

Web-GIS based Outdoor Education Program for Junior High Schools

Noriyoshi Hosoya and Kayoko Yamamoto

Abstract—This study, focusing on the importance of encouraging outdoor activities for children, aims to propose and implement a Web-GIS based outdoor education program for junior high schools, which will then be evaluated by users. Specifically, for the purpose of improved outdoor activities in the junior high school education, the outdoor education program, with chiefly using the Web-GIS that provides a good information provision and sharing tool, is proposed and implemented before being evaluated by users. The conclusion of this study can be summarized in the following two points.

- (1) A five -step outdoor education program based on Web-GIS was proposed for a “second school” at junior high schools that was then implemented before being evaluated by teachers as users.
- (2) Based on the results of evaluation by teachers, it was clear that the general operation of Web-GIS based outdoor education program with them only is difficult due to their lack of knowledge regarding Web-GIS and that support staff who can effectively utilize Web-GIS are essential.

Keywords—Outdoor Education, Web-Based GIS (Geographical Information Systems), Junior High Schools, School Education

I. INTRODUCTION

URBANIZATION in recent years has reduced opportunities and places for children to have contact with nature while playing in everyday life. The Environmental Education Promotion Law (2004) was enacted to promote outdoor education as environmental education. This law proposes the enhancement of outdoor education to promote environmental education for a sustainable society and to raise peoples' consciousness about environmental conservation. Furthermore, the School Education Law, as revised in 2007, includes “encouraging outdoor activities”. Thus, the three ministries of Education, Culture, Sports, Science and Technology, Agriculture, Forestry and Fisheries, and Internal Affairs and Communications started the “Project for Interaction in Farming and Fishing Villages” (2008)⁽¹⁾ in which elementary and junior high school students stay for one week or more in farming or fishing villages for outdoor activities. Therefore, it can be said that outdoor education is extremely important as school-based environmental education for children.

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On the other hand, since GIS (Geographic Information Systems) have various functions for database creation, information analysis, information provision and sharing and decision making support, they have often been used in school education in a versatile manner in recent years. Web-GIS are defined as information systems to manage, process and visualize the data which gives geographical location information on digital maps using the Internet. It is possible for anyone to use Web-GIS anywhere, anytime by accessing the Internet without installing any application software on their PC.

Consequently, based on the background mentioned above, this study, focusing on the importance of encouraging outdoor activities for children, aims to propose and implement a Web-GIS based outdoor education program as environmental education for junior high schools, which is then evaluated by teachers. By using the unique Web-GIS functions, since teachers input information about outdoor activities into digital maps and add pictures, comments and detailed information on them, they can clearly show students the object of study visually just by clicking on the screen. Therefore, it is possible to effectively focus students' interest on the object of study and enhance their understanding better than with any other teaching materials in paper format. Additionally, students can refer to and search information about outdoor activities with the teachers' guidance.

Studies on the actual use of GIS or Web-GIS in school environmental education are divided into the following two groups. Itoh et al. [1], Ludwig and et al. [2], Itoh et al. [3], Murayama [4], Bendnarz [5] and Demirci et al. [6] concern the usage of GIS and Web-GIS as educational tools to support environmental education, and Yan et al. [7], Kerski [8], Miura et al. [9], Kubota et al. [10], Bodzin et al. [11] and Yuda et al. [12] relate to environmental education classes using GIS and Web-GIS.

Among these studies, Murayama [4] demonstrates the effectiveness of GIS as exercise/task-learning aid tools in school education as well as having high expectations for Web-GIS, in particular, to be used in whole-class teaching that is available online without having to install any application software. Miura et al. [9] shows the importance of meeting needs in an education field by conducting a class using Web-GIS at a junior high school. Additionally, although GIS for Education has not yet been fully developed in Japan, Itoh et al. [1] pointed out that GIS had been used in school environmental education since the 1990s in the U.S. However, these previous studies only introduce examples of the usage of

GIS and Web-GIS as educational tools and environmental education classes using GIS and Web-GIS. They do not propose or implement a series of outdoor education programs for school environmental education based on GIS or Web-GIS.

Taking into consideration the above-mentioned importance of outdoor activities as school environmental education for children and the potential use of GIS and Web-GIS in school environmental education presented by previous studies in related areas, this study proposes an outdoor education program for the purpose of improved outdoor activities in junior high school education chiefly using Web-GIS which offers an excellent tool for information provision and sharing. Using Web-GIS in the outdoor education program, teachers can enhance educational effects on students because the students are able to visually refer to diverse information about the outdoor activities on digital maps in order to understand the object of study. Additionally, teachers preserve a record of the second school on digital maps so that they can reflect their teaching methods and effectively make plans for future activities. Moreover, the proposed outdoor education program is actually implemented in junior high school education. These two points show the originality and utility of this study compared to previous studies.

