Development and Application of Teaching Materials for Ocean using JOISS

MIRINAE KIM, TAEYOON SONG, MINYOUNG KIM
KESTI(Korea Environmental Science & Technology Institute, Inc.)

Introduction

Recently, it has been a trend to provide teaching methods for students to collect and analyze data. While collecting and processing scientific data are also a necessary capability(data literacy) for students in the fourth industrial revolution, there are few textbooks using marine observation data. If students use marine education textbooks with observed data, they will be able to more easily improve their understanding and interest. Also, in 2020, many schools switched to online classes because of COVID-19 pandemic and online classes need more material to support the online classes. Thus, it is necessary to develop teaching materials for ocean that is suitable as materials that reflects the goals, contents, and achievement standards of the curriculum.

In this study, we aim to introduce the contents of teaching materials for the curriculum using the marine data provided by JOISS and analyze the results of applying them.

Methodology

- JOISS(https://joiss.kr)

JOISS is a portal that collects and provides marine research data in Korea, and students will be able to easily access the data that fit the subject of the class at JOISS.

- Development of teaching materials for Ocean

In order to develop teaching materials, we analyzed each subject with 16 middle and high school teachers and extracted the contents related to the ocean. Extracted contents were divided into 5 parts: marine physics, marine chemistry, marine biology, marine geology· geophysics and marine weather. The teaching materials were developed by selecting themes suitable for each part and reviewing the JOISS data for the themes. The developed materials was demonstrated at each school to identify advantages and disadvantages, and evaluated whether materials were applied to the class. There were three workshops for exchange of opinions to develop teaching materials.

- Development of education application

The user interactive education web apps that can be used in class was developed by selecting representative themes that are common themes of middle and high school curriculum. These apps were developed in R using Shiny, an application building package.

Results

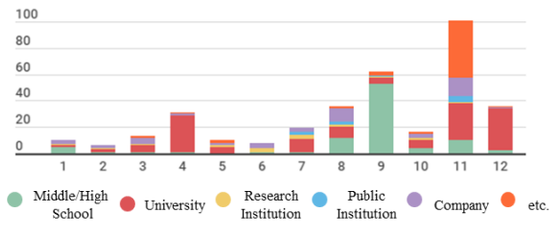
We developed teaching materials for a total of 31 themes: 11 marine physics, 7 marine chemistry, 5 marine biology, 3 marine geology/geophysics and 5 marine weather. The contents of the materials consist of 1) outline, 2) open thinking, 3) using JOISS, 4) inquiry activities, 5) result report and 6) reference.

The developed materials have been distributed as a booklet to all middle and high schools located in Incheon Metropolitan City, and JOISS has been providing these materials since 2017, so every users can easily obtain them on the web. Several workshops for earth science teachers were held to encourage classes using these materials and some of them were published in related reference books for teachers.

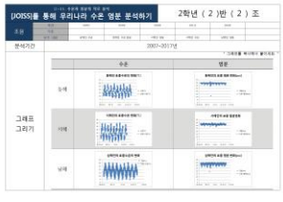
Several schools had classes using these material according to the curriculum. The overview of the class is as follows.

No.	Process	Summary
1	Open Thinking	Teachers arouse students' interest in the subject of inquiry.
2	Using JOISS	Teachers tell how to search and download ocean observed data related to the subject of inquiry from JOISS.
3	Inquiry Activities	Students solve problems on the subject of inquiry by processing and analyzing the downloaded data from JOISS.
4	Result Report	Students write a report on the results of inquiry activities and the teachers score and evaluate them.

As of December 2020, 716 students and teachers from 55 schools joined JOISS and took a class using JOISS. As a result of analyzing the new JOISS members in 2020, about 26% of new members are belong to middle and high schools and they joined to use teaching materials and JOISS owing to their classes. With the start of the second semester, one content in Science Inquiry Experiment course, 'Identifying the trends of climate change on the Korean peninsula', made increase of new student membership in JOISS from the end of August to September.



Developed materials are highly utilized in curriculums that use water temperature and salinity, such as 'Identifying the trend of climate change on the Korean Peninsula' or 'The property of seawater'. In the class on the climate change, students can download the water temperature and salinity data around Korea for 30 years from JOISS and draw a time series graph with trend line to interpret data. In the class on the nature of seawater, it is easy for students to understand the thermocline by drawing a graph from the vertical water temperature and analyzing the seasonal variations of water temperature by depth.



For popular themes of developed materials, JOISS has developed a user interactive education web application so that users can draw and analyze graphs on the web without downloading data. This education app in JOISS is used in online classes due to COVID-19 pandemic.

Conclusion

There is an increasing demand for developed teaching materials all over the country, starting with Incheon. These materials can enhance the intellectual curiosity and creativity of students and teachers, and the load on teachers will be reduced by developing the ocean inquiry activities. In addition, the experience of using ocean data can influence students' career into the marine field. Recently, the prevalence of smartphones and tablet PCs has increased. If education web application is developed for mobile, it is expected that the demand will increase because of its better accessibility. Therefore, major themes will be developed as mobile applications for supporting classes.

Acknowledgments

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