Utilization of Geographic Information Systems in Education Reform in Japan

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SUMMARY

The use of GIS in education in Japan has not yet widely been distributed, even though its effectiveness and the successful classroom practices with this tool have been reported. In recent years, along the education reform, "the integrated study" program has been launched in all elementary and secondary schools. At the same time, the computing environments in classroom have been improved. Circumstances for using GIS in schools seem to be almost ready; however, only some motivated teachers have been using GIS for their classes. It's clear that the utilization of GIS in education depends a lot on teachers who decide to use this tool in lessons. To enable more utilization of GIS in education, in-service teachers and students in teacher training in universities or collages need to get not only knowledge of GIS and its method of operation but also facilitation skills to involve students and generate ideas with GIS in classes.

KEYWORDS: *GIS in education, Education Reforms, Teacher training*

INTRODUCTION

The effects of Geographic Information System (GIS) in education have been discussed in the last decade and many practices with this tool in K-12 and university level have been introduced in Japan. The potentials of utilization of GIS have been pointed out not only in geography but also in other related subjects in recent years (Akimoto 2003), however, GIS is not actually in wide-spread use in the field of education. This article provides the status quo of GIS in education in Japan and suggests future directions to utilize this tool.

JAPANESE EDUCATION REFORM AND INTEGRATED STUDY

Education reform in Japan has been discussed for decades. In recent years, it has been pointed out decrease in educational functions at home and in society and heightened calls for education oriented toward individuality and competence of the children. Reflecting these demands, The Curriculum Council of The Ministry of Education brought up a five-day week system, reduction of number of lessons and introduction of the "integrated study" program in 1998. In accordance with a report by the council the National Curriculum Standard Reform for elementary and secondary schools was announced in the same year. The integrated study program, one of the notable changes in the new curriculum standard, is interdisciplinary learning. The main aim of the course is to give pupils and students problem-solving abilities and a voluntary and creative attitude toward questions which they find by themselves. Since 2002 the integrated study program has been officially launched in compulsory education, and this course was also introduced in high schools from the next year on.

This new educational curriculum shows only the guidelines for the integrated study program. Although the new curriculum mentions international understanding, information technology, environment, welfare and health as examples of topics to be handled in the program, the curricula suggest that themes in the programs should be made involving pupils and students' interests or ideas. Furthermore, they say that it's effective to utilize in the lessons the resources of a local community where the school is located in. One of the goals of this subject is to enhance students' intellectual creativity and logical thinking ability through experiences of learning and solving issues from diversified viewpoints. The main approach used in the integrated study program is making pupils to see things from different perspectives. It is similar to the approach used in geography which has been

developed in relationship to various other disciplines. Therefore, some geographers have pointed out the possibility to adjust the way of geographic approach to the integrated study program's approach (Ida 2002). GIS also has basically the cross-discipline characteristics. This tool can be applied to different fields and it can visualize different kinds of spatial data on maps which will help to understand issues deeply. GIS has potential to change the traditional approach. Some teachers have already used this tool in the integrated study program (Itoh et al. 2005). However, it's hard to say that GIS is being positively utilized in geography or the integrated study program.

CURRENT SITUATION AND POSSIBILITIES OF GIS IN K-12 EDUCATION

The term "GIS" has been introduced in geography text books for high school since 1995. Therefore a number of experimental lessons with GIS have been reported in recent years (Itoh 2002, Itoh et al. 2005, Tani et al. 2002). Actually these studies revealed that the use of GIS has been growing gradually in mainly geography classes in lower and upper secondary schools in Japan. At the same time these reports indicated the existence of some motivated teachers who know the characteristics of GIS. These teachers have reported their experiences of using this tool in classes of geography, information or integrated study. A handful of teachers are surely using computers including GIS frequently, whereas GIS has been still out of the mainstream in classes. One of the reasons why GIS has not been distributed in K-12 education might be that the National Curriculum Standard has not forced the schools to use GIS in a class. The curriculum just highly recommends using computers and information and telecommunications network. But in these studies, some problems have always been pointed out as disincentives for using GIS in classes. These problems are computer environment, software and data and the quality of teachers.

