

GI@School: GI Education and Marketing at High Schools

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SUMMARY

The Institute for Geoinformatics in Münster (IfGI) cooperates with High Schools in order to address two objectives simultaneously: i. Improving High School education by supporting the introduction of GI as an emerging topic into classes, and ii. To perform a marketing strategy for students' recruitment for IfGI's GI Bachelors program. IfGI students went into High Schools teaching short modules in GI Science. Based on the very positive feedback of High School students and teachers, we are already initiating to extend the measures, e.g., by GI training courses for teachers. A positive side effect was the introduction of new learning styles for GI undergraduates: They were guided to develop and teach the GI modules in High Schools. Being recognized as a regular course in "general studies", they acquired additional, non-technical key qualifications in teaching, didactics, and presentations.

KEYWORDS: *GI education, cooperation with High Schools, GI@School, marketing*

INTRODUCTION

GI Science (Geographic Information Science) found its way to the general public via tools such as Google Earth, navigation services etc. Education systems in many different countries have also took account for the relevance and the potential of GI, and have developed new strategies to implement GI as integral parts of their curricula. Often, GI entering education systems is a slow process:

1. High schools:
E.g. in Germany, GI is a standard compulsory component of High School curriculum in some states, whilst
 - It is either optional or does not even appear in other states (De Lange, 2006)
 - It focuses only on GIS instead of GI Services, Tools and GI Science
 - Many High School teachers lack the know-how for teaching GI
2. Universities:
GI study programs are emerging, but
 - Most students are currently not aware of the potential of GI and career chances. The result is a lack of applicants for GI study programs (in terms of both, quantity and quality), which inevitably results in a lack of educated GI professionals in industry.
 - Due to a demographic decrease of adolescents in many countries (e.g., Germany, Portugal, Austria), the quantity of people interested in attending university is going down.(Eurostat, 2007).

The IfGI initiative GI@School (<http://www.gi-at-school.de>) addresses both impediments, GI education in High Schools and Marketing for GI study programs. Our motivation is as follows:

1. Supporting the introduction of up-to-date GI topics into High Schools
 - a. The universities' tasks for education do not only include university students but also the general public, and in particular, teachers and High School students.
 - b. High School students shall benefit from gaining direct contact with university students, and thus gain knowledge in GI applications (GIS, GPS etc.) and GI Science. This is an essential function of up-to-date High School education systems.
 - c. High School students receive support for planning their future careers. Our GI modules create awareness for a field with very good career chances (Richardson, 2004).
 - d. Many teachers are interested in teaching GI Science, but they lack the necessary skills.
 - e. We present an alternative for schools to the commercial offers of GIS providers and publishers.
2. Marketing for GI study programs
 - a. Increase the general awareness for GI – currently, many people do not know what Geographic Information is used for (Dailey, 2006)
 - b. Face the increasing competition between universities
 - c. Face the need for active students' recruitment.

It cannot be denied that good marketing strategies become indispensable for university institutes that take part in the (worldwide) competition in gaining motivated and capable students (Brox, 2005). Especially natural sciences and engineering in Germany suffer from the decrease of applications (DER SPIEGEL, 2006). Other important reasons for a decreasing number of students, e.g., in Germany, Portugal, and Austria, are due to the demographic factor. Competition is increasing by new study programs in Geoinformatics; and an internationalization of education in Europe.

In addition to the need for marketing strategies for university institutes, it is necessary to apply "general studies" in GI Science Education. Our concept strives to cover both needs by implementing a cooperation program with High Schools. We bring together university students, High School students and teachers who can all benefit from this collaboration.

The following section will describe the realisation of the project. Learning modules for schools are then explained. Finally, first results and a conclusion and description of future steps will be presented.

REALISATION

The main goal of GI@School is to cooperate with High Schools and to hold practice-oriented classes in GI Science. We particularly aim to attract those High School students in geography and computer science courses.

