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Applying the GIS in school education: the experience of Japanese geography teachers

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This article describes the main difficulties and barriers which reduce Japanese geography teachers' efforts to apply the Geographic Information System in teaching in order to promote geographic skills in students. The article provides the status quo of the GIS in education in Japan and suggests future directions of how to utilize this tool.

Key words: Geographic Information System (GIS), information technologies (IT), geography education, integrated studies, teaching methods

INTRODUCTION

The use of computerized information is a growing part of everyday life. More and more people around the globe are plugging into geographic, social, economic, political and environmental information to answer practical questions in their lives.

To explore this growing part of everyday life, people use a range of electronic tools designed for acquiring and presenting information and interacting with it. One of such tools is the Geographic Information System, known as GIS. Basically, *GIS is a system designed for storing, updating, analysing, displaying and manipulating spatial data – information about places on the planet. This system uses the power of the computer to answer geographic questions by arranging and displaying all kinds of data about places in a variety of ways such as via maps, charts and tables.*

The effects of the Geographic Information System in education have been discussed in the last decade, and many practices with this tool on secondary school and university levels have been introduced in Japan. The potentials of GIS utilization have been pointed out not only in geography but also in other related subjects in recent years. However, GIS is actually not widespread in the field of education (Yuda, Itoh, 2006).

GEOGRAPHY TEACHING AND GIS INTEGRATION IN JAPAN

The use of the Geographic Information System (GIS) in education in Japan has not yet widely been distributed. It is because there are few teachers skilled in GIS and some of the software is expensive (Ida, 2006). In recent years, along the education reform, an "integrated study" program has been launched in all elementary and secondary schools in Japan. At the same time, the computing environments in classroom have been improved. The conditions for using GIS in schools seem to be almost ready. However, only some motivated teachers have been using GIS for their classes. It is clear that the utilization of GIS in education depends a lot on teachers who decide to use this tool in lessons. To enable a wider utilization of GIS in education, in-service teachers and students in teacher training universities or collages need to get not only knowledge of GIS and its method of operation, but also skills to involve students and generate ideas with GIS in classes (Yuda, Itoh, 2006).

The term "GIS" has been introduced in high school geography textbooks since 1995. Therefore, a number of experimental lessons with GIS have been reported in recent years (Itoh, 2006). These studies educe that the use of GIS has been growing gradually, mainly in geography classes in lower and upper secondary schools in Japan. At the same time these reports have indicated the existence of some motivated teachers who know the characteristics of GIS. These teachers have reported their experience in using this tool in classes of geography, information or integrated studies. A handful of teachers surely often use computers including GIS, whereas GIS has been still out of the mainstream in classes. One of the reasons why GIS has not been distributed in secondary education might be that the National Curriculum Standard has not forced schools to use GIS in a class. The curriculum just highly recommends using computers and information and telecommunication network. Other problems for using GIS in classes are the computer environment, software and data, and the quality of teachers.

Now, it would not be an exaggeration to say that the use of GIS as a tool in lessons depends on teachers themselves. They should know GIS in some way because they live with this tool today. Teachers have to get much information interactively with maps freely on the computer. There are many services supported by GIS, and teachers can use them without regard to this tool. As Satoru Itoh has mentioned, 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 it 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 experience in using GIS as an education tool before. Although GIS started to develop in the 1960s, it became widely known in the 1990s. Coincidentally, GIS has 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 social studies, people who have studied other disciplines in social sciences or humanities, such as history, economics, politics or sociology, at the 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 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, for this kind of teachers it must be hard to introduce this tool into their lessons.

CLASS OBSERVATION

During the research (2007 September 10 – November 22), there were observed three geography classes at junior high schools and one at an upper secondary school in Japan. The class observation in an upper secondary school was done at the Komaba school. Two observations were done in the Keio Gijyuku Futsubu junior high school. One more geography class was observed at the Tsukuba Daigaku Fusoku junior high school. These schools are advanced schools in using GIS and cannot be considered as representative in GIS use for geography lessons in junior high schools in Japan. These schools can serve as a very strong guide for employing GIS in geography lessons at lower secondary schools of Lithuania.

The main purpose of the observation was to get acquainted with the teaching methods and the ways of GIS integration in geography teaching to promote pupils' geographical skills.

The geography class observation has shown that apart textbooks and paper maps, Japanese geography teachers use many innovations in teaching, such as computers, the Internet, projectors, video, geographical computer programs ("Green Map"), GIS programs such as "Chizu Taro", computer application programs ("Power Point", etc.).

