Chapter 15
GIS Specialists' Support for Geography Education

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Abstract Senior high school teachers in Japan are obliged to develop practical applications of geographic information systems (GIS) to meet the new National Curriculum Standards, although they have little formal education in GIS during their undergraduate and in-service training. Therefore, GIS specialists have supported the schools in choosing suitable GIS for their facilities and budgets, in training teachers to manage GIS, and in the development of GIS teaching materials. These experiences revealed that: (1) Reading GIS maps is a higher priority than editing them; (2) delivering datasets via web GIS is the easiest method, as long as the school internet can support the bandwidth; and (3) GIS training videos are required to demonstrate how to create GIS maps in a classroom without the internet.

Keywords Geography education • GIS • GIS movies • Senior high school • Web GIS

15.1 Introduction

Senior high school geography teachers in Japan must develop practical geographic information system (GIS) use to meet the new National Curriculum Standards. However, they have little formal education in GIS during their undergraduate and in-service training, because many of their professors also had little GIS knowledge. Although some teachers have learned GIS through other means, they continue to face difficulties such as slow internet speed at their schools, which affects web GIS use. Another issue is the compatibility of saved maps when shared across computers. Given these limitations, GIS specialists have been hired to support schools to resolve these problems. This chapter reviews the roles of these specialists and how this effort is supporting the spread of GIS use in schools.

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Y. Ida et al. (eds.), *Geography Education in Japan*, International Perspectives in Geography 3, DOI 10.1007/978-4-431-54953-6_15

15.2 Support Menus by GIS Specialists

A survey was conducted with senior high school teachers regarding barriers to implementing GIS in class lessons (Fukuda and Tani 2003). Teachers noted a lack of computer facilities, budgets to buy GIS software, in-service teacher training, and textbooks. Ito (2012) suggested that GIS could be taught across multiple subjects. If teaching resources and lessons were shared between teachers, support would be more accessible. For optimal GIS instruction, Itoh (2004) described a list of must-haves: GIS software and websites, and in-service training for GIS learning.

15.3 Choosing and Developing Suitable GIS

Teaching styles, available facilities, and budgets are requirements for determining a suitable GIS at each school. Table 15.1 summarizes GIS software and functions already in use in Japanese schools.

15.3.1 Requirements for Suitable GIS

In a linguistics context, the ability to read sentences is a requirement to write them. The parallel in geography education is that the ability to read maps is the foundation to edit them. Various types of GIS can be used with map data for visualization and

Table 15.1 Functions, facilities and budgets for each GIS

Software	Web GIS	Google Maps/ Earth	Picasa	Chizutaro	MANDARA	Quantum GIS	Arc GIS	Green Map/ Hi map mister
Functions								
Reading GIS map								
Topographical map	•			•	•			
Town map	•	•	•	•	•	•	•	
Aerial photo	•	•	•		•	•	•	
Editing GIS map								
Editing GIS data	•	•		•	•	•	•	
Editing photo	•		•	•				
Statistic map	•			•	•	•	•	•
Elevation map	•			•	•	•	•	
Facilities								
Offline use				•	•	•	•	•
Budgets								
Free	•	•	•		•	•	•	

editing. Some GIS maps are easily read but cannot be edited, whereas others can be easy to edit but difficult to interpret without advanced skills. Determinants of GIS selection depend on teaching facilities and budget.

The author currently operates the website "Easy Digital Maps[1]" to introduce "easy" GIS for beginners. The materials are categorized in the following groups: (1) "Looking at GIS Maps", (2) "Looking at Old GIS Maps", (3) "Looking at Satellite Data", (4) "Looking at Maps in an Atlas in GIS", (5) "Looking at Statistics for Each Street Number of Districts in a Town", (6) "Looking at Local Disaster Risks", (7) "Looking at Distribution of Stores", and (8) "Editing GIS Maps". A record of webpage visitor logs was analyzed for one full year in 2010. The findings indicate that only 20 % of all visitors viewed "Editing GIS Maps". Thus, most GIS beginners simply want to look at GIS maps rather than edit them. This trend applies to both teachers and student users.

The author found that in addition to perusing and editing maps, teachers mark on printed GIS maps. They select visible items (e.g., roads or buildings), adjust the scale and zoom the map with GIS, and then print the outline map. Students also mark symbols or other features on the printed map. Used in this way, GIS is a platform for looking at maps, loosely coined "analog GIS".

GIS functions can be used for all geographic instruction. For example, reading GIS maps can be satisfied by displaying topographic, large-scale, and satellite maps, as well as aerial photographs. In case students are expected to make GIS maps, they can manipulate data to create thematic maps.

The other requirements for implementing GIS in schools are facilities and budget. Money is needed to set up the facility, which includes but is not limited to personal computers, software, and internet access in the classrooms. Fujisawa City (2007) reported that a GIS specialist advised teachers in the city to use the desktop GIS software Chizutaro. As a result, it was installed on all personal computers for teachers in every primary and junior high school in the city. Other sources of suggestions include the Ministry of Land, Infrastructure, Transport and Tourism (MLIT),[2] which introduces GIS and selection requirements in their teacher manuals.

15.3.2 Selected and Developed GIS

15.3.2.1 Web GIS

Web GIS uses a web platform by storing data in the cloud to support GIS activities and only requires access to the Internet and a web browser. Web GIS has the capability to debug issues quickly and revise online programs, because the application is on the provider's server(s). Datasets are also stored on that server, allowing the user immediate access and use. Ugawa et al. (2003) saw web GIS as a solution to current budget cuts, simplifying operation menus, and free sharing of maps without a need

[1] https://sites.google.com/site/dejichizu/. Accessed 31 July 2012. (J)

[2] http://www.mlit.go.jp/kokudoseisaku/gis/gis/kyoiku/index.html Accessed 31 July 2012. (J)

to download or purchase software. Datasets served on web GIS are the easiest means of school access, given that internet speeds exceed 30 mbps.

