, which was finalized through discussions between the Interpreter, a school teachers and a coordinator. Unlike conventional packaged lectures depending on the lecturer's specialty, the lecture was designed to be an introduction of the specific subject on volcano taught in regular science curriculum at schools.

This new style of on-site lecture is expected to be effective for students in following aspects;

- 1) To stimulate their interests in cutting-edge science and technology including research activities,
- 2) To impress them with the link between cutting-edge science and basic science in textbook, and
- 3) To give them familiar images to science and researchers.

4. Implementation of New Model of Outreach Activity

This new style of on-site lecture, as a new model of outreach activity by Miraikan, was carried out on 7 and 8 February 2006 at Kawaguchi Municipal Junior High School as an introductory part of 15 hour curriculum over 5 weeks of earth science for six classes of seventh grade including 217 students. The lecture was given in team teaching style by the Interpreter and a school teacher (see Fig. 1).

In order to analyze the effect of the on-site lecture as a new model of outreach activity, the questionnaire surveys to students were carried out before, right after, and five weeks after the lecture.

The lecture consisted of following topics;

- 1) Self-introduction of the lecturer including her motivation and particular interest in studying volcano,
- 2) Showing a video on volcanic activities and some stone specimens,
- 3) Experiments on the properties and components in stones and discussions,

- 4) Showing photos of laboratories and researchers and introducing their activities, and
- 5) Introducing latest topics on volcanic researches and their potential applications.



Fig. 1 On-site lecture by an Interpreter and a school teacher at a junior high school

5. Effect of New Model of Outreach Activity

According to the collective impression of the on-site lecture by students, the on-site lecture included too many topics to absorb immediately for some students. However, the topics introduced in the lecture were brought up through the regular curriculum by school teachers, so that the students could eventually understand difficult topics. This may be a good chance for them to experience the joy in learning.

The results of the questionnaire surveys indicate some points concerning this new model of outreach activity. Here, the attainment of each aspect of this lecture is analyzed.

5.1 Interest in Science and Technology

In this on-site lecture, the scientific topic was focused on volcano especially lava. Fig. 2 suggests that the students' interest was obviously influenced by the topic dealt in the lecture. Also, 53 students out of 71 who answered 'unchanged' five weeks after the on-site lecture were already interested in volcano in the previous questionnaire. Most of students became interested in volcano throughout the curriculum, which means that the whole educational curriculum including the on-site lecture was successful to attract their interests in this topic.

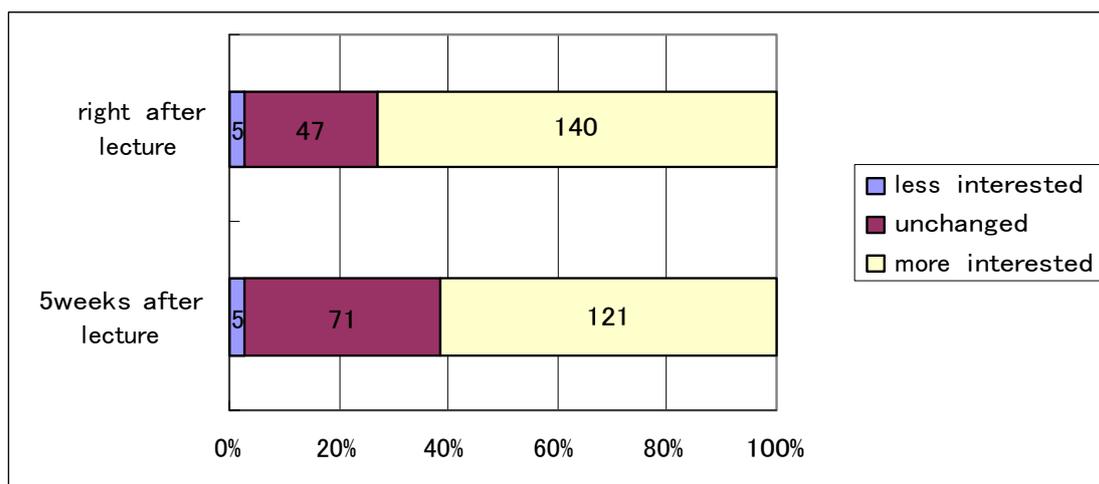


Fig. 2 How has your interest in volcano changed?

Furthermore, as shown in Fig. 3, approximately 30% of students carried out some searching activities on volcano after the on-site lecture. Including the students who intend to carry out these activities, nearly half of the students showed interest in this topic.