The noteworthy points observed are as follows:

1. Innovations can motivate and encourage students to learn, because they are very interested with the lesson and want to use the computer or any geographic computer program provided for each activity of the class in order to improve geographical skills.

2. Some students do not know how to use some software. As a result, they get bored with the whole class activities.

3. Some students do not want to work with GIS, because they are afraid to make mistakes.

4. GIS in education could be used at different levels, depending on pupils' learning abilities, knowledge of GIS and of the teaching subject.

5. Moreover, the Geographic Information System is not only a tool that supports the teaching–learning process. It is also a method which helps students and teachers engage in studies that promote critical thinking, integrated learning, and intelligence at any grade level.

6. The teachers must be competent enough to work with the Geographic Information System.

INTERVIEW WITH GEOGRAPHY TEACHERS

We interviewed five geography teachers. The interview lasted about 50 minutes. The information obtained during the interviews shows the situation of geography teaching in a junior high school in Japan in two aspects: teachers' perception of using GIS in teaching and the way of using the software and the results.

During the conversation, some teachers have argued that GIS really increases students' geographical skills. However, teachers should have definite goals when using technologies in class. For example: "*Teachers should integrate the Geographic Information System when they are doing with students some projects in which pupils must compile their own maps or make a presentation*".

The interview has shown that only few Japanese geography teachers are able to use GIS during their lessons in junior high schools. They argue that there are a lot of difficulties in applying the GIS software into teaching. Teachers have no competence enough to work with the software, lack time because they are very busy working in other spheres. Some schools even cannot buy the GIS software because the license is expensive. Moreover, some students in lower secondary schools do not have enough skills to use a computer or manage software.

RESULTS OF QUESTIONNAIRES

The questionnaires were distributed among 15 junior high school geography teachers in Ibaraki Prefecture and Tokyo. It was decided to give these questionnaires only to teachers from special schools which are attached to universities, to avoid asking for the permissions from schools principals. The content of the questionnaires concentrated on GIS integration into geography teaching in junior high schools.

The results of the questionnaires showed that 11 teachers had been using information technologies during geography lessons (Table 1).

Table 1. **Use of information technologies in geography teaching**
1 lentelė. **Informacinių technologijų taikymas mokant geografijos**

Do you integrate information technologies in geography lessons? *Ar taikote informacines technologijas per geografijos pamokas?*	Number of teachers *Mokytojų skaičius*	Respondents (%) *Respondentai (%)*
Yes / *Taip*	11.0	73.3
No / *Ne*	4.0	26.7

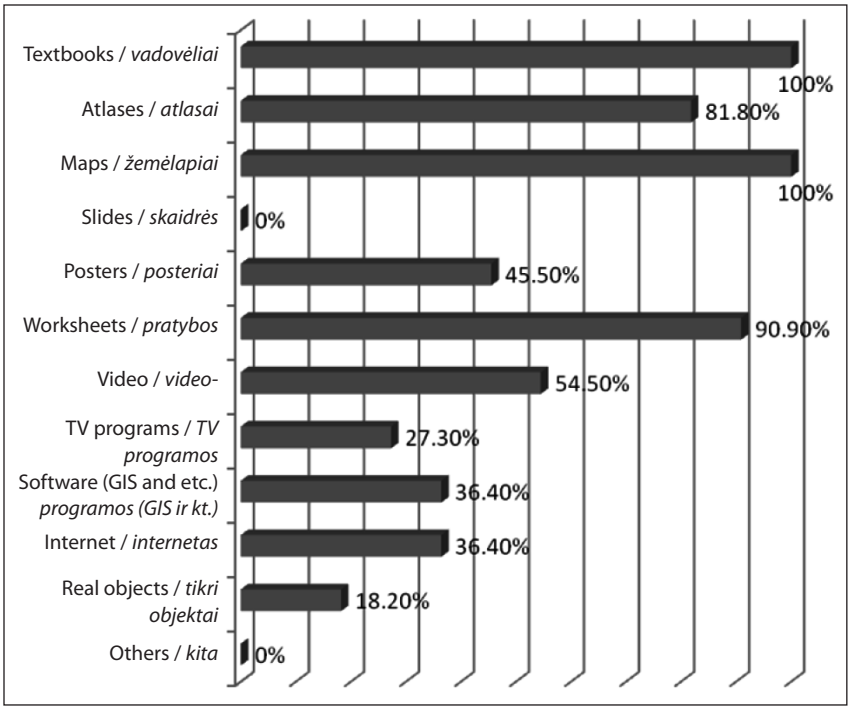

Fig. 1. Teaching aids used in geography lessons
1 pav. Per geografijos pamokas naudojamos priemonės

Figure 1 shows that all teachers use textbooks and maps. But they rarely use teaching materials such as TV programs, Internet, GIS and video. It is really surprising that teachers do not use slides at all.

