Introduction of Supporting Framework for Motivated High School Students’ Research Activity on Environment Safety and Risk

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The purpose of this study is to introduce a developed supporting framework for research activities on environment safety and risks conducted by motivated young people. This study focuses on the next generation of researchers: high school students who are in the latter part of their secondary education, and are at the stage of development in which abilities so vital to conducting independent survey research such as thinking and acting independently are nurtured. In addition, young people must learn to discuss their research topics with colleagues, and to be able to announce their findings before specialists and the public. This framework intends to cultivate human resources for science and technology in Japan.

In 2013, six participating schools conducted research and seven schools in 2014. Compared to conventional frameworks, this framework provides flexibility for student activities that leads to difficulties. The essential purpose and valuable experience of this framework are that students find difficulties think how to overcome them, to make adjustments for their activities based on their own action, and judge suitability of their plans before implementing them. This whole process enables students to acquire how to learn, how to undertake to solve real problems, and how to experience the evaluation of research achievement.

**Keywords:** Supporting Framework, High School Student, Research Activity, Environment Safety and Risk

1 Introduction

In safety education at the high school level, knowledge-acquiring/manual-obeying type education broadly used in industry as applied education of industrial health and safety, or as disciplinary training education conventionally conducted¹. However, these types of conventional safety education are essentially different from encouraging education in which young people undertake research and development enthusiastically and challengingly. We insist that human development for core personnel in charge of science and technology should include motivation, consideration, and implementation of environment and safety in the learning process of research and development. Also, we consider that this human development cultivates “risk management ability” for protecting oneself and “accident avoiding ability” based on safety and security for sustainable development of humans, environment, and society.

We show the consideration process which reached to installation of a human development tool as a package on a trial basis, and introduce the overview of the last two years’ experiences of the installation. This study describes an educational framework for solving such as issues, and expresses some ideas for future prospects.

2 Details of a Supporting Framework

Compared with the conventional framework, the practical framework of this study is designed to support research activities for highly-motivated high school students: 1) decide a research theme on environment safety and risks for their research activity by themselves, 2) conduct research activity independently, 3) summarize the results into reports, 4) make presentations of the results in a public forum, and 5) exchange opinions with colleagues and others. This framework started in 2013 and is now in its second year.

Participating high schools are chosen from among applicants on broad themes related to designated themes of environment safety and risks: “Chemical Substances”, “Bioscience”, “Radiation”, and “Others.” The high school students first independently determine their theme related to one of the broad themes of “Usage”, “Safety”, “Risk”, or “Management”. The activities were scheduled for one-year projects (Figure 1) from April to March. The students

![Figure 1](https://example.com/figure1.png)
must submit interim and final reports, and some excellent schools are selected based on the report evaluations by a review committee. The schools selected are then invited to participate in the Excellent Schools Research Forum (open to the public) and a facility tour of The University of Tokyo at the end of the academic year. Some financial support is provided to participating schools to fund their research activities and the students may use the funds to conduct their research activities according to their own student-developed plan. This funding for the schools and other expenses comes entirely from contributions of sponsoring companies, organizations, and associations (10 sponsors in 2013, and 14 in 2014).

In this framework, six participating schools conducted research projects in 2013 and seven schools in 2014. The research topics are shown in Table 1. Some schools participated as a part of after-school club activity, and others join this framework from their own motive.

In this framework, independent research activities were enthusiastically conducted and the forum was highlighted by active presentations and lively exchanges of opinions. The students were required to accentuate their abilities to think creatively and take initiative to act, not knowledge acquisition abilities. And, in addition, students were basically required to organize all activities by themselves. Although a teacher in charge of each school and a mentor who was appropriate to the research theme was assigned to each school, neither of them was allowed to give inductive leading to the students.

After the midterm report this year, some characteristic points of this framework were clarified. This framework allows participating students to focus on any issue that the students want to select as their topics, to comprise their members students from more than two schools, and to use the funding for anything related to this activity. The topics do not necessarily scientifically right, but need to be selected according to student interests. The degrees of freedom in this framework can lead to difficulties; however, the freedom is an essential purpose and valuable experience of this framework. That is, in each of their actions, students discover difficulties, need to think how to overcome them, and to make adjustments for their activities. Students also need to judge their plans appropriate and safe before implementing. These processes enable students to acquire how to learn, and how to solve real problems, and to experience the evaluation of not the research achievement but the ways of effort.

The winning team in 2013 selected the topic on “power generation by radiation” which seemed to reject other conventional frameworks because of its no-feasibility in technically. However, the students of the team realized their misconception through self-directed learning of their research. After that, the team leader showed more interest in radiation fields and majored in radiation in the university. In the next year, the younger students of them continued the same stream of research in this framework.

Table 1  Research titles in 2013 and 2014

<table>
<thead>
<tr>
<th>2013 Titles</th>
<th>2014 Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Water quality survey on Tama River by COD and Nitrogen sulfate</td>
<td>1 Challenge for power generation by radiation - Improvement of efficiency and use of decay heat -</td>
</tr>
<tr>
<td>2 Safety of genetically engineered foods</td>
<td>2 Comparison of personal radiation dose around Fukushima</td>
</tr>
<tr>
<td>3 Measurement of the concentration of heavy metal in soil of Yodo River</td>
<td>3 Process analysis from rain water to river water</td>
</tr>
<tr>
<td>4 Society for coexistence with detergents</td>
<td>4 Measurement of radioactive material and effect of radiation in spring water</td>
</tr>
<tr>
<td>5 Challenge for power generation by radiation</td>
<td>5 Risk assessment and road safety on bicycle</td>
</tr>
<tr>
<td>6-1 Development of unmanned submarine and measurement of gamma rays</td>
<td>6 Actual state and issues on rare metals</td>
</tr>
<tr>
<td>6-2 Measurement of aerial radiation</td>
<td>7 Effects of ultraviolet ray on Euglenophyceae - UV-C resistance -</td>
</tr>
</tbody>
</table>

3 Conclusion

This study reported a developed supporting framework for research activities on environment safety and risks conducted by motivated young people. This educational framework was a challenge that aimed for a qualitative shift on education from passive learning to active learning.

As secondary effects of this framework, we would like to emphasize the merit of supporting industries and academia such as the interaction with Company/University Social Responsibility, and to expand the view of social contribution of supporters for collecting more participants, human and financial supports.

The activities and results of this framework are posted at the website of REHSE (http://rehse2007.com/koukousei_Shien.html).

4 Acknowledgement

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References