Web-GIS based Outdoor Education Program for Elementary 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 elementary schools, which will then be evaluated by users. Specifically, for the purpose of improved outdoor activities in the elementary 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. Conclusions of the study boil down to:

(1) An eight-staged outdoor education program based on the Web-GIS was proposed for a "second school" of an elementary school that was then implemented before being evaluated by users (teachers, instructors, students, and their parents).

(2) The program generally received a good evaluation, while a lot of students and their parents evaluated negatively for the degree of discovery and for the degree of interest, respectively, in the questionnaire survey of students and their parents conducted after the "second school". The surveys clearly show that an issue to be solved, from the viewpoint of teachers in particular, is the establishment of the GIS that will easily represent teaching materials developed by teachers and of Web-GIS, and improved significance of the use of GIS and Web-GIS for their widespread.

Keywords—Elementary Schools, School Education, Outdoor education, Web-GIS

I. INTRODUCTION

URBANIZATION in recent years has reduced opportunities and places for children to play in their daily life while contacting with nature. "Measures to Improve Environment for Fostering a 'Zest for Life' of Young People in a Community"(interim report) presented by Lifelong Learning Council, Ministry of Education, Culture, Sports, Science and Technology (1999) mentions that "The more experienced in outdoor activities a child is, the stronger senses of morality and justice he/she has." School Education Law as revised (2007) includes "encouraging outdoor activities". Thus, three ministries of Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries, and Ministry of Internal Affairs and Communications started "Project for Interaction in Farming

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and Fishing Villages" (2008) where elementary and junior high school students stay for one week or more at farming or fishing villages for outdoor activities. 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 for elementary schools, which will then be evaluated by users.

Recent studies on outdoor activities in the school education include the one: that advocates the importance of capacity building for students to be an outdoor activity instructor by Adachi, et al. [1]; that recommends forests as a place for outdoor activities in the school education by Takemoto and Nagata [2]; and that demonstrates that the more experienced in outdoor activities a child is, the more positively he/she studies science by Nukui and Kageyama [3]. In addition, recent studies on the actual use of the GIS or Web-GIS in the school education include the one: that identifies "sufficient facilities", "teachers with appropriate skills", and "positioning of its educational significance" as challenges following a survey on the Web-GIS introduced into the school education by Minamino [4]; and that shows the importance of meeting needs in an education field, with conducting a class using the Web-GIS at an elementary school by Sasatani [5]. Additionally, Murayama [6] demonstrates the effectiveness of the GIS as an exercise/task-learning aid tool in the school education as well as high expectation for the Web-GIS, in particular, to be used in whole-class teaching that is available online without the need of installing any application software.

Taking into consideration the importance of outdoor activities and potential use of the GIS and Web-GIS in the school education presented by the above-mentioned preceding studies on the related areas, the study proposes the outdoor education program, for the purpose of improved outdoor activities in the elementary school education, with chiefly using the Web-GIS that provides a good information provision and sharing tool. Moreover, the outdoor education program proposed is actually implemented in the elementary school education before being evaluated by users.

II. OUTLINE OF THE EXAMPLE

Identifying outdoor activities as an important program in the school education, Musashino-shi has made various efforts since 1989 for the establishment of long-term outdoor activities. In 1996, it decided the implementation of outdoor activities for seven nights or more for fifth graders and four nights or more for first-year junior high school students. Since

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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 that is positioned as a pilot case for the "Project for Interaction in Farming and Fishing Villages" mentioned in Chapter I above.

The example taken by the study is the second school for fifth graders (45 students in FY 2009) at Honjuku Elementary School in Musashino-shi that kindly gives cooperation to the study. The elementary school provides seven-night outdoor activities called second school for fifth graders, and two-night activities called pre-second school for fourth graders as preparation for the second school. In 2009, the second school for fifth graders was given mainly in Iiyama-shi, Nagano from September 29 to October 6. A survey conducted on the usage of the Web-GIS found that the computer room was well equipped and available to 40 students a class, while many of teachers in charge had not used the GIS and Web-GIS before.