IfGI students (Bachelor, Master and Diploma students in Geoinformatics) have developed teaching units (modules) in a range of topics in GI Science. The modules are well described with extensive documentation, which includes (1) The presentation in lecture form – as presented by the IfGI student in class. (2) The didactical concept describing the workflow of the lesson – important for the teachers. (3) The 'one-pager' containing a short summary of the topics discussed – for the High School students. These detailed documentations make the modules reusable independently for the school and for the person presenting them. We have included a proposal for the implementation of cooperative modules on our webpage (www.gi-at-school.de).

We also combined modules and arranged complete GI project days at schools. Teachers can choose modules according to their syllabus and interests. Classes are held several times a day, so different

classes can attend various modules. This allows us to address many High School students in a time-efficient way.

Further opportunities are available for school classes to visit the Institute for Geoinformatics in Münster, where they can experience research and university life. Various research projects are presented by cooperating students from different IfGI workgroups. The visit closes with a discussion among High School students, IfGI students, and research assistants. The High School students gain an impression of the various fields of activity and the curriculum at the IfGI.

In order to initiate cooperation with schools in the Federal State of North Rhine-Westphalia, Germany (NRW), we sent a proposal for cooperation to approximately 100 schools. After a short period of time first contact was made with a number of teachers. Arrangements to implement the GI modules in classes promptly followed. We list our experiences and impressions of the cooperation in the 'Results' part of this paper.

The learning modules

Most of the activities of big publishers in Germany, such as Klett (<http://www.klett.de/>) and Westermann (<http://www.westermann.de/>), and big GI companies, such as ESRI (<http://www.esri.com/>), mainly focus on applying GIS in schools. They distribute GIS-versions, especially released for schools (e. g. DierckeGIS from Westermann, which bases on the ESRI ArcView 3.x product line) or initiate campaigns like "GIS macht Schule" (<http://esri-germany.de/schule/index.html>) or the "GIS-Day" (<http://www.gisday.de/> or <http://www.gisday.com/>). We decided to develop teaching units (modules) that are not "restricted" to GIS but include other GI topics. The objective is to promote spatial literacy in schools, which becomes absolutely necessary in a world, in which spatial data is increasingly used (Goodchild, 2006).

The modules are mostly designed for two school hours (= 90 minutes). It is essential to make sure that High School students are not strained with information too complex and difficult for such a short period of time. The modules consist of a short lecture by the IfGI students, followed by an intensive group work of the High School students, where they use GI tools to complete problem-solving exercises. Depending on the schools we attend, we focus to a greater or lesser extent on geographical, mathematical, or computer science topics.

The modules are well integrated in the subjects curricula. We provide modules i.e. for the units urban spaces, tourism, cartography (geography), linear algebra (mathematics) and object-oriented programming with java (computer science) in different forms. Teachers can supplement their units by starting or ending with one of the modules. The short modules in different subjects and units shall motivate the High School students and spark their interest in an interdisciplinary science.

Four basic modules have been developed by voluntary advanced IfGI students, two more modules are currently in progress. We decided to use application-oriented topics in order to let High School students gain very practical experiences. The following modules have been developed (modules in brackets are those still in progress):

- **Digital Cartography**
Principles of digital cartography are conveyed to the High School students. With an increasing availability of broadband LAN in many schools, we decided to use a WebGIS application (here: CommonGIS) to eliminate the problem of installing software in school networks, thus saving the precious resource of time. Another positive factor of using a WebGIS is that it offers easier access to the topic, because its functionality is reduced compared to a Desktop GIS; and High School students and teachers alike are mostly familiar with the use of browsers and the internet. Requirements: computer lab and broadband internet connection.