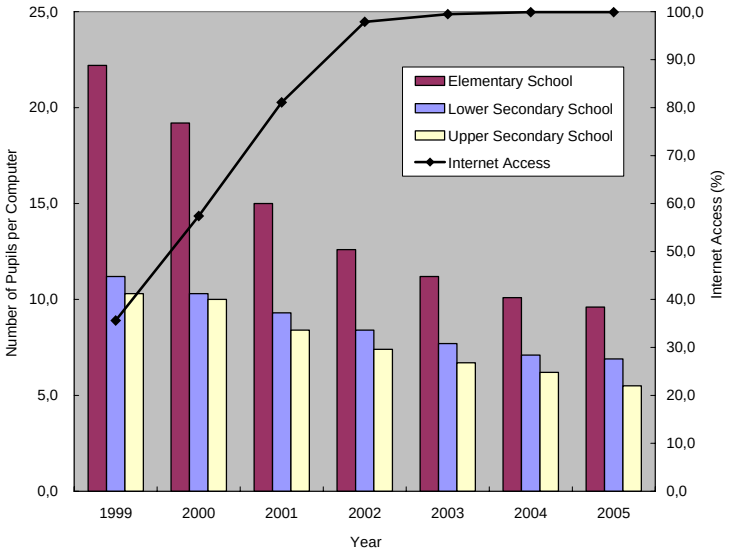

Figure 1: Number of Pupils per Computer in Elementary and Secondary Schools and Internet Access in Schools in Japan
Source: MEXT(2005)

Along the education system reform, the computer and network environment in schools has been dramatically improving for several years. Since government of Japan propounded to reinforce IT-driven education in 2001, all schools have installed computers on the initiative of the government.

Today, every school in Japan has computers and has access to the Internet[15]. In elementary schools 9.6 pupils shared one PC, in lower secondary schools 6.9 students shared a PC and 5.5 students used a PC in upper secondary schools in 2005 (Figure 1).

The computing environment in schools has almost reached a sufficient level. Most of problems on computers and peripherals in classes seem to be dissolving. Along with these improvements the environment for the use of GIS in schools has become better and better. GIS software and data are generally expensive and schools can't afford them within their small budgets, though, nowadays these circumstances have been changing. In these years there has been a movement toward development and provision of free GIS software for education[16]. The government of Japan has realized the effectiveness and impact of GIS to various fields long before, Ministry of Land Infrastructure and Transport has provided some free GIS applications to make more people acquainted with this tool since 2003. Today Geographical Survey Institute supplies 1:25,000 topographic maps and 1:2500 and 1:25000 digital map data on the web. These maps and data can be used in classroom without permission from the institute. Also major GIS companies are distributing free map viewers and related data and files and some of them have launched donation programs to provide sets of software and support their usage in schools. Furthermore some universities and municipalities have set up web GIS for education. On these web sites users can add their original data, make their own maps and get thematic maps by statistic data[17].

Many contents on the web have been already provided for teachers who say no ideas for lessons. IT environment in schools is almost in order. In addition, it's possible to get many kinds of statistical and spatial data from the web sites. The percentage of teachers who are able to teach with computer is over 70% across all school types[18]. Computers have already taken root in class rooms in all schools. Now it has already become difficult to blame computer environment for the underutilization of GIS. However this tool hasn't significantly penetrated into classrooms yet. These things show that user's technical abilities, ideas for lessons or the accessibility of data cannot become fundamental solutions to the utilization of GIS.

Now it would not be an exaggeration to say that the use of GIS as a tool for lessons depends on teachers themselves. They should know GIS in some way because we are living with this tool today. We can get much information interactively with maps freely on the computer or the cellular phones. There are many services supported by GIS transparently and we are using it without regard to this tool. In other words, GIS is a popular 'invisible' tool for us today and our daily lives rely on this tool in many aspects. Yet teachers don't adopt that in their classes. One of the reasons why GIS hasn't been accepted widely in education might be that many of the teachers have neither studied it before when they were students nor had experiences to use GIS as an education tool before. Although GIS started to develop in 1960s, it became widely known in 1990s. Coincidentally GIS have been introduced in geography and relevant fields in universities. Therefore, the absolute number of teachers who have studied GIS in university is small. The lack of teachers with GIS literacy can be also explained by the schoolteachers' licensing system. Since geography as a subject belongs to the social studies, people who have studied other disciplines in social sciences or humanities like history, economics, politics or sociology in a university can get a teaching qualification in geography and history in lower and upper secondary school under the existing system. Actually a number of teachers without the learning experiences of geography as a major are teaching geography in schools. It is

[15] 84.0% of schools use a broadband Internet connection (MEXT 2005).
[16] MANDARA (http://www5c.biglobe.ne.jp/~mandara/) and Kashimir 3D (http://www.kashmir3d.com/) are famous representative examples of free GIS software.
[17] For instance, http://land.geo.tsukuba.ac.jp/teacher/murayama/
[18] The percentage of teachers who can use computers is over 90% across all school types, and the percentage of teachers who can teach with computers is 74.0% (MEXT 2005).

necessary for the utilization of GIS that users have a geographical way of thinking. The geographical way of thinking helps to read many phenomena from overlapping information on a map and this skill can be acquired through geographical education. From this point of view, it can be said that for these kinds of teachers it must be hard to accept this tool into their lessons. Due to these factors, GIS haven't considerably penetrated into the field of education.