Musashino-shi recruits students aspiring to be a teacher and others to employ as instructors for the second and pre-second schools, because the number of teachers at an elementary school is not enough to have the manpower. As a part of the study, the authors had participated, as an instructor, in the second and pre-second schools organized by Musashino-shi since 2008, and accompanied fourth graders to the pre-second school in 2009. Based on these experiences, the authors identified "conducting a class related to experiences during the second school", "operation of outdoor activities (risk management)" and "briefing for students' parents about outdoor activities" as main objectives of the outdoor education program proposed.

For the smooth operation and enhanced educational effects, Honjuku Elementary School has taken some measures before and after the second and pre-second schools that include:
(1) Teachers: Teachers in charge inspect beforehand a place where the school will be held, and meet with a receiving counterpart for arrangements, as preparation for classes before and after the schools, indirect experiences, and for outdoor activities, direct experiences.
(2) Instructors: A training session is given to instructors to ensure safety during outdoor activities.
(3) Students: Students implement a specific study before and after outdoor activities mainly during integrated learning periods.
(4) Parents: As the second and pre-second schools involve overnight stay, a briefing is given to the students' parents by a teacher in charge on meaning and details of the schools for their understanding on the activities. After the second and pre-second schools, an open class is conducted that provides an opportunity for students to talk about their experiences during the schools in front of the class.

III. WEB-GIS BASED OUTDOOR EDUCATION PROGRAM

As shown in TABLE I below, the study proposes, implements and evaluates the outdoor education program in the eight steps.

1. Current situation survey: The authors participated in and accompanied to the second and pre-second schools in order to understand, and know the details of, them, and subsequently acquired knowledge about events held by the elementary school before and after the second and pre-second schools.
2. Proposal of the program: A briefing on the purpose of the study and on the outdoor education program was given to the principal at the elementary school, who permitted the acceptance of the program. Then, a concrete form of the Web-GIS based outdoor education program was considered, and the resultant proposal was presented to the principal and teachers in charge of the schools.
3. Adjustment to the elements: Specific elements of the Web-GIS based program were considered after understanding of learning objectives and other issues for the second and pre-second schools, with taking the intention of the teachers into consideration.
4. Composition of the program: The specific elements of the program were determined before preparation for operation.
5. Preliminary operation: An operational test was conducted during the pre-second school in FY 2009.
6. Evaluation/Re-composition: The program was re-composed based on teachers' reaction to and results of self-evaluation of the preliminary operation.
7. Operation: The program was fully operated during the second school in FY 2009.
8. Evaluation: A face-to-face interview for teachers and questionnaire survey for instructors, students and their parents were conducted for the evaluation of the program.

IV. HOW TO USE WEB-GIS FOR THE OUTDOOR EDUCATION PROGRAM

As presented in Chapter II above, main objectives of the outdoor education program are "conducting a class related to experiences during the second school", "operation of outdoor activities (risk management)" and "briefing for students' parents about outdoor activities", for which the Web-GIS was used. Specifically, the usage of the Web-GIS includes preparation of teaching and briefing materials and description of how to operate, and operation of the outdoor education program was done in accordance with the flow in TABLE I (Hosoya and Yamamoto) [7]. Learning and briefing materials, of which example illustrated in Fig. 1 and 2, were prepared according to the following procedure, with chiefly using the Web-GIS.

1. An inspection of specific places, where the outdoor activities would be done, was conducted to collect information on the local area through a face-to-face interview and fieldwork.
2. Kashmir 3D was used as application software for the GIS to overlay a "Denshi Kokudo"[1] map from Geographical Survey Institute on the geographical location information related to the outdoor activities that was obtained through the GPS.
3. The geographical location information on spots and a route

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prepared with Kashmir 3D[2)] was placed on the Denshi Kokudo Web version map.

