Science Fieldworks leveraging Plant Information Search System using Cellular Phones: A Case Study

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Abstract
This article discusses the value of cellular phones use in science education. 74 elementary school students participated in this research. They were connected to the plant information search system for cellular phones which was constructed by National Institute for Educational Policy Research (NIER) of Japan. They retrieved plant information using cellular phones via the Internet. The results were as follows: (1) pupils learned about plants in the field, and retained the knowledge for at least a week, (2) the score of ‘interest’ increased, (3) the score of ‘motivation’ also increased. It is believed that cellular phones could be one of the most effective tools for fieldwork in science classes because students could access information immediately in the field.

1. Introduction
It is important to cultivate a students’ capacity for scientific attitudes through observations in fieldwork [1][2]. In recent years, science students often go to outside their classroom for field observation. At that time, they usually do a sketch of plants, insects, or geological layer and so on.

The hypothesis of this research is that cellular tools can support science classes effectively [3]. In the field, students want to know about various things immediately. If they have a mobile terminal, they can retrieve information instantly from a search system via the Internet.

The purpose of this study was to practice fieldwork in science classes with cellular phones, and to evaluate the effectiveness of cellular tools in science education.

2. Method
2.1 Fieldwork
The fieldwork with cellular phones practiced at 12th of October in 2002 at Hitoyoshi Municipal Tokan Elementary School of Kumamoto prefecture in southwest part of Japan.

In the classes, 74 elementary school students of K-4 grade participated and studied a unit ‘Nature in autumn.’ In the Unit, two classes were studied. There were 12 phones in total, one for each trio of students.

During fieldwork, the pupils identified a number of plants. They accessed and searched the plants’ name, characteristics, and so on, from the plant information search system using a cellular phone. Then, the pupils sketched the plants and made a brief note of their characteristics.

2.2 Plant information search system
The plant information search system for cellular phones was developed by the Center for Educational Resources in National Institute for Educational Policy Research (NIER). It was specialized for students to allow them to study science using cellular phones or PCs via the Internet.

Table 1 shows the system specification. The system contains two special features. One of them is to convert a 360x360 pixels picture into 120x120 pixels automatically, in order for it to be displayed on cellular phones, using ‘ImageMagick.’ Another is to detect the

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carrier of the cellular phone and to generate a contents page for each phones’ markup language. The markup language for a cellular phone is different for each carrier in Japan, Compact HTML, HDML, MML and so on.

Figure 1 shows the overview of the Plant Information Search System. A learner inputs search conditions into a browser of a cellular phone (or a personal computer). The web server in the Plant Information Search System creates the SQL sentence based on search conditions. Plant information is searched with the SQL sentence from a database. In accordance with learner’s terminal judged from HTTP REFERER, it resizes automatically in the picture suitable for the kind of terminal. And then, plant information is displayed on a browser.

The plant information on 127 kinds of "grass and flowers," and 15 kinds of "trees" was registered into the database (as of December, 2003). Besides a plant, the "insect," the "bird," and the "fish" were registered. It is extending so that it can use for all kinds of fieldworks.

2.3 Analysis of effectiveness

In order to discuss the effectiveness of the fieldwork using cellular phones, multiple-choice recognition tests and questionnaires were used.

In the recognition tests, 13 full color printed plants were shown to pupils, and they selected the correct name from 13 items. The tests were done 3 times, before the fieldwork, after it, and a week after.

There were 18 items in the questionnaire, but this article reported mainly 4 items which categorized 'interest' and 'motivation.' The questionnaires were done 4 times, a week before the fieldwork, just before it, just after it, and a week after. The mean scores were calculated on the total number of 68 pupils using a scale of 1-4, with 1 representing 'strongly disagree' and 4 indicating 'strongly agree.'
**Fig 2:** Pictures of Students Activity in the Field

**Figure 3:** Score of Recognition Tests

**Figure 4:** Score of Interesting

**Figure 5:** Score of Motivation
3. Results and Discussions

Figure 2 shows pictures of students’ activity in the field. They could use cellular phones easily and could search information of plants.

68 elementary school students participated fully in the recognition tests, so their data was used to analyze the effectiveness of the fieldwork for knowledge.

Figure 3 shows the mean scores of recognition tests. The scores of ‘just after’ the fieldwork and ‘a week after’ the fieldwork increased. The differences of the scores were tested using one-way analysis of variance (ANOVA) within groups. The analysis of the scores showed a significant main effect ($F(2,134)=87.95$, $p<.01$). Follow-up analysis using LSD procedure revealed that ‘just after’ the fieldwork and ‘a week after’ the fieldwork scored significantly higher than ‘just before’ the classes. The pupils learned about plants using cellular phones in the field, and their knowledge was retained for at least a week.

Figure 4 shows the mean scores of ‘interest’ items of questionnaires. The analysis of the scores on the item ‘I’ll be excited to observe plants.’ showed a significant main effect ($F(3,198)=5.85$, $p<.01$). Follow-up analysis using LSD procedure revealed that ‘just after’ the fieldwork and ‘a week after’ the fieldwork scored significantly higher than ‘a week before’, and ‘just after’ it scored significantly higher than ‘just before’ it. It was considered that the score of interest increased because of the effectiveness of immediate access the plant database using the cellular phones in the field.

Figure 5 shows the mean scores of ‘motivation’ items of questionnaires. The analysis of the scores on the item ‘I’d like to do some research on plants on the Internet using a cellular phone.’ showed a significant main effect ($F(3,198)=3.45$, $p<.05$). Follow-up analysis using LSD procedure revealed that ‘just before’ and ‘just after’ the fieldwork scored significantly higher than ‘a week before.’ It was considered that pupils found that cellular phones were one of the most useful tools to research something.

4. Conclusion

In this research, 74 elementary school students of K-4 grade participated. In the fieldwork, pupils connected to the plant information search system for cellular phones which was constructed by NIER, Japan, and retrieved plants information using cellular phones.

The results showed as follows: (1) pupils learned plants in the fieldwork and their knowledge wasn’t lost in oblivion at least for a week, (2) the score of ‘interest’ increased, (3) the score of ‘motivation’ also increased. It was considered that cellular phones could access the information immediately in the field.

Therefore, cellular phones could be one of the most useful tools to encourage learners’ interest and motivation in science class fieldwork.

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References