II. OUTLINE OF THE EXAMPLE

Identifying outdoor activities as an important program in school education, Musashino-shi, Tokyo has made various efforts to establish long-term outdoor activities since 1989. In 1996, Musashino-shi made the decision to implement outdoor activities for seven nights or more for fifth graders and four nights or more for first-year junior high school students. In 2003, a two-night "pre-second school" began for fourth graders as an introductory program for the second school. In Musashino-shi, 12 elementary and six junior high schools currently conduct the program every year. This program is designated as a pilot study for the "Project for Interaction in Farming and Fishing Villages" mentioned in Chapter I. Hosoya et al. [13] [14] propose and implement an eight-step outdoor education program based on Web-GIS for second and pre-second schools at an elementary school in Musashino-shi.

The examples taken by this study are the second schools at the Third Junior High School which kindly cooperated with this study. The junior high school provides four-night outdoor activities called second school for first graders in one class (33 students in the 2009 academic year). Since 2003, the second have taken place mainly in Ohmachi-shi, Nagano in May. TABLE I shows the outdoor activities during the second school.

Musashino-shi recruits university and graduate students aspiring to be teachers to work as instructors for the second and pre-second schools of elementary and junior high schools because the number of teachers at these schools is not high enough to be able to provide the necessary manpower. The authors have participated as instructors for the second school at the Third Junior high School since the 2008 academic year. (See Chapter III for details.)

In order to achieve smooth operation and enhanced educational effects, the Third Junior High School takes a number of measures before and after the second school that include:

1. Teachers: Teachers in charge inspect in advance the places where the second school will be held and meet with local staff there to make arrangements as preparation for classes before and after the second school and outdoor activities.
2. Instructors: Before the second school, a training session is given to instructors to ensure safety during the schools.
3. Students: Students carry out specific study before and after the second school mainly during integrated learning periods.
4. Parents: As the second school involves overnight stays, a briefing session is given to the students' parents beforehand by the teacher in charge concerning the purpose and details of the second school to give them an understanding of the activities. Additionally, after the second school, an open class is conducted to provide an opportunity for students to talk about their experiences during the schools in front of their parents.

III. WEB-GIS BASED OUTDOOR EDUCATION PROGRAM

As shown in TABLE II, this study proposes, implements and evaluates the five steps of the Web-GIS based outdoor education program. Its aims are as follows: (1) to enhance the educational effects on students, by arousing their interest in nature, promoting their understanding about the object of outdoor activities and supporting their choices of actions especially during hiking in mountainous areas. (2) to promote parents' understanding of the second school, by visually referring, in particular, to the information about the outdoor activities on digital maps, and (3) to ensure students' safety during outdoor activities. In the program, using the unique functions of Web-GIS especially for database creation, and information provision and sharing, it is possible to realize such aims. Moreover, the program is applicable in similar outdoor activities as junior high school education.

Each step is explained in detail below.

Step 1. Survey of second schools: The authors participated and accompanied the second school in order to understand and grasp their contents and subsequently acquired knowledge about events held by the junior high school before and after the second school in the 2008 academic year.

Step 2. Proposal of the program: A briefing on the purpose of this study and on the Web-GIS based outdoor education who permitted the acceptance of the program. Then, a program was given to the principal of the junior high school concrete

TABLE I
 OUTDOOR ACTIVITIES DURING THE SECOND SCHOOL

Date	Second school
1st day	Trying farming, Visiting ranch
2nd day	Rice planting, Making blueberry jam and soba, School songs competition
3rd day	Visiting Matsumoto Castle and history museums, Making agar jelly
4th day	Outdoor cooking, Visiting electricity museum and dam, Campfire
5th day	Trying carpentry, Trail, Visiting natural museums and aquarium

form of the program was considered and the resultant proposal was presented to the principal and teachers in charge of the schools.

Step 3. Specific composition of the program: Specific elements of the Web-GIS based outdoor education program were considered after understanding learning objectives concerning the second and school and after the intentions of the teachers were taken into consideration. With the supposition that Web-GIS would be used as teaching and briefing materials, the specific elements of the Web-GIS based outdoor education program were determined before preparation for operation.