TRENDS OF SUPPORTS FOR TEACHERS

The fact is that the number of teachers who have had adequate knowledge and skills of GIS is not sufficient at the moment. Actually, for using GIS not only operation skills but also understanding fundamental ideas of the system are required. Teachers have many small jobs besides teaching and are learning more in the limited time. It is very hard for them to acquire fully new knowledge and skills. What really matters to utilization of GIS in classes is the empowerment of the teachers making use of their limited time. To salvage the situation, academic organizations and universities have convened many in-service training programs to support GIS usage (Itoh 2004). Aims of these programs have been mainly to provide GIS knowledge and skills of operation to teachers as participants. The GIS Association in Japan and the Human Geographical Society of Japan have had GIS courses on the GIS Day since 2002. Some of these courses have been targeting teachers. Also other workshops and symposiums co-hosted by a voluntary association for GIS in education[19] and an academic society or university have been provided for active teachers. In these programs teachers not only learned what GIS is but also exchanged opinions among other participants, lecturers and GIS vendors. These efforts seem very effective and help to recruit new users. But in fact these events always involve the same few motivated teachers. Hereafter we must keep providing learning opportunities for ordinary teachers where they can join easily. Besides we need to develop training programs targeting teachers who don't know what GIS is.

INTEGRATED STUDY AND GIS

As has been mentioned, issues dealt with in the integrated study program are flexible as far as it gives students the possibility to decide by themselves. This means that this subject can be developed arbitrarily with students, teachers and others. GIS is a flexible tool which can deal with all types of spatial data, hence this is not only a tool for geography but also can be used in biology, chemistry, history, computer science, language studies and so on (Johansson 2005). With information integration skills and presentation tools like maps GIS can play a leading role in classes. And also if more teachers realize the flexibility of GIS, they can develop more unique integrated lessons with this tool. These are the main reasons that GIS has been highly recommended for this subject, though, the utilization of GIS depends, in large part, on teachers' experiences and knowledge. The same can be said for the integrated study.

Although the integrated study was introduced with anticipation into the school curricula, the characteristics of the lessons, flexibility and ambiguity, mix up teachers and, in a way burden them. Ida (2002) indicates that teachers have 3 sorts of confusions: choice of issues in classrooms, contents of classes and teaching methods. These confusions are due to the vagueness of the guideline and the role of the teacher in this subject. In the program a teacher rather acts as a facilitator and is required to have not only specialized but comprehensive knowledge to lead discussions and develop students' ideas. To acquire facilitation skills, teachers have to change their ways of thinking. Teachers are expected not only to give knowledge to students but also develop students' abilities in a society. To deal with diverse students, unique issues and new tools like GIS, the flexibility of thinking skills will be required more for teachers.

[19] GIS Forum for Education, a voluntary association, was established in 2002 by university professors and major GIS vendors as a bridge sector to involve teachers in schools and consider utilization of GIS.

Now, teachers need to change fundamentally. From this point of view education in a stage of teacher training at a university will become more important in the future. Elementary schoolteachers have learnt all subjects because they must teach basically all subjects by themselves. On the other hand teachers in lower and upper secondary schools can concentrate in their own subject areas. Naturally the curriculum for teacher training at university has been designed in line with teachers' roles in schools. Therefore would-be teachers have had little chance to know other students in the different major subjects at university. If there would be a course to make a project using GIS with people from different fields of studies, students could learn ways of facilitation and get an experience of carrying out a project with diverse opinions. When they work as teachers in schools, actually they will work with various students and many teachers from different majors. Then they will have many opportunities to hear and summarize different opinions and, in addition, visualize and share results. GIS, that can show not only image and texts but also space relationships, can be used as a key tool for facilitation. It is essential to develop human resources who can use GIS regardless of specialty.

It is needed for future teachers at university to know GIS operation and analysis to develop enriched lessons when they become real teachers. At the same time they must consider and understand how to use GIS with people. Universities and colleges have to provide more programs that meet the needs of compulsory and secondary education. Higher education refluxes directly to the basic education. Universities will have much to contribute to society. Increased use of GIS in higher education will nurture teachers who can use this tool with flexible ideas. These teachers are expected to make a basis for utilization of the tool not only in elementary and secondary schools but also in our society.

CONCLUSION

The education reform in compulsory and secondary education brought a new curriculum which utilizes GIS in schools. At the same time infrastructure of computing environment in schools is being put into place, though, current status of GIS haven't been changed so much. Now it is clear that the problems for utilization of GIS are teachers' skills and their ideas for using this tool. Universities or colleges which foster future teachers will need more changes in their curriculum such as adding exchange between people in diverse fields besides GIS education. This problem is not only in Japan. It will occur in European countries after clearing problems of computer environment, software and data. Here we need again to recognize that all levels of schools from compulsory to higher education are linked in some way or another. To utilize GIS in education it is absolutely necessary to support teachers developing classes in many aspects like providing contents, data or ideas and to try to keep their qualities high.

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