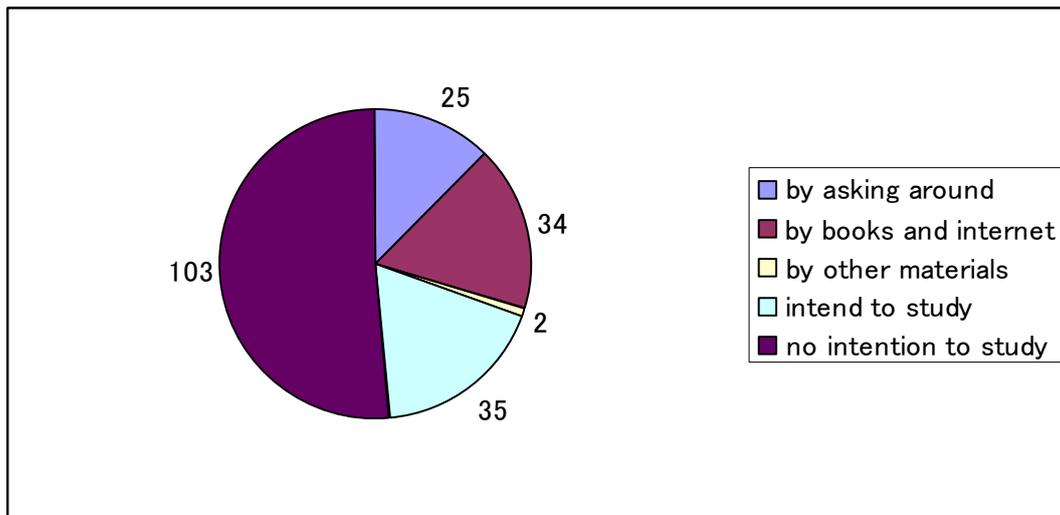


Fig. 3 Have you studied on volcano by yourself after the lecture?

5.2 Link Between Cutting-edge Science and Textbook

Fig. 4 shows that most students are recognized that cutting-edge science is based on the subject taught in the textbook. This means that such a new style of on-site lecture can be quite effective as the introduction of the regular educational curriculum. However, for more reasonable analysis, it is necessary to carry out a long-term observation on this issue.

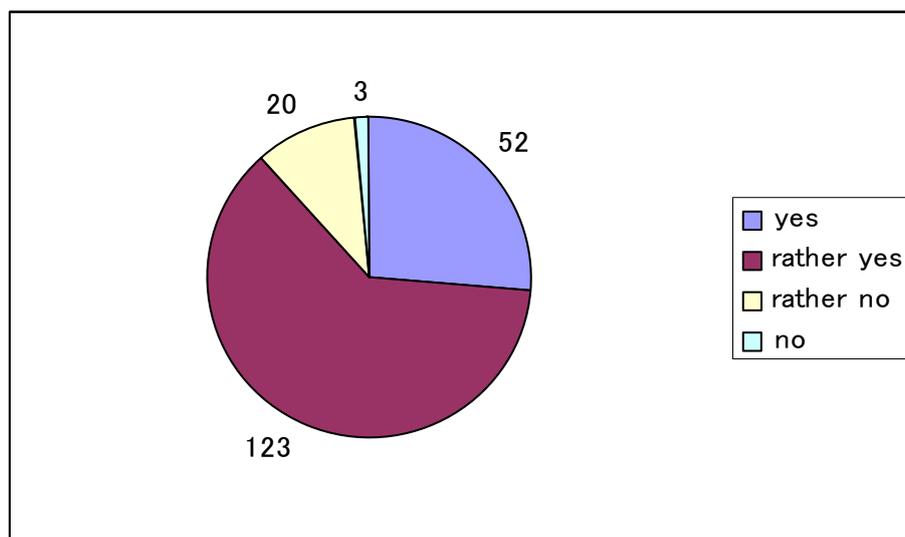


Fig. 4 Do you think the topics in on-site lecture is based on the subject in textbook?

5.3 Affinity to Research Activities and Researchers

Most students basically have high interests in volcano and earthquake. This is because Japan has been having many earthquakes including recent serious disasters so that they can recognize it as a familiar issue. So their interests tend to be focused on the phenomena of eruption and earthquake and the disaster prevention information, but not on research activities and researchers to give them those information. This suggests that students feel unfamiliar with researchers and they pay little attention to them and their technologies, even though they use the products based on these technologies. However, after the on-site lecture, the number of students interested in researchers was increased as mentioned above. This means that students felt familiar with research activities and researchers by seeing and hearing the real story of them through the lecture (see Fig. 5).