4. Figures and graphics created with Kashmir 3D were clipped for editing in order to insert a digital image and/or comment to them. They have been posted, with using Pukiwiki[3)], on the website run by the authors[4)] in a format that allows reference to supplementary data. A summary of the

procedure mentioned above is shown in Hosoya and Yamatomo [7] as "Flow Chart of Web-GIS based Aid for Outdoor Activities". The study uses the "Denshi Kokudo version" map because it shows more detailed geographical characteristics especially in a mountainous area than other digital maps including from Google and Yahoo.

TABLE I
STEPS FOR WEB-GIS BASED OUTDOOR EDUCATION PROGRAM (FROM 2008 TO 2009)

Step	Objective	Period	Activities
1. Current situation survey	To know realities of outdoor education programs	June, 2008	Accompanying to the second school
		October, 2008	Accompanying to the pre-second school
		November, 2008	Acquiring knowledge of events held by the elementary school before and after the second school
2. Proposal of the program	To propose the Web-GIS based outdoor education program	November, 2008	Giving the principal a briefing on the purpose of the study and on the program
		Nov. – March, 2008	Considering a concrete form of the program
		April, 2009	Proposing the concrete form of the program
3. Adjustment to the elements	To make adjustments to determine specific elements of the program	April, 2009	Making adjustments to the specific elements of the program before determination, given learning objectives for the second school
4. Composition of the program	To determine composition of the Web-GIS based outdoor education program	May, 2009	Determining the specific composition of the program
5. Preliminary operation	To conduct an operational test	June, 2009	Conducting an operational test during the pre-second school
6. Evaluation/ Re-composition	To work for re-composition	July, 2009	Re-compose the program based on teachers' reaction and results of self-evaluation
7. Operation	To fully operate	September – October, 2009	To conduct full operation during the second school
8. Evaluation	To evaluate the program	October – November, 2009	Evaluation by teachers, instructors, students and their parents

Fig. 1 Route for Activities at Shinanodaira, Iiyama-shi, Nagano for Learning Material (Denshi Kokudo Web version)
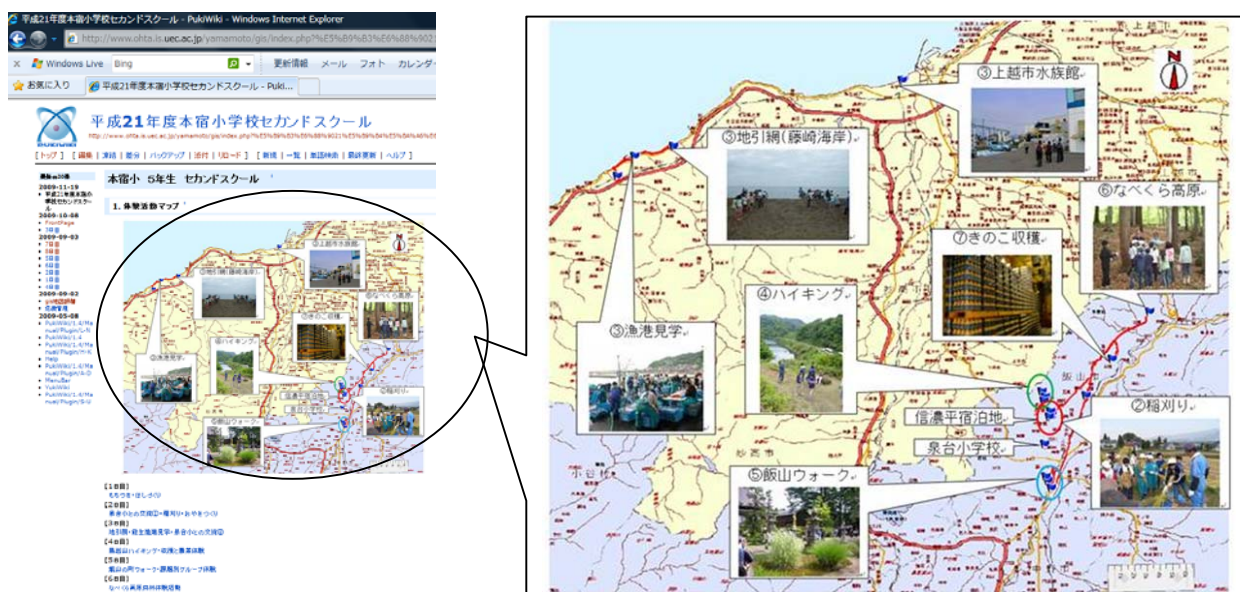
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Fig. 2 Outdoor Activity Map for the Second School for Briefing Material