Step 4. Operation: The program was fully operated for the second school including the period before and after it for fifth graders in the 2009 academic year. Web-GIS are used as teaching and briefing materials in specific study for students and the briefing session and open class for students' parents before and after second schools, as mentioned in Chapter II.

Step 5. Evaluation: Face-to-face interviews and questionnaires were conducted on teachers, instructors, students and parents in order to evaluate the program.

IV. USE OF WEB-GIS FOR THE OUTDOOR EDUCATION PROGRAM

A. Usage of Web-GIS

The usage of Web-GIS mainly includes the specific composition of the Web-GIS based outdoor education program in Step 4 and operation of the program in Steps 5 respectively. This was carried out in accordance with the process in TABLE II. The functions of the Web-GIS for database creation, and information provision and sharing were used.

The "Denshi Kokudo" Web System⁽²⁾ was used as Web-GIS application software and Kashmir 3D⁽³⁾ as GIS application software in the Web-GIS based outdoor education program. Additionally, since the "Denshi Kokudo" version digital map from the Geographical Survey Institute shows more detailed geographical characteristics than any other digital maps such as Google maps especially in mountainous areas where outdoor activities are carried out at second school, it is used as a basic map in this study. Kashmir 3D is used to process and overlay the geographical location information related to the outdoor activities obtained in Steps 1 and 3 on a "Denshi Kokudo" version digital map.

B. Web-GIS as teaching and briefing materials

1) Specific composition of the program

Based on the experiences of participating in the second school as instructors in the 2008 academic year in Step 1, the authors identified "conducting a class related to student experiences during the second school both before and after it", "operation of outdoor activities considering risk management for teachers and instructors during the second school" and "briefing session and open class about the second school for students' parents before and after it" as the main objectives for the use of Web-GIS. In Step 3, based on the survey in Step 1, the authors considered when and how to use the Web-GIS as

teaching and briefing materials and what kinds of information should be included on the digital maps, consulting with the teachers about learning objectives.

Taking the above-mentioned things into consideration, therefore, teaching and briefing materials were composed according to the following procedure in Step 3 chiefly using the two kinds of applications software.

1. An inspection of specific places where the outdoor activities would be implemented was conducted to collect geographical location information on locations and routes through GPS and to carry out face-to-face interviews and research in the field.
2. Using Kashmir 3D, the information related to the outdoor activities was placed on the "Denshi Kokudo" version digital map to be processed as a Kashmir 3D version digital map in GPX format. It was converted into XML format to be used in the "Denshi Kokudo" Web System.
3. The Kashmir 3D version digital map in GPX format was clipped for editing in order to insert photos and comments. Additionally, it was converted into HTML format that allows reference to supplementary data and was posted using Pukiwiki⁽⁴⁾ on the website run by the authors⁽⁵⁾.

2) Operation

In Steps 4, the Web-GIS were used as teaching and briefing materials as illustrated in Fig. 1, 2, 3 and 4 respectively for the three main objectives. Fig. 1 shows a route for outdoor activities in Omachi-shi and Azumino-shi, Nagano which is made by Kashmir 3D. The authors placed the geographical location information that was obtained especially by GPS on Kashmir 3D version digital maps and used it as the basic map to make "Denshi Kokudo" version detailed digital maps and Kashmir 3D version detailed digital maps. Fig. 2 shows all routes including the same route as shown in Fig. 1 which is prepared with the "Denshi Kokudo" Web System. It enables students and parents to search the locations and routes for outdoor activities during the second school.

Fig. 3 describes the authors' website entry of a hiking route map which was inserted with geographical location information and information about dangers obtained in Steps 1. It enables teachers and instructors to consider risk management during the second school. Fig. 4 also shows the authors' website entry of an outdoor activities map which was inserted with photos and comments related to the outdoor activities. It enables students and parents to understand the status of outdoor activities at a glance and it was printed to distribute as a briefing material at the open class after the second school.

Before the second school, referring to the digital maps as illustrated in Fig. 1, 2 and 3, teachers explained the outdoor activities including risk management and notices to students and their parents to enhance their understanding. Since the details of the outdoor activities were shown visually on the digital maps, the students and their parents could understand the locations and contents. Additionally, using the Web-GIS, they could search the locations and routes for outdoor activities with the authors' guidance. After the second school, showing the digital maps inserted with pictures, comments and detailed information as

illustrated in Fig. 4, teachers explained the outdoor activities to students and their parents. This made students recollect their experiences and their parents understand the details of the second school.