Table 2 shows that some teachers use GIS in their lessons quite often. But they argue that it depends on the topic of the lesson or some project stages.

Table 2. **How often do you use GIS in geography lessons?**
2 lentelė. **Kaip dažnai jūs naudojate GIS geografijos pamokose?**

How often do you use GIS in geography lessons? / *Kaip dažnai jūs naudojate GIS geografijos pamokose?*	Number of teachers *Mokytojų skaičius*
1 hour / *1 valandą*	5
2 hours / *2 valandas*	2
1 or 2 times into two weeks / *1 ar 2 kartus per dvi savaites*	3
1 time per month / *1 kartą per mėnesį*	1

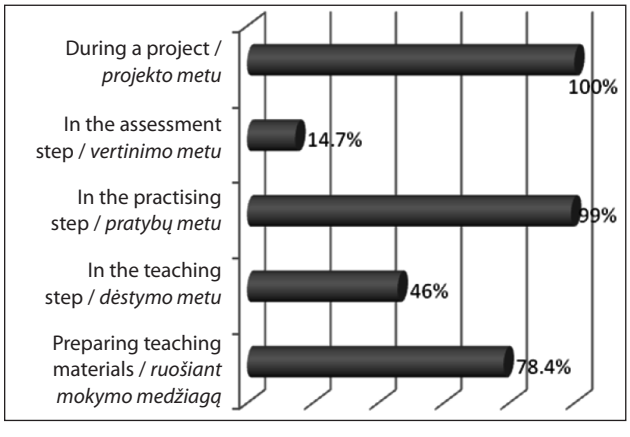

Fig. 2. At which stage do you use GIS in geography teaching?
2 pav. Kuriuose geografijos mokymo etapuose naudojate GIS?

According to Fig. 2, teachers and students use GIS mostly in different projects. It is also clear that GIS is not a very popular tool in the assessment step.

Table 3 shows that the main purposes of using GIS in the class are to encourage students to learn by doing and thus to promote their self- learning and also to form a positive attitude toward learning geography.

Table 3. **Reasons for integrating GIS into geography teaching**
3 lentelė. **Pagrindinės GIS naudojimo mokant geografijos priežastys**

The main reason why you integrate GIS in geography teaching / *Pagrindinė GIS naudojimo priežastis*	Respondents (%) *Respondentai (%)*
GIS enables students to learn by doing / *GIS suteikia galimybę dirbant mokytis savarankiškai*	100%
GIS enables to develop students' geographic skills / *GIS ugdo geografinius gebėjimus*	80%
GIS enables to work using new technologies *GIS suteikia galimybę mokytis dirbti su naujomis technologijomis*	60%
GIS enables students to develop a positive attitude toward geography / *GIS formuoja teigiamą požiūrį į geografiją*	100%

In general, geography teachers think that the GIS helps students to improve geographical skills, and they recommend to use innovations along with the traditional methods of teaching.

CONCLUSIONS

Analysis of the literature, interviews with Japanese of teachers geography, visiting lessons in classes have shown that geography teachers see many benefits of integrating information technologies, especially GIS, in junior high schools:

1. Integrating GIS into teaching geography is necessary for developing the education system and society.

2. The GIS enables teachers to better engage and motivate pupils as regards geographical concepts.

3. Using GIS software in compiling and reading maps can save time and give better results.

4. The GIS allows more time for observation, discussion and analysis.

5. Using IT increases the opportunities for communication and collaboration.

6. In junior high schools, it is enough to use simple GIS programs. These programs are not expensive, some of them are possible to download from the Internet free of charge or to use them online.

7. Using IT during geography lessons does not mean that teachers have to abandon traditional methods of teaching. Conversely, they have to endeavour to use both teaching methods together.

8. It is not necessary to use GIS in all lessons. It depends on the topic of a lesson.

9. The best way to start using GIS in junior high classes is when pupils are doing some research or participate in projects.

