

How do we stimulate the interest for GIS in Swedish secondary schools?

Anders Wellving

Assistant Professor, Linköpings University, Institution of Technology and Natural Science, Sweden

Introduction

Courses in GeoInformation Science and Technology (GIS&T) started in Swedish higher education in the beginning of the 90's. We were also early in introducing GIS at schools compared to most other countries. An elective GIS course for students at the theoretical programmes in upper secondary schools was created already in 2000/01. The author of this paper wrote a special textbook on initiative of a publisher and a set of computer exercises were developed. The course was included in the subject Geography and hence primarily the geography teachers were supposed to offer it. Other teachers can however also give the course if they have GIS competence. The learning outcomes were formulated as shown in Figure 1.

The student should
Be familiar with modern cartography and GIS
Be familiar with different types of geographic information (GI)
Be able to work independently with GI in projects
Be able to do simple modeling of environmental parameters
Understand the importance of aerial photography in spatial planning
Be able to design cartographic presentations

Figure 1: Learning outcomes for the 50-hour elective course GE1203, Geographical Information Systems (source: Swedish National Agency for Education).

There are about 40,000 students per grade in the theoretical programmes (Figure 2). Several thousands of them were expected to choose the new GIS-course but in practise, only a few hundred have done this choice each year. It is a disappointment both for me as textbook writer and for the Swedish National Agency for Education (Skolverket), who believed that this course would stimulate the interest for technology and help the recruitment to different engineering professions.

Level	Grades	
Pre-school		Age < 7 years
Compulsory school	1-9	
Upper secondary school (gymnasium)	10-12	818 schools; 120 000 students; 40 000 in theoretical programs;
University		

Figure 2: The Swedish education system

At the moment there are only 15-20 upper secondary schools out of about 800 that offer the course GE1203. The number is not increasing over time. A common explanation to this is that elective course must have at least 15 students to be economically justified and the number of students that chose the course in a certain school are mostly less than that. Due to the low general interest, the course is under threat to be removed from upper secondary schools. My own opinion is that the GIS education should remain as a separate elective course and that radical efforts should be made to increase its popularity. But how do we stimulate the interest for the course?

Do we need GIS education at all?

At first, we can turn to the question of why the student should learn GIS. The Committee on Support for Thinking Spatially (NRC, 2006) argues in a well-founded report, which has had a great deal of attention, that students need to work with a computerized support system in schools in order to improve their "spatial thinking". Such a support system would preferably be a GIS software. Spatial thinking is said to be "based on a constructive amalgam of three elements: concepts of space, tools of representation, and process of reasoning". I fully agree with the committee's conclusions but I would prefer to put it in a less sophisticated way:

Students generally learn to use word processing, spreadsheets, Internet, image processing and other software's, even CAD in school. Why should they not learn to use GIS, which is the main tool to handle all kinds of spatial information?

Several other reasons could be added to the list, for instance that GIS promotes problem based learning and dealing with authentic data, pedagogic methods which are considered as stimulating for students. A substantial number of research projects have been focused on use of GIS in schools. Even if it is not finally proven that GIS is a valuable pedagogic tool I would claim that it is obvious that a GIS course should be included in the theoretical programmes in secondary schools.

Interviews

As mentioned above, there are only 15-20 secondary schools in Sweden that can offer a GIS course, and there is generally only one responsible teacher in each such school. I have had interviews with a handful of them in the preparation of this paper and also met or talked with some teachers that have considered offering the course but not fulfilled the intention. The interviewed persons teach geography or technology and they are generally more enthusiastic about GIS than the medium teacher is. They have acquired their competence on their own and often struggled to get resources for their GIS-labs. After the interviews, I have realized that the low number of schools with GIS-courses not is a result of low interest from the students but a combination of three related causes: the teachers have limited GIS competence, the students are not aware of the subject and the the school management gives poor support to the teachers

The teachers GIS competence

At a closer look at the situation I found that not only the students but also most teachers and school managers seem to show little interest for the GIS course. If a school cannot afford to the necessary equipment for a GIS-lab or if the teachers do not have sufficient competence, the marketing of the elective course will be poor and the students will be reluctant to choose it. The key issue is probably to get the teachers more interested. If they feel confident that they can arrange a good GIS course, they would certainly promote the course better and convince more students to choose the course.

The GIS courses are supposed to be given by geography teachers as it “belongs” to this subject. Most of them have studied geography in different universities during one or two semesters. According to professors at a couple of geography departments there are clear differences in the level of GIS education between universities. Some professors claim that their students get sufficient skills to arrange the elective GIS course (i.e. Linköping), others do not agree with that (i.e. Göteborg).

From interviews with teachers that actually provide GIS courses it is obvious that there is a demand for further GIS training even among them. There are some possibilities for adult training, primarily in the form of distance courses at Swedish or other universities. A few universities have designed special courses for adult teachers aiming at giving competence for teaching GIS in schools (i.e. University College in Dalarna). The numbers of participants in these courses have not however been large enough to make them permanent. My impression is that practising teachers for some reasons are reluctant to attend optional courses, at least in this subject.