Many schools in Japan are facing budget deficits and do not have funds for internet connection. A classroom internet (LAN) for all schools in the same city is connected to the city education center. At least one internet circuit is connected to that center. To prevent students from browsing non-educational sites, software is used to block search engines such as Google and Yahoo. This filter makes it difficult to access web GIS sites, because Google Maps[3] is one mapping platform used in classrooms. Its use during instruction is for the display of elements on town maps, as well as satellite and aerial photos. With a login account, students can have editing capability with the "My Places" menu.

Web GIS sites for geography education are developed by GIS specialists. For example, Murayama (2002) developed "Web GIS for Geography Education,[4]" which stores census statistics on population, industry, and cultural information for cities, prefectures, and nations. Users can create and edit maps, produce scatter plots, and do multivariate analysis. Another platform was designed by Ugawa et al. (2003) called "Let's inspect it—The frog map".[5] This website stores base maps and allows users to browse and edit. There is an element of citizen science, in which students can input frog habitats on a public web map. The last example is led by Oshima et al. (2011), who operates "Teaching materials for 'geographic and earth scientific experiments' in junior and senior high schools with satellite data".[6] This site uses a web GIS management software (ArcGIS Server[7]) and stores satellite images (visible and infrared), population density maps, green coverage maps, and heat island maps for browsing.

15.3.2.2 Desktop GIS Software

Desktop GIS software allows users to display and edit spatial data stored in personal computers or on servers. Data can be accessed and manipulated online or offline. However, there is a financial cost to purchase the software and robust computer hardware is needed. Fortunately, there are some free desktop GIS software that have a low-demand computer specification. Generally, proprietary desktop GIS software has advanced and additional functions relative to web GIS. Some desktop GIS software has been revised for geography education. A summary of these and associated software are provided below.

[3] https://maps.google.com/maps. Accessed 31 July 2012.

[4] http://giswin.geo.tsukuba.ac.jp/teacher/murayama/edugis/index.html. Accessed 31 July 2012. (J)

[5] http://map.edb.miyakyo-u.ac.jp/kaeru/. Accessed 31 July 2012. (J)

[6] http://earthgis1.isc.chubu.ac.jp/Jikken/. Accessed 31 July 2012. (J)

[7] http://www.esri.com/software/arcgis/arcgisserver. Accessed 31 July 2012.

MANDARA[8] Tani et al. (2002) revised this free software for junior high school student use, from the original that was aimed at university students. MANDARA can display topographic maps, town maps, and aerial photos, and support color classification of statistical maps with Excel data. Tani et al. (2002) added a "Start Menu" and a form for students to input property data.

Chizutaro[9] This software has been revised to accommodate minor requests from primary and junior high school teachers in Fujisawa City (2007). The original Chizutaro was a desktop GIS software for local government use. It displays topographic maps and town maps, has an edit function for data and photos, plus a color classification option for statistical maps. Its cost is attractive for school implementation, only 3,500 yen (approximately 35.00 USD).

Google Earth[10] This is a free digital globe software that can display large-scale maps, satellite and aerial photos, and has an edit feature.

Picasa[11] This is a free photo software that displays photos in Google Maps.

Kashmir 3D[12] This is a free GIS software that displays topographic maps.

Quantum GIS (QGIS)[13] This is an open-source GIS that can display topographic maps, town maps, satellite and aerial photos, and allows editing of GIS data and color classification of statistical maps.

ArcGIS Desktop[14] This is an international commercial GIS software. Schools in Japan have a 2-year license with free support for primary, junior, and senior high school education. Since ArcGIS is a specialized and complex system, trained personnel are needed to manage and install it on computers. It has the same functions as QGIS.

Textbook Publishers School textbook publishers provide software that displays maps from atlases and supports color classification of statistical maps, such as "Hi Map Mister[15]" and "Green Map".[16] Diercke (2010) is a world atlas written in English, published in Germany. A license key is provided in the textbook to access the digital globe software "Diercke Globe".[17]

[8] http://ktgis.net/mandara/index.php. Accessed 31 July 2012. (J)

[9] http://www.tcgmap.jp/product/chizutaro/. Accessed 31 July 2012. (J)

[10] http://www.google.com/intl/en/earth/index.html. Accessed 31 July 2012.

[11] http://picasa.google.com/intl/en/. Accessed 31 July 2012.

[12] http://www.kashmir3d.com/. Accessed 31 July 2012. (J)

[13] http://qgis.org/. Accessed 31 July 2012.

[14] http://www.esri.com/software/arcgis/arcgis-for-desktop. Accessed 31 July 2012.

[15] http://www.teikokushoin.co.jp/products/pc_soft/index01.html. Accessed 31 July 2012. (J)

[16] http://www.tcgmap.jp/product/greenmap_world/. Accessed 31 July 2012. (J)

[17] http://www.diercke.com/dierckeglobe_download.xtp. Accessed 31 July 2012.

15.3.2.3 Datasets for Desktop GIS Software

Data are needed for GIS use. These may be provided by the software developer, government agencies, GIS specialists, or developed by teachers. The following sources provide data compatible with most GIS systems.

Our World GIS Education This is a series