It is clear that information computer technologies have a lot of advantages in geography education. GIS implementation in comprehensive education is quite a complicated and long process. The results of this study show that one of the most important things on which we have to concentrate now is educating geography teachers and helping them to understand how GIS could improve geography teaching. This problem exists in both Lithuania and Japan.

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GEOGRAFINIŲ INFORMACINIŲ SISTEMŲ TAIKYMAS MOKYKLOJE REMIANTIS JAPONIJOS GEOGRAFIJOS MOKYTOJŲ PATIRTIMI

S a n t r a u k a

Pastaruoju metu vis dažniau pažangūs mokytojai stengiasi naudoti Geografines informacines sistemas pamokų metu. Šiame straipsnyje kalbama apie GIS naudojimą geografijos pamokose remiantis japonų geografijos mokytojų patirtimi.

Pastarąjį dešimtmetį Japonijos pedagogai daug diskutuoja apie GIS naudojimą vidurinėje mokykloje ir jų poveikį mokinių žinių įsisavinimui. Nors kalbama daug, tačiau geografijos pamokų metu GIS nėra labai dažnai taikomas metodas (Yuda and Itoh, 2006).

Pastaruoju metu Japonijos pagrindinėse ir vidurinėse mokyklose pamokos labai stipriai kompiuterizuotos. Vyksta integruotos studijos, mokiniai gilina savo žinias per pamokas naudodami įvairias mokomąsias kompiuterines programas. Jau nuo 7 klasės mokiniai per geografijos pamokas dirba su skaitmeniniais žemėlapiais, tačiau GIS naudoja tik nedaugelis mokytojų (Yuda and Itoh, 2006). Kodėl taip yra? Egzistuoja keturios rimtos problemos:

1. Japonijos bendrosiose programose ir standartuose nėra griežtų nurodymų, o tik rekomendacijos naudoti GIS geografijos pamokose, todėl mokytojai gali laisvai rinktis kitus mokymo metodus.

2. Ne visai tinkama mokytojų licencijavimo sistema. Japonijos aukštųjų mokyklų studentai, studijuojantys pedagoginiuose universitetuose socialinius mokslus (istoriją, politologiją, sociologiją ir pan.), taip pat gauna licenciją dėstyti geografiją. Tokie geografijos mokytojai nėra kompetentingi dirbti su GIS.

3. Vyresnieji mokytojai turi didelius pamokų krūvius ir neturi laiko mokytis dirbti su GIS. Jie večiau renkasi tradicinius mokymo būdus.

4. GIS licencija yra brangi, todėl ją dažniausiai gali įsigyti tik privačios ar prie universitetų prijungtos mokyklos.

2007 m. rugsėjo–lapkričio mėnesiais buvo atliktas tyrimas Ibaraki prefektūros ir Tokijo mokyklose Japonijoje. Informacija gauta stebint geografijos pamokas, kalbinant geografijos mokytojus, jiems užpildžius klausimynus.

Teigiami GIS naudojimo aspektai:

1. GIS integravimas į kitus bendrojo lavinimo dalykus padeda sparčiau plėtotis švietimo sistemai.

2. GIS padeda mokytojams sudominti, motyvuoti mokinius, ir tai leidžia siekti geresnių rezultatų dirbant su kartografine medžiaga;

3. GIS suteikia mokiniams galimybę įsitraukti į komandinį darbą, padeda apdoroti informaciją ir pateikti ją žemėlapio pavidalu.

Pagrindiniai sunkumai, su kuriais susiduria mokytojai ir mokiniai, naudodami GIS geografjos pamokose:

1. Mokytojams trūksta kompetencijos dirbant su GIS.
2. Brangios GIS programų licencijos.
3. Mokytojams trūksta laiko pasiruosti darbui su GIS.
4. Žemesniųjų klasių mokiniai nėra pakankamai įgudę dirbti su šia programine įranga.

Nepaisydami sunkumų geografijos mokytojai rekomenduoja pagal galimybes taikyti GIS pamokose atsižvelgiant į jų turinį. Mokytojai pataria GIS jungti su tradiciniais mokymo būdais ir tuo paskatinti didesnį žinių įsisavinimą ir įgūdžių formavimą.

Tyrimas taip pat atskleidė, jog viena iš rimtesnių problemų yra Japonijos geografijos mokytojų abejingumas naujovėms. Būtina jiems išaiškinti, jog IT ir GIS yra labai svarbūs mokymo įrankiai tobulinant geografijos mokymo metodiką. Deja, ši problema egzistuoja ir Lietuvoje.