However, Fig. 5 also suggests that the students with less interest in researchers have lost their interests further over the entire curriculum, while the positive interests in researchers seems to be abided. This may be because the opportunities to think of researchers have been lost as the curriculum proceeded. In order to maintain or stimulate their interests in researchers, it is necessary for teachers to try to bring up the topic on researchers in classes occasionally.

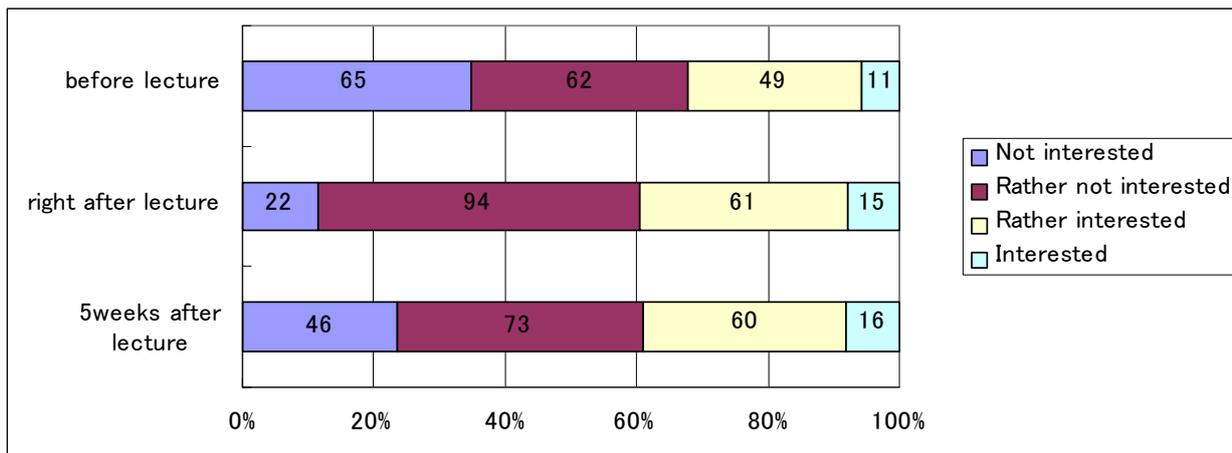


Fig. 5 Are you interested in volcano scientists?

The results of other questionnaires suggested that this on-site lecture was effective to give students clear ideas on their interests in the topic to stimulate them to explore on volcano and earthquake by themselves. This means that students had an experience through the lecture that having more knowledge makes them to study deeper.

Also, the survey revealed that most students do not pay much attentions to the scientific topics in their daily lives other than volcano and earthquakes. This suggests that they do not have many opportunities to feel and think about the link between their own lives and science. Therefore, it is important to bring topical subjects in science with high social interests to the science classes in school, including the introduction of researchers engaged in such subjects and the comparison between approaching methods to the research field.

Fig. 6 indicates that the students were impressed by the enjoyment of research activities as well as volcano itself. This is considered that the on-site lecture successfully presented the importance of seeing genuine research activities. Furthermore, many students still have strong impression of the topics talked in the on-site lecture even after 5 weeks after the lecture. It is necessary to emphasize that the scientific curiosity leads to cutting-edge research activities in the future classes.

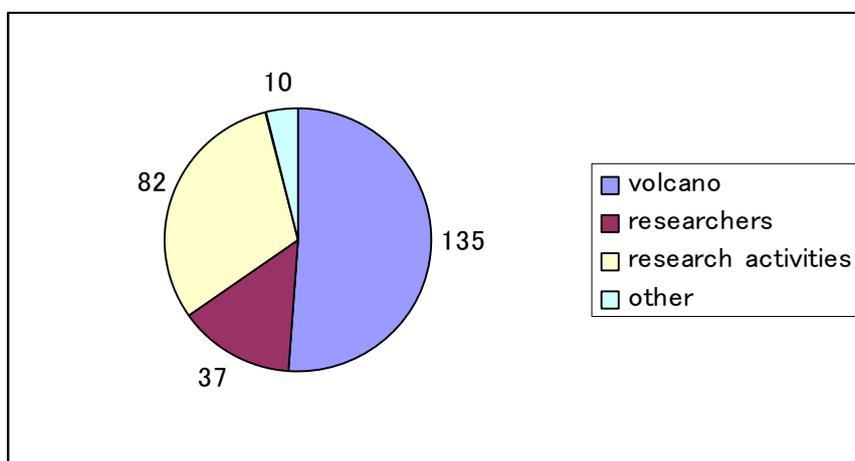


Fig. 6 What was most impressive topic in on-site lecture?