V. EVALUATION AND ISSUES TO BE SOLVED OF THE OUTDOOR EDUCATION PROGRAM

A. Outline of Evaluation

The outdoor education program proposed was evaluated by its users (teachers, instructors, students and their parents) after its operation. The overview of the evaluation is shown in TABLE II below. Specifically, as shown in TABLE III, a face-to-face interview for teachers and questionnaire survey for instructors, students and their parents were conducted between September and November 2009 for the evaluation of the program. The questionnaire surveys of students and their parents were implemented both before and after the second school.

B. Evaluation by Teachers

Results of the face-to-face interview of the three teachers in charge of the second school are summarized below for two items: Evaluation in terms of operation and availability of educational effects.

1) Evaluation in terms of Operation

Intention to continuously use in a positive manner, and issues to be solved when using the Web-GIS based outdoor education program presented by the respondents are:

(1) As many of the teachers had no knowledge of the GIS and Web-GIS, this opportunity offered them incentives to learn about them.

(2) A more simplified package would be preferable, without the need to learn about the GIS and Web-GIS from scratch.

(3) A written guide to use of the GIS and Web-GIS would be useful.

(4) It would be applied in the social studies, life environmental studies, Japanese language, science, and integrated learning period.

(5) An assistant specifically for the use of the GIS and Web-GIS would be necessary.

(6) Use of a computer will require reduction of time to install for a classroom and of time to move from a classroom for a computer room.

(7) Excessively long time to prepare learning materials will not be suitable for use in an elementary school.

2) Availability of educational effects

Remarks shown below indicate that the Web-GIS based outdoor education program is acknowledged as having education effects.

(1) Its adequate coordination with the elementary school allowed addition of the educational effects on students to those already produced during a regular class.

(2) It was useful to obtain information on places where outdoor activities were going to be carried out (spatial recognition).

(3) It was useful to organize knowledge and experiences acquired through preparation for the outdoor activities and through the activities themselves.

C. Evaluation by Instructors

First of all, use of Internet by the six instructors and their awareness of the Web-GIS boil down to:

(1) Frequency of Internet use
Using everyday: 5 persons, Not using at all: 1 person

(2) Frequency of map retrieval page use: Using once in a while: 4 persons

(3) Awareness of GIS and Web-GIS: Being aware of Web-GIS: 1 person

TABLE IV below shows the evaluation in terms of operation by the instructors. Positive evaluation constitutes

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the majority of the total for the four sub-items: Level of difficulty, degree of expectation, possibility of continuation, and level of understanding. One instructor who does not use Internet at all, however, evaluated negatively for all the five sub-items.