The students awareness of GIS

In order to keep the interest among students alive it is important to provide a meaningful curriculum. The American GIS-professor Bob Coulter has said, “instead of seeking ways to get GIS into classrooms, we should be seeking ways to create meaningful learning opportunities in which the need for GIS is obvious”. According to him, the curriculum should support following generic goals formulated by U.S. Department of Education in 1997:

- Turning students on to a discipline;
- Making students think;
- Embodying high-quality content and pedagogy;
- Enabling meaningful classroom assessments; and
- Encouraging teachers to teach differently

I will not discuss the curriculum content in this paper, just give a good example how a course that seems to fulfill the goals above can be organized (Figure 3).

The course is extended over one semester
10 x 2 hours exercises combined with lessons in a computer lab; 1 student per computer
15 hours: Individual tasks with a GIS project
One study visit at a community department using GIS and at the county administration
Final presentation before the class
Software: ArcView 3
Data: local databases, ortophotos and digital maps from the county and community
Literature: a compendium with theory and ten exercises

Figure 3: Some facts about a popular GIS course which is held annually by a teacher in Kalmar

Exciting new technology is developing all the time and it should be included in the course agenda when relevant. There are for instance different kinds of web-application to explore, there are a lot of interesting data to download from all over the world, GPS's are rather cheap to buy and useful for data collection, almost professional presentations can be made using large size plotters, Internet and PowerPoint, and so on.

Support from the school management

An inspired teacher with good knowledge can often persuade a reluctant head-master or principal to allocate means for the necessary equipment. He or she can generally handle the technical problem that will occur. The ordinary geography teacher may however not be so skilled in dealing with the software and hardware's. The earlier mentioned Committee on Spatial Thinking (NCR, 2006) recognized this and stated that five different types of support to the teacher must be in place to implement GIS successfully: (1) material support, (2) logistical support, (3) curriculum support, (4) instructional support and (5) community.

This appears to be very demanding for the head-master, and even if I agree fully, I claim that most of the support either is available already or not very expensive to give. Much has happened during later years, for instance: there is a general increase in computer ability among teachers, there are free and cheaper software's which are designed for education and fairly easy to handle, there are possibilities to create project tasks in cooperation with communities because they are increasingly using GIS, and so on. What is needed is maybe only a handbook on how the teachers can find this support as easy as possible.

Common for the teachers in my sample is that they have lists of things they wish to have improved, such as

- Better training in the daily work with computers
- Special training in managing the GIS software and related problem solving
- Access to local data and digital maps for the exercises
- Help to design lessons and exercises
- A higher budget for purchase of software and databases
- Time to spend on personal training

Conclusions

When searching ways to stimulate the interest for GIS we must consider the situation for the students as well as the teachers and for the school management. The key issue seems to be to increase the number of competent teachers. There must be at least one in each secondary school, but ideally, there are several teachers with GIS knowledge or awareness in a school so that the students can use the tool in different subjects. Efforts should be made, if the school authorities are serious in their ambition to introduce GIS, to convince the teachers that GIS is useful for their classes and not very difficult to learn.

It is also important to make the students aware of the benefit of being able to master GIS software. The Swedish education system invites unfortunately the students to make tactic choices of elective subjects since the marks in each course have influence on the final overall mark. The student may therefore avoid courses with uncertain degree of difficulty. The student must become convinced that the opportunity to get training in "spatial thinking" give them an improved ability in several situations within or outside school.

A third conclusion is that the teachers need support when implementing GIS education. This has been stated by most of the interviewed persons and in international research and investigations. The support does not have to be very costly, however, and much of the needed information could be compiled in a handbook.

This paper is prepared on my personal initiative and with low budget. (My daily duty is GIS&T education and applied research regarding intelligent transport systems at Linköpings University). In order to bring the case “GIS in schools” in Sweden forward I propose some kind of working group with participants from school authorities, secondary school teachers and experienced GIS teachers and professors at university level. The group should first reach a consensus regarding the importance of GIS education in schools and continue by creating a plan for actions.

Finally, I have a comment to a proposal from the Swedish National Agency for Education (Skolverket) that the course GE1203 should be removed from the curriculum. The GIS stuff would be an optional component included in other courses, mainly Geography B. To me this seems to be a big step back. It would create problems for the geography teachers to decide which parts of the ordinary content that must be removed. More important it would mean that GIS education would be available only for those who study Geography B, which are a small part of the total number of students. Another objection is that only the geography teachers would be eligible for GIS education. My opinion is that the geography teachers generally are best suited for the task but that any teacher with great interest for the subject could be considered.

References

- Bob Coulter: *GIS - A Key to Educational Reform or Just Another Fad?* ESRI user conference 03. Downloadable as pdf from www.esri.com.
- NRC, 2006: *Learning to Think Spatially: GIS as a Support System in the K-12 Curriculum*. Committee on the Support for Thinking Spatially and The Incorporation of Geographic Information Science Across the K-12 Curriculum, Committee on Geography. Editors Downs, Roger, and Anthony de Souza. National Research Council and National Academies Press