TABLE II
 FIVE STEPS OF WEB-GIS BASED OUTDOOR EDUCATION PROGRAM (ACADEMIC YEAR 2008-2009)

Step	Period	Activities
1. Survey of second school	May-July, 2008	Acquiring knowledge of events held by the junior high school including the period before and after the second schools
2. Proposal of the program	May, 2009	Giving the principal a briefing on the purpose of the study and on the program Considering a concrete form of the program Proposing the concrete form of the program
3. Sprcific composition of the program	May, 2009	Making adjustments to the specific elements of the program before determination, given learning objectives for the second school Determining the specific composition of the program, supposing the use of Web-GIS as teaching and briefing materials
4. Operation	May, 2009	Conducting operation during the second school using Web-GIS as teaching and briefing materials
5. Evaluation	July, 2009	Evaluation by teachers, instructors, students and their parents

②武蔵野市立第三中学校セカンド(5/15-19)行動内容

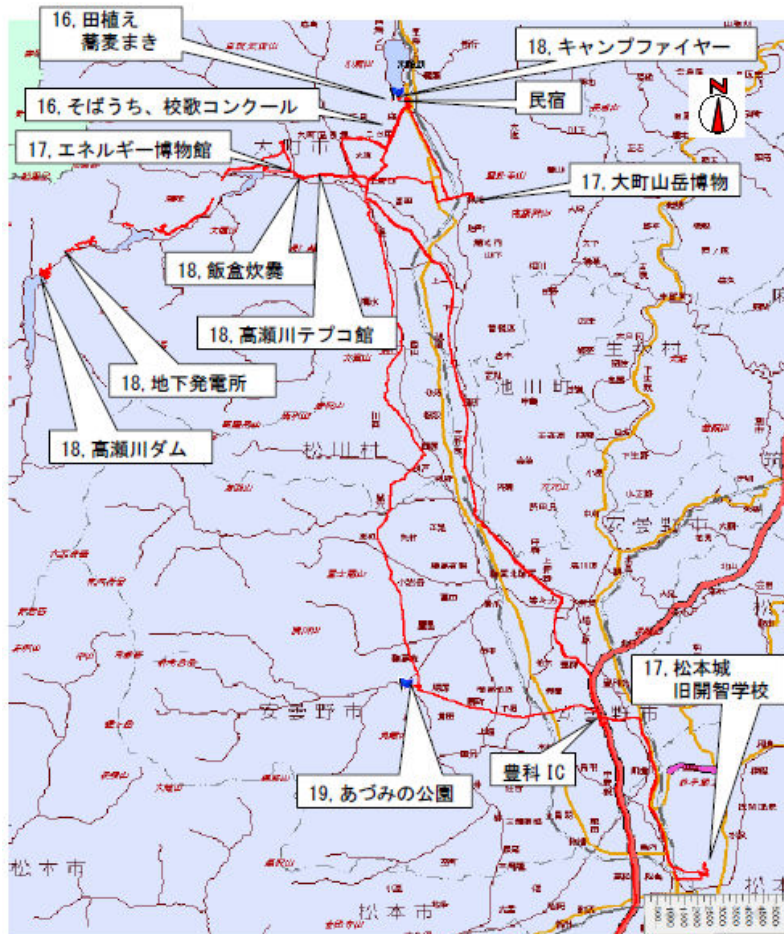


Fig. 1 Kashmir 3D version digital map

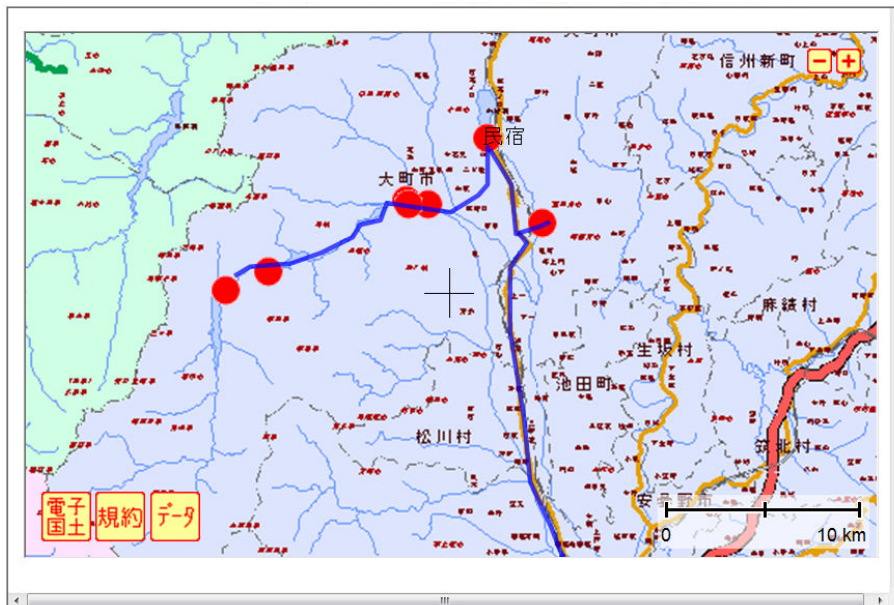


Fig. 2 Map using the “Denshi Kokudo” Web System



Fig. 3 Hiking route map for risk management on authors' website



Fig. 4 Outdoor activities map on authors' website

V. EVALUATION OF WEB-GIS BASED OUTDOOR EDUCATION PROGRAM

The Web-GIS based outdoor education program that was proposed and implemented was evaluated by teachers in Step 5 shown in TABLE II. Face-to-face interviews to the teachers were conducted for the evaluation of the outdoor education program in this study. At the evaluation, mainly the usage of Web-GIS in the outdoor education program was evaluated. From the below, it was clear that the general operation of Web-GIS based outdoor education program with teachers only is difficult due to their lack of knowledge regarding Web-GIS and that support staff who can effectively utilize Web-GIS are essential.

A. The utility of Web-GIS as a teaching material in classes before and after second school

Teaching materials utilizing digital maps were printed on paper and distributed as a consequence of a regular classroom, not a computer room, being used for the classes before and after second school. Students had positive opinions of these materials such as "It's easy to look back on our experience". However, as the difficulty of devising lesson plans and

teaching materials due to the teaching teachers' lack of understanding of Web-GIS was clear, the authors have created a guidance plan to give an example of the utility of Web-GIS as a teaching material. Teachers showed interest in Web-GIS becoming an important and useful material if it were possible for them to become able to use it as a teaching material after this experience. However, there were also opinions that if it would take too long to prepare teaching materials using Web-GIS, they couldn't be used in an actual class no matter how much they would contribute to the students' understanding.

B. The utility of Web-GIS as a risk management map

