

WebGIS – A Methodical Tool for Applicable Across the Curriculum Wherever There is a Sp

As GIS technology expands into many markets, it is becoming an important part of daily life in Germany. Despite this fact, the technology's presence in schools remains weak although in the last 5 years remarkable progress has taken place in schools in Germany. This paper presents a solution for a simple but effective and straight-forward introduction of GIS in schools based on WebGIS-technology.

By Dirk Schaefer

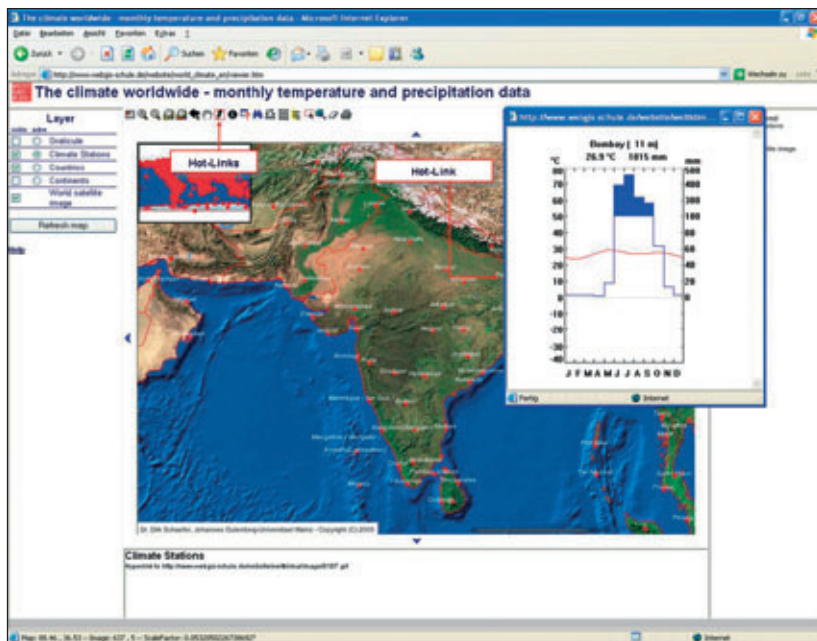


Figure 1: Screenshot of the map service "The Climate worldwide" on <http://www.webgis-schule.de>.

GIS in German Education

Since the 1990s geoinformation and GIS technology have become an increasingly important part in many areas of German daily life: the weather forecasts in the daily news on TV include satellite images and even animated flights through 3D-landscapes. Navigation systems are available in cars, travel planners are used via the Internet to find the best route. Professional planners, emergency and disaster response personnel, government agencies, businesses in Germany (and around the world as well) use GIS as a tool for their everyday work. For many years, GIS has been applied and used in research in many universities in Germany. Also, the students in different fields of study, such as Geography and surveying, learn how to use GIS to solve geographical

questions. Additionally, numerous new institutes have been established in Germany during the last 20 years focussing on the topics geoinformation and GIS, offering different study courses in higher education, including e-learning, with different academic grades (BILL, 2005).

Unfortunately, the significance of GIS in schools still remains weak. However, in the last few years a remarkable progress in deployment of new media took place in schools due to a governmental initiative that gives every school in Germany computers and Internet access. GIS is slowly, but steadily becoming an integral part in teaching geography. Some states have already integrated GIS in the curriculum, like Hamburg, Baden-Wuerttemberg, and Bavaria. Other states will follow.

New Access

GIS is more than just another software tool or programme that can be used in schools. It is also more than just computer mapping. Applying GIS offers new access to geographic data and therewith it helps to answer questions related to space as well as changes in space and time. Therefore, GIS can be used in geography classes and other classes as well. Due to the access to the database and different new media, GIS gives more interactions for students than an ordinary atlas, where many limitations are found in map and data analysis. As an interactive tool, GIS allows students to visualize and manipulate data and draw their own maps and graphs. Another advantage is the possibility of editing and updating maps and tables. Furthermore, data from governmental organizations or others can be integrated into the system to analyse regional and local data from the environment of the students. The application of GIS in schools is therefore very important because it helps to achieve the specified competencies as defined in the education standards by the German conference of the ministers of education: examples are competence of matter, media competence, competence in presentation, spatial or orientation competence, and social competence.