Above all, it is considered that this new style of on-site lecture is effective in terms of increase of scientific interests and close felling to researchers, and changes of images towards research activities. However, it should be mentioned that a long-term survey is necessary to see the changes in the awareness of the link between cutting-edge science and technology and basic knowledge in textbooks.

6. Discussions

It is clear that the new model of outreach activity by an on-site lecture gave school teachers an opportunity to get useful information on earth sciences including experimental methods and educational materials. However, some problems are also pointed out by teachers as follows;

6.1 Preliminary Studies

Since this on-site lecture is designed as a new model of outreach activities, its objective is to introduce the cutting-edge science and researchers to students and teachers in an easy-to-understand manner, and to increase their interests and understanding in science. Therefore, it is important to select topical or controversial issues in the lecture and to study several research institutes or researchers with their cooperation for comprehensive and objective information collection. Also the study should include the information to be used throughout the regular classes by teachers, such as scientific information, messages from researchers, problems to be solved in the research.

6.2 Preparation Procedure

During the preparation of the lecture, the Interpreter had to do their regular tasks in Miraikan as well. This makes it difficult to spend enough time for preliminary study for the lecture, which prevented to have time to examine the collected information and organize it effectively. The examination of the information is essential work for the lecture, so it is necessary to establish the internal system of Miraikan for the Interpreter to spend more time for the study.

Also, since there are various elements in the on-site lecture including the activities by students, the time allocation for these elements varies in each lecture. Flexible time allocation is a key to a successful lecture, which requires good experience of school teachers and cooperation between the Interpreter and a teacher during the lecture. And for this purpose, it is necessary to provide the adequate time to rehearse the lecture thoroughly beforehand.

6.3 Participation of the Interpreter, School Teachers and a Coordinator

As this on-site lecture involves an Interpreter as a main lecturer, a school teacher as an assistant lecturer, and a coordinator who organizes all participants in this activity, it is important to clear the role-sharing among them.

The role of an Interpreter is to study the cutting-edge science and technology and to introduce it to students using their experience as a researcher. And school teachers should plan the structure of the lecture including scientific topics to be dealt and the link to the regular classes, based on the school environment. A coordinator plays an important role as a bridge between them, by understanding the objective of the lecture and supporting to design the effective lecture. This kind of tasks requires considerable experience and knowledge in teaching and schools, so that an experienced teacher is considered to be suitable for a coordinator.

The whole process to develop this on-site lecture is expected to be a good training opportunity for these participants to improve their science communication skills such as presentation, communication, research and management skills.

6.4 Systematic cooperation with school

In this case, a school teacher participated in the preparation and implementation of the lecture on personal activity basis, however, teachers are often under a temporal constraint within the school activities. In order to implement this kind of activity in effective manner, the systematic cooperation from school is essential. This would be a great help for the smooth implementation of the lecture.

The important objective of this outreach activity is not to give a science event but to enhance educational effect on students. Therefore, it is necessary to investigate the educational effect by this activity including a long-term survey. Also the implementation of this kind of lectures on regular basis is expected to be effective to increase and maintain the students' interests in science. This requires to fit the on-site lectures in the annual regular class schedule in advance.

7. Conclusion

In general, this new type of on-site lecture was revealed to be an efficient educational measure to stimulate students' interests in science and researchers. This may bring greater effects not only on the students but also on the participants in this lecture with careful following up throughout the curriculum by school teachers.

To reflect the results of the implementation described above, it is necessary to improve the new model of outreach activity using on-site lecture to make it more effective program.

It is quite difficult to measure essential educational effects of this new model of on-site lecture though, it is possible to evaluate some aspects. Long-term questionnaire surveys for the students on regular and systematic basis may indicate changes in their impressions and interests in science, for example, the comparison between students who took on-site lecture and who did not.

In such long-term and systematic surveys at schools, it is essential to clear some issues, such as arranging time schedules of classes and financial matters, and to establish the cooperative structure by school teachers. And for this sake, it is desired to prove the effectiveness of such activities and to improve the lecture to be valuable for both students and teachers.

It is meaningful for Miraikan, as a science museum with close cooperative relationships with schools and research institutes, and with a social function as an educational institute for science communicators, to work on this kind of on-site lecture as one of outreach activities. These activities need to be provided continuously in order to enhance educational effect as well as to increase training efficiency for science communicators, thus, considering the information from this on-site lecture described above, the implementation procedure and operation system within Miraikan and between schools and research institutes should be established in the future.