- **3D City Modeling**
This module is based on a cooperation project between IfGI and the Department of Computer Science at the University of Münster, where IfGI students take part in the development of an application that enables the user to interact with a virtual model of a city (<http://viscg.uni-muenster.de/>). As it is a tool for city planning and decision making, the High School students acquire the principles of city planning and cadastre. Important terms are illustrated with the aid of analogues development plans. Afterwards, requirements for a computer application, which converts the 2D analogues plans into 3D virtual models, are discussed in class. Requirements: classroom and projector.
- **GNSS / Geocaching**
In the first part of this two-hour session, the principles of Global Navigation Satellite Systems (GNSS) and especially the NAVSTAR Global Positioning System (GPS) will be explained. The High School students shall get familiar with local and global reference systems and gain some insight into how to deal with coordinates. The functionality of the devices is explained to the High School students, and they are sent into the schoolyard for some testing. Geocaching (www.geocaching.com) is applied as a method to associate the topic with having fun. Afterwards, the tracks and waypoints that have been generated are visualized with different GIS. Requirements: classroom and projector.
- **Google Earth**
This module deals with the very popular program Google Earth and also gives a theoretical introduction to the functioning of GIS. The High School students implement geographical related content, e.g. their journey to school, with the help of the Keyhole Markup Language (KML), which is the interface of Google Earth for managing geospatial data. The High School students gain understanding about data models and learn simple techniques of modeling geodata. In addition to the demonstration of differences and similarities of a “common” Desktop GIS and Google Earth, the High School students are given short problem-solving exercises. Requirements: computer lab, broadband internet connection and Google Earth installations.
- **(Implementing Geographic Information Systems)**
This is a special module targeted towards students and schools focusing on computer science and math. A presentation leads to how a rudimentary GIS can be implemented and the High School students will be supported by implementing standard functions of a GIS and also more specific algorithms (e. g. shortest path algorithms).
- **(GPS and Reference Systems)**
This module is designed for schools that specialize in natural sciences. High school students get familiar with GPS and reference systems and deal with conversions of coordinates etc.

These modules have been revised by scientific assistants. They underlay a permanent adjustment process to new developments in science. We are also closely affiliated with High School teachers, who can confer with us regarding didactical efficient materials.

RESULTS

To examine the results of this project, we used evaluation forms for all participants, which will be described, analyzed and discussed as follows:

- The evaluation questionnaires for High School students contain general questions regarding their interests, education, and personal thoughts. For evaluating purposes, our questions

were designed to indicate: complexity, mediation, the current understanding of what a GIS is; their interest in studying GI Science, and a total grade for the module.

- The evaluation questionnaires for teachers address the level of complexity, mediation, interest in further training and a total grade.
- The evaluation questionnaires for the participating IfGI students address their personal opinion about the educational benefits; the relation between work and benefit; gain of experience in teaching; revision of knowledge in the respective field of GI Science; and personal opinion about the valuation by the employers.

The possible answers, if not yes/no, are based on the German school grade system (grades between 1 = best and 6 = worst) which is very useful in the school context.

After analyzing the evaluations, we split the results into three parts:

- GI education in High Schools
- Students' recruitment
- New learning styles at IfGI for undergraduates.

GI education in High Schools

Within a period of two months, we reached three hundred High School students and eight teachers in five different schools with our program. Another twenty schools booked our learning modules in 2007. Resulting feedback shows that we reached ~ 25 % of the addressed schools (~ 100).

The cooperation between university and High School fulfils this mission, by allowing the High School students to experience topics far from their existing (because not yet realized) curriculum, yet in an easily accessible way. The teachers experience an insight into GI Science by accompanying the modules in their classes.

Computer Science as a school subject is not obligatory in secondary schools in North Rhine-Westphalia and rarely taught in High Schools. Although the general interest of High School students in Computer Science is rather low (see Figure 1), the acceptance of our modules has been very positive.