TABLE II
OUTLINE OF EVALUATION

Respondents/Method	Item	Sub-item	Description
Teachers /Face-to-face interview	Evaluation in terms of operation	1. Level of difficulty	Level of difficulty in terms of aid process
		2. Cost/Man-hour	Their view on cost/man-hour
		3. Degree of expectation	Applying the digital map in other subjects or themes
		4. Possibility of continuation	Whether they would like to continuously use the Web-GIS as aid tool
		5. Degree of motivation improvement	Whether they become more motivated in terms of their commitment to the second school
		6. Survey on Internet and Web-GIS	Frequency of Internet use
			Frequency of map retrieval page use
			Awareness of GIS/Web-GIS
	Availability of educational effects	1. Level of understanding	Whether the Web-GIS based aid contributed to students' understanding of what they learned
Instructors /Questionnaire survey	Evaluation in terms of operation	1. Level of difficulty	Level of difficulty in terms of use
		2. Degree of expectation	Whether the digital map will be applied in other learning materials
		3. Possibility of continuation	Whether they would like to use the digital map during outdoor activities
		4. Degree of motivation improvement	Whether the digital map gives them an inspiration for a new commitment they should make
		5. Level of understanding	Whether the digital map gives them a general idea of the place where the activities will be carried out
			Whether the digital map provides them with necessary risk management information
		6. Survey on Internet and Web-GIS	Frequency of Internet use
			Frequency of map retrieval page use
			Awareness of GIS/Web-GIS
Students /Questionnaire survey before school	Availability of educational effects /Evaluation at class before school	1. Level of understanding	Whether they understand what they will do during the second school
		2. Degree of interest	Whether they become interested in presentation with the digital map
		3. Possibility of continuation	Whether they would like to have presentation with the digital map in the future
		4. Degree of motivation improvement	Whether they are more motivated, in terms of participation in the second school, by presentation with the digital map
		5. Level of difficulty	Whether presentation with the digital map is easy to understand
		6. Degree of discovery	Whether presentation with the digital map inspires them to study something or enables them to discover something
		7. Survey on Internet and Web-GIS	Frequency of Internet use
			Frequency of map retrieval page use
/Questionnaire survey after school	Evaluation at class after school	1. Level of understanding	Whether they can look back on their experiences during the second school
		2. Degree of interest	Whether they become interested in presentation with the digital map
		3. Possibility of continuation	Whether they would like to have presentation with the digital map in the future
		4. Degree of motivation improvement	Whether they are more motivated, in terms of their commitment to the work assigned, by presentation with the digital map
		5. Level of difficulty	Whether presentation with the digital map is easy to understand
		6. Degree of discovery	Whether presentation with the digital map inspires them to study something or enables them to discover something
Parents /Questionnaire survey before school	Evaluation at briefing session for parents before school	1. Level of understanding about the place for activities	Whether they identify the place where their children will carry out their activities
		2. Level of understanding about the activities	Whether the digital map gives them a general idea of the meaning of the activities and their children's experiences
		3. Degree of interest	Whether they would like to view the digital map online if it is available
		4. Possibility of continuation	Whether they would like to have presentation with the digital map
		5. Survey on Internet and Web-GIS	Frequency of Internet use
			Frequency of map retrieval page use
			Awareness of GIS/Web-GIS
/Questionnaire survey after school	Evaluation at open class	1. Level of understanding	Whether they understand their children's experiences and outcomes
		2. Degree of interest	Whether they would like to view the digital map online if it is available
		3. Possibility of continuation	Whether they would like to have presentation with the digital map

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D. Evaluation by Students

1) Evaluation based on results of the questionnaire survey before the school

A questionnaire survey of 46 students was conducted following a class given before the second school, with 45 valid responses received. Use of Internet by the students and their awareness of Web-GIS boil down to:

(1)Frequency of Internet use

Using everyday: 26.7%, Have used: 73.3%

(2)Frequency of map retrieval page use:

Have used: 55.6%, Have never used: 44.4%

A digital map appropriate to the outdoor activities was created with the Web-GIS as a learning material to show in the class before the school along with images of outdoor activities during the second school held last year. TABLE V below provides results of the questionnaire survey conducted following a class given before the second school. Positive evaluation accounts for approximately 80% of the total for all the six sub-items, indicating that students generally give good marks.

2) Evaluation based on results of the questionnaire survey after the school

A questionnaire survey of 44 students was conducted following a class given after the second school, with 42 valid responses received. A digital map appropriate to the outdoor activities was created with the Web-GIS as a learning material to show in the class after the school along with images of their outdoor activities during the second school. TABLE VI below gives results of the questionnaire survey conducted following a class given after the second school. Positive evaluation makes up more than 60% of the total for the five sub-items of level of understanding, degree of interest, possibility of continuation, degree of motivation improvement, and level of difficulty, except for degree of discovery with predominant negative evaluation of about 80%. Reaction of the students during the class given after the school implies that the negative evaluation might be due to their inability to find what they should study further for the second school that had already ended.