Barriers

ESRIs ArcView 3.X and 9.X and "Diercke GIS" are the most popular GIS-software in German schools. Diercke GIS (<http://www.diercke.de/gis/gis.html>), an adapted version of ArcView GIS 3.2, was developed by ESRI Germany in collaboration with Westermann Textbook Publishing Company ("Westermann-Schulbuchverlag"), one of the leading publishing houses for geographic educational materials in Germany. Diercke GIS features a special menu bar in German and English so it can be used in bilingual teaching. The package comes with a large collection of maps and ready-to-use data. Diercke GIS includes all mapping and analysis functions of ArcView and can be used out-of-the-box. These products and others that are similar are evidence that GIS tools for schools are available, but the acceptance of GIS in schools is developing slowly. This raises the question why the introduction and use are proceeding so slowly.

the Introduction of GIS

atial Question

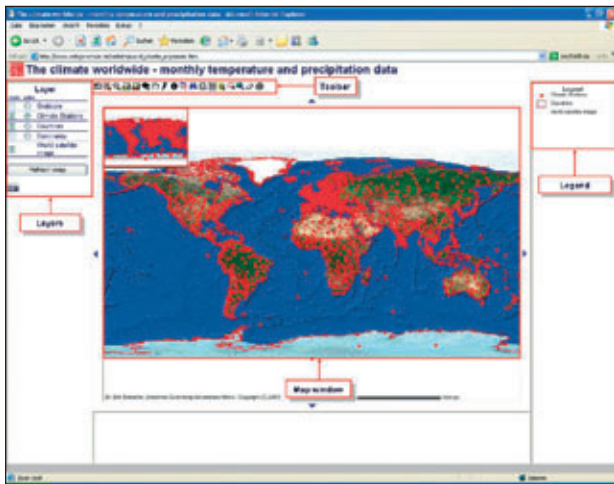


Figure 2: Monthly temperature and rainfall data of 1270 stations can be identified.

The biggest barriers to the introduction of GIS in schools remain its cost, and the necessary hardware and data. In addition, it takes a long time to learn GIS, especially with time-consuming acquisition and practice is prejudicial for the introduction in schools. According to this, learning materials and easy-to-use tools for the introduction of GIS need to be prepared to enable every teacher to apply GIS in the classroom. Also, it is very important to implement GIS in teacher-training in the universities in order to prepare future teachers to apply the technology in their schools. Consequently, the curriculum in the universities for students who want to become teachers must be adapted to the developments in schools in order to enable these students to learn GIS as soon as possible. Additionally, universities (and/or other institutes) have to provide further training on GIS and its applications for the teachers already teaching in schools.

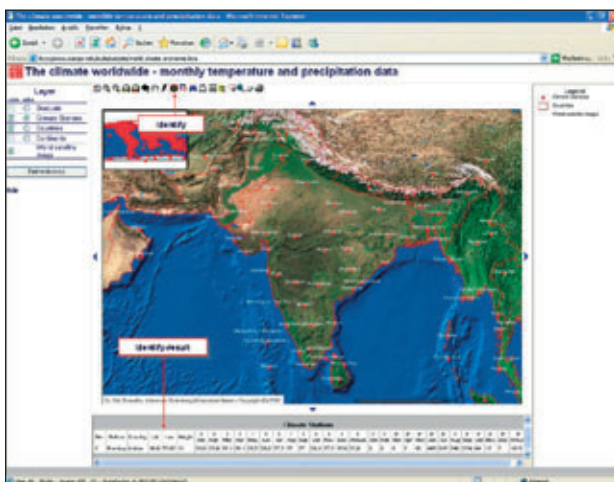


Figure 3: Climate diagrams are available for all stations.