In step 1, the authors conducted our own prior investigation and created a risk management map as shown in Fig. 3. However, the hiking in the second school was canceled due to rain and this map was unable to be used in the teachers' and trainers' training as well as in the classes and the briefing session for parents prior to the second school. However, some of the teachers recognized the importance and showed an interest when the risk management map was shown to them. As the second school will be conducted at the same location each year, managing the risk management map with Web-GIS was

thought to be effective by some teachers as the information could be shared among them as handover information. More specifically, it can be expected that the risk management map would be used as a database for storing risk management information and that information sharing would be carried out among teachers. However, there were also teachers concerned about the effort required to learn the Web-GIS technology.

C. The significance of Web-GIS use in general nature experience activities

Although the authors were unable to conduct training and classes where Web-GIS was actually used in classes before and after second school and in risk management, some of the teachers recognized the importance of Web-GIS use in increasing student's understanding of nature experience activities and had a desire to use Web-GIS in the future.

VI. CONCLUSION

This study aims to propose and implement a Web-GIS based outdoor education program as environmental education for junior high schools, which is evaluated by teachers. The conclusion of this study can be summarized in the following two points.

- (1) A five -step outdoor education program based on Web-GIS was proposed for a "second school" at junior high schools that was then implemented before being evaluated by teachers as users.
- (2) Based on the results of evaluation by teachers, it was clear that the general operation of Web-GIS based outdoor education program with them only is difficult due to their lack of knowledge regarding Web-GIS and that support staff who can effectively utilize Web-GIS are essential.

Issues to be studied include the application of the Web-GIS based outdoor education program proposed by the authors to other junior high schools.

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NOTES

- (1) Project for Interaction in Farming and Fishing Villages, <http://www.maff.go.jp/j/nousin/kouryu/kodomo/index.html>. Assessed May 15, 2008
- (2) "Denshi Kokudo", a concept proposed by the Geographical Survey Institute, Ministry of Land, Infrastructure, Transport and Tourism in 1999. Refer to Cyber Japan Portal.
- (3) Kashmir 3D is an application software for GIS that provides functions including analyzing views of mountains, creating 3D computer graphics of landscapes, real-time flight simulation, analyzing GPS data and creating hyper maps.
- (4) Pukiwiki, one of the so-called WikiEngines, is a content management system (CMS).
- (5) The authors established "the Web-GIS based Outdoor Education Program" website using the "Denshi Kokudo" Web System. It can be found at <http://www.ohta.is.uec.ac.jp/yamamoto/gis>

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