E. Evaluation by Parents

1) Evaluation based on results of the questionnaire survey before the school

A questionnaire survey of 38 parents was conducted following the briefing session given before the second school, with 29 valid responses received. Use of Internet by the parents and their awareness of Web-GIS boil down to:

(1) Frequency of Internet use

Using everyday: 69.0%, Using once in a while: 24.2%,

Using rarely: 3.4%, Not using at all: 3.4%

(2) Frequency of map retrieval page use:

Using frequently: 20.7%, Using once in a while: 55.2%,

Using rarely: 17.2%, Not using at all: 6.9%

(3) Awareness of GIS

Being aware of GIS: 13.8%, Being aware of Web-GIS: 6.9%

TABLE III
OUTLINE OF FACE-TO-FACE INTERVIEW AND QUESTIONNAIRE SURVEY (FROM SEPTEMBER TO NOVEMBER, 2009)

Respondents	Teachers	Instructors	Students		Parents	
			Before school	After school	Before school	After school
No. of respondents	3	6	46	44	38	15
No. of valid responses	3	6	45	42	29	13
Response rate (%)	100	100	97.8	95.5	76.3	86.7

TABLE IV
EVALUATION IN TERMS OF OPERATION BY THE SIX INSTRUCTORS

Sub-item	Positive Evaluation	Negative Evaluation
1. Level of difficulty	Easy: 5 persons	Difficult: 1 person
2. Degree of expectation	Would like to apply: 4 persons	Would not like to apply: 2 persons
3. Possibility of continuation	Necessary: 4 persons	Neither: 2 persons
4. Degree of motivation improvement	More motivated: 3 persons	Neither: 3 persons
5. Level of understanding	Understood well: 2 persons	Did not understand well: 1 person
	Understood somewhat: 3 persons	

TABLE V
RESULTS OF QUESTIONNAIRE SURVEY OF 45 STUDENTS BEFORE SCHOOL

Sub-item	Positive Evaluation	Negative Evaluation
1. Level of understanding	Understood well: 44.4%	Did not understand well: 2.3%
	Understood somewhat: 51.0%	Did not understand at all: 2.3%
2. Degree of interest	Become interested: 91.1%	Do not become interested: 8.9%
3. Possibility of continuation	Necessary: 91.1%	Unnecessary: 8.9%
4. Degree of motivation improvement	More motivated: 80.0%	Do not know: 15.6%
		Discouraged: 4.4%
5. Level of difficulty	Easy: 93.3%	Difficult: 6.7%
6. Degree of discovery	Inspired to study something or enabled to discover something: 77.8%	Did not inspire to study anything or enable to discover anything: 22.2%

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TABLE VI
RESULTS OF QUESTIONNAIRE SURVEY OF 42 STUDENTS AFTER SCHOOL

Sub-item	Positive Evaluation	Negative Evaluation
1. Level of understanding	Understood well: 50.0%	Did not understand well: 11.9%
	Understood somewhat: 38.1%	
2. Degree of interest	Become interested: 64.3%	Do not become interested: 35.7%
3. Possibility of continuation	Necessary: 66.7%	Unnecessary: 33.3%
4. Degree of motivation improvement	More motivated: 26.2%	Somewhat discouraged: 33.3%
	Somewhat more motivated: 38.1%	Discouraged: 2.4%
5. Level of difficulty	Easy: 78.6%	Difficult: 21.4%
6. Degree of discovery	Inspired to study something or enabled to discover something: 21.4%	Did not inspire to study anything or enable to discover anything: 78.6%

TABLE VII
RESULTS OF QUESTIONNAIRE SURVEY OF 29 PARENTS BEFORE SCHOOL

Sub-item	Positive Evaluation	Negative Evaluation
1. Level of understanding about the place for activities	Understood well: 65.5%	
	Understood somewhat: 34.5%	
2. Level of understanding about the activities	Understood well: 51.7%	
	Understood somewhat: 48.3%	
3. Degree of interest	Would like to view: 82.8%	Will not view: 17.2%
4. Possibility of continuation	Necessary: 82.8%	Unnecessary: 17.2%