Free GIS Technology

An easy and cost-effective introduction of GIS in schools and universities is possible via the Internet with specific Internet mapping solutions, such as WebGIS. The website WebGIS-Schule (Schule is the German word for school) was developed by me, the author of this article, in order to provide map-services that can be used for an introduction of GIS in high schools, comprehensive (middle) schools, and universities. All map-services on WebGIS-

Schule were evaluated in schools, including universities. The WebGIS-Server is provided by the Department of Geography at Mainz University in cooperation with the Data Processing Center of Mainz University. All WebGIS services are based on ESRI ArcIMS 9.x, running on a Windows 2003 server with an Apache Web-Server and Tomcat 4 as servlet container.

WebGIS-Schule (<http://www.webgis-schule.de>) provides different services with a collection of data components that can directly be used in classes following the general requirements of the curriculum. Most of the map-services are bilingual. The following are examples of different data sets:

- The Climate of Germany (German);
- The Climate worldwide (German, English);
- WebGIS Rhineland-Palatinate (German);
- WebGIS Spain (German, Spanish);
- WebGIS France (German, French).

Another WebGIS about China that provides interactive maps, data and diagrams about the climate and climate change is also available (<http://www.webgis-china.de>). The applications provide the usual GIS tools (zoom, pan, identify, hyperlinks, buffer) and also allow the user to query the database. In addition, step-by-step instructions can be downloaded (PDF-documents) and directly used in the classroom, which is

the easiest way to introduce GIS in schools. The diverse lessons and data on WebGIS-Schule can be used as a methodical tool for the introduction of GIS in schools and universities. It provides a simple, straightforward and very cost-effective introduction and the use of this GIS technology is free. Furthermore, WebGIS can be used all over the world, only a computer with internet access is needed and no additional GIS software has to be installed.

Applying WebGIS in Schools

The map-service "The Climate Worldwide" includes a world map, a graticule, a world satellite image and monthly temperature and rainfall data of 1270 reference stations, see Figure 1. According to Walter and Lieth climate diagrams for all stations are available as "Hot-Links" or hyperlinks. Data and maps can be used to analyse various topics about the climate, such as climate classifications or regional climates. The format of the map service "The Climate Worldwide – Monthly Temperature and Precipitation Data" is clearly structured. It contains the map window, the layer list, the legend and the toolbar, see Figure 2. The toolbar provides typical GIS functions, corresponding to the functions of a tool border in a full version of a GIS, such as ArcView 3.X or Diercke GIS 1.X or 2.0. Both Web Services can be found on <http://www.webgis-schule.de>. Students can learn about the layer technique and the meaning of "visible" and/or "active" layers. The layers can be made visible or hidden by simply clicking the check box beside the layer name (and clicking the "Refresh Map" button). In order to identify objects or to query the database the layer has to be active. However, only one layer can be active in WebGIS.

Monsoon in India

The following example demonstrates how WebGIS can be applied in the school (11th class). The students can learn about the monsoon climate in India by applying typical GIS functions. The monsoon in India is a topic that can be found in many curricula around the world; see the example in the text book for teachers "Mapping Our World: GIS Lessons for Educators (Malone et al., 2002)". Teachers need basic computer literacy and knowledge how to use the Internet

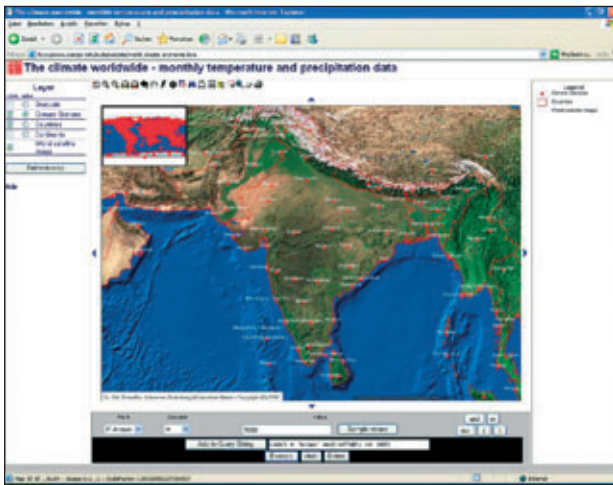


Figure 4: Query to select all stations in India with an annual precipitation amount > 1800 mm.

and a computer pool with Internet access is necessary. First, the students have to zoom on South Asia by using the "Zoom" tool. Then, individual stations can be selected and be compared concerning the monthly temperature and precipitation data applying the "Identify" tool.