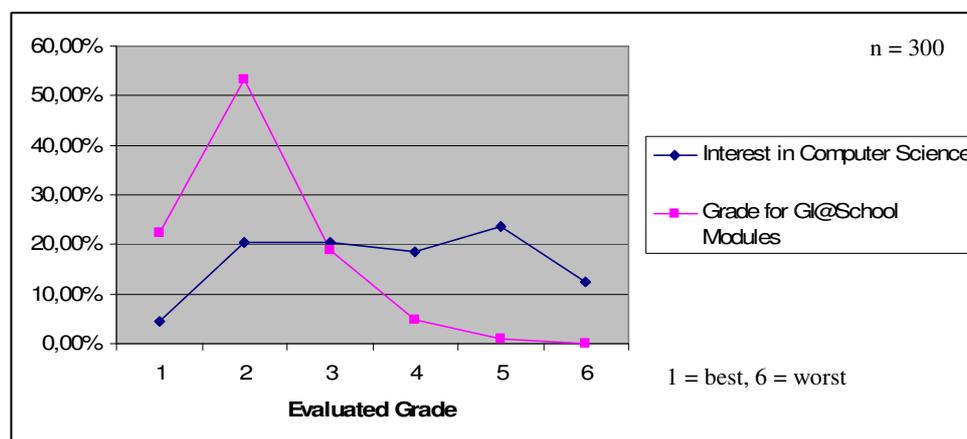


Figure 1: High School students' interest in computer science compared to their acceptance of the GI@School modules.

Students' recruitment

Approximately 90% of the High School students said that they now understand the role of GI Scientists; 30% even stated that they would consider studying GI Science. In their personal comments about the GI modules, the High School students emphasized the practical aspects of the modules, the teaching by university students, and the prospect of being able to get information about studies and university in general. These results indicate a success regarding the recruitment of new students for the IfGI GI Bachelor program, the awareness of GI Science, and the reputation of the IfGI. A final proof of success will be the number of new applications for the GI Bachelors Program in the next winter semester. Considering the preliminary feedback, we anticipate that our efforts will pay-off. The number of teachers, who participated in the cooperation, is relatively small, so their feedback is not statistically representative. However, it should be considered that all teachers showed interest in further training in the area of GI Science; and all have been very satisfied with the cooperation. It is very important to apprehend the role of the teacher as a multiplier for students' recruitment.

New learning styles for undergraduates

GI Science education means not only teaching technical know-how, but also additional key competencies. The GI@School project contributes to fulfil this goal. The university students learn to develop and teach training modules, to cooperate with schools, and to provide information for larger groups without knowledge in GI Science. They get feedback for their work through evaluations and are therefore able to improve their techniques and challenge the knowledge they have acquired.

The acceptance of the project among the students is very high. Although participation was voluntary and not paid, ten IfGI students worked in the project. The evaluation also showed that the participating students could refresh and broaden their own GI knowledge. All IfGI students believe that future employers will validate the acquired and certified teaching experience. They enjoy working in a team, developing modules and the teaching experience in High Schools. More than 50% of the High School students awarded the IfGI students with the best grade possible. The average grade was 1,6 (1 = best, 6 = worst).

CONCLUSION AND FUTURE STEPS

Cooperation between High Schools and universities is beneficial for both sides. High School students and teachers provided a very positive feedback for introducing GI topics into classes. They gain knowledge about new topics concerning science, tools and university life. Based on the feedback of the High Schools (25 schools out of 100) on our suggestion for cooperation, and the teachers' and High School students' evaluations, the IfGI will establish school visits as a permanent offer.

In terms of marketing, our strategy is a successful means for creating awareness for GI. We directly addressed the High School students attending the GI classes, and the teachers as multipliers for addressing many additional students. In order to use the multiplier role of teachers more extensively, we are preparing training course for teachers, i.e. in Geography and Informatics. Very few of them have know-how in GI, but GI is entering High School curricula. Therefore, training courses were not only requested by the High School teachers, but also by authoritative decision-makers for teachers' education. In terms of marketing, GI training courses for teachers will significantly increase the awareness of GI and establish a big number of sustainable multipliers.

GI@School provides new learning methods ("learning by teaching") to the undergraduate students. Teaching provides essential key qualifications for their professional careers in academia as well as in the private sector. And by teaching how to teach in regular classes of the study program, we have a permanent pool of undergraduates for a sustainable updating and performing GI modules in High Schools.

Due to very positive results, our future plans are to expand this new field:

- Continue teaching GI modules in High Schools, but also addressing a bigger region.
- Offer GI training courses for High School teachers, providing them with didactical and technical concepts for teaching our GI modules on their own.
- Initiate a national GI competition for High School students' projects.
- Open GI beginner courses of the GI Bachelors program (Introduction to GI Science and Digital Cartography) for High School students.

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