TABLE VIII
RESULTS OF QUESTIONNAIRE SURVEY OF 13 PARENTS AFTER SCHOOL

Sub-item	Positive Evaluation	Negative Evaluation
1. Level of understanding about the activities and outcomes	Understood well: 30.8%	
	Understood somewhat: 69.2%	
2. Degree of interest	Would like to view: 46.2%	Will not view: 53.8%
3. Possibility of continuation	Necessary:84.6%	Unnecessary: 15.4%

The results show that the parents rather frequently use the Internet and map retrieval services while only some 10% are aware of GIS and/or Web-GIS. Like in the class given to the students before the second school, presentation using the Web-GIS was provided during the briefing session given to the parents. TABLE VII below shows results of the questionnaire survey conducted following the briefing session given before the second school. Positive evaluation occupies more than 80% of the total for all the four sub-items of level of understanding about the place for activities, level of understanding about the activities, degree of interest, and possibility of continuation, indicating that the parents generally give good marks.

2) Evaluation based on results of the questionnaire survey after the school

A questionnaire survey of 15 parents was conducted following the open class given after the second school, with 13 valid responses received. Like in the class given to the students after the second school, presentation using the Web-GIS was provided during the open class. TABLE VIII below presents results of the questionnaire survey conducted following the open class. While positive evaluation by the parents constitutes more than 80% of the total for the level of understanding about the activities and outcome as well as for possibility of continuation, positive and negative evaluation are almost equal in proportion for the degree of interest. The percentage of positive evaluation for the sub-item is remarkably lower compared to the questionnaire survey conducted before the school. This is presumably because the parents became less interested and/or found no need to view the Web-GIS after the

end of the second school.

F. Issues to be Solved

The results of evaluation by the users (teachers, instructors, students and their parents) provided in this chapter clearly show issues to be solved from the viewpoint of teachers in particular. These include:

(1) Establishment of the GIS and Web-GIS that will easily represent teaching materials developed by teachers

1) Establishment of facilities/system that allow quick use at a classroom

2) A written guide for learning about the GIS and Web-GIS, as well as widespread of packaged software providing easy accessibility

(2) Improved significance of the use of the GIS and Web-GIS for their widespread

1) Increased number of examples of actual use in a class

2) Training session given to instructors-to-be, and technical guidance provided to teachers

3) Development of personnel with capabilities to give a briefing on the purpose of introducing the GIS and Web-GIS to chiefs (principal and chairman of a school board)

VI. CONCLUSIONS AND ISSUES TO BE STUDIED

Conclusions of the study boil down to:

(1) An eight-step outdoor education program based on the Web-GIS was proposed for a "second school" of an elementary school that was then implemented before being evaluated by users (teachers, instructors, students, and their

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parents).

(2) The program generally received a good evaluation, while a lot of students and their parents evaluated negatively for the degree of discovery and for the degree of interest, respectively, in the questionnaire survey of students and their parents conducted after the "second school". The surveys clearly show that an issue to be solved, from the viewpoint of teachers in particular, is the establishment of the GIS that will easily represent teaching materials developed by teachers and of Web-GIS, and improved significance of the use of the GIS and Web-GIS for their widespread.

An issue to be studied includes application of the outdoor education program proposed by the authors to the other elementary schools.

NOTES

1) "Denshi Kokudo", a concept proposed by Geographical Survey Institute, Ministry of Land, Infrastructure, Transport and Tourism in around 1999, refers to Digital Japan (cyber space).
2) Kashmir 3D is an application software for GIS that provides functions including analyzing view of mountains, creating 3D computer graphics of landscape, real-time flight simulation, analyzing GPS data, and creating hyper maps.
3) Pukiwiki, one of those called WikiEngines, is a content management system (CMS).
4) "Flow Chart of Web-GIS based Aid for Outdoor Activities" is available at:http://www.ohta.is.uec.ac.jp/yamamoto/gis

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