According to Walter and Lieth climate diagrams can be analysed using the "Hot-Link" tool. On the basis of typical stations, like Bombay, the monsoon climate of South Asia can be divided into the four seasons and it clearly shows that precipitation represents the crucial climatic element for the partitioning into the seasons, see Figure 3.

The spatial and temporal distribution of rainfall shows large differences in South Asia, which can be analysed using and comparing the climate data and climate diagrams. Stations can be selected to draw profiles, for example north-south; west-east. The query manager can be applied to identify the regions receiving highest annual precipitation amounts (>1800 mm) in India, see Figures 4 and 5, identifying the two branches of the monsoon system during south west summer monsoon, which can be explained as a part of general circulation of the atmosphere.

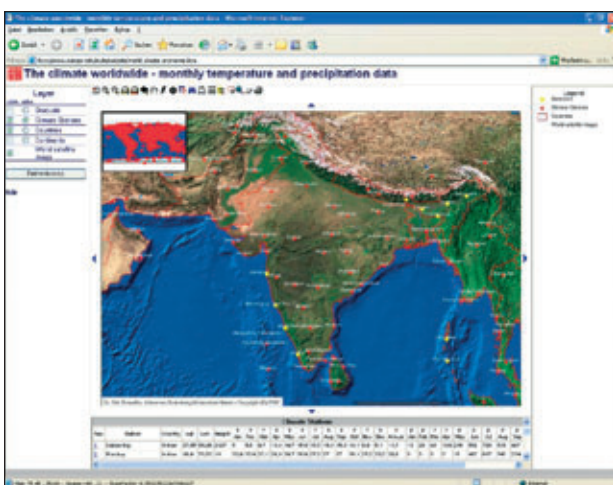


Figure 5: The query results show the stations and areas receiving the highest rainfall amounts in India.

The added value of applying WebGIS is evident. On the one hand, students learn about the monsoon system as part of the general circulation of the atmosphere and on the other hand, students learn the basic functions of GIS: zoom, identifying, query-manager, and Hot-Links.

Conclusion

GIS is a modern tool that can be used across the curriculum wherever there is a spatial question to be answered, including History, Biology and other school subjects. Teaching GIS in schools contributes to the development of essential skills in daily life and helps students to understand and handle computers and new media. GIS is one of the most important tools in the 21st century. Using GIS in schools demonstrates to students the ubiquity and importance of geography in every area of their daily lives. It also teaches them to work with new technologies as a fundamental research tools. Students apply GIS as an information system in order to learn more about their immediate and larger environment and begin to understand how everything on earth is truly connected in one system. Advanced students use GIS to solve problems, such as regional case studies about changing the environment due to human activities, and become active contributors to the quality of life of our society. I think WebGIS is an excellent approach to introduce the use of GIS in schools. In Germany, every school has access to the Internet and the use of the map services provided by WebGIS-Schule (<http://www.webgis-schule.de>) is free. Various (mostly bilingual) map services can be used for the introduction of GIS at schools and universities. Students learn not only the thematic contents but also GIS principles and backgrounds (layer technique, database, maps), typical GIS functions (such as zoom, pan, identify, search, query) and the overall benefits of GIS.

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Dr. Dirk Schaefer (Dirk.Schaefer@Uni-Mainz.de; <http://www.geo.uni-mainz.de/schaefer>) works as a senior researcher at the Department of Geography, Mainz University in Germany, responsible for the education in GIS. Go to <http://www.webgis-schule.de> to learn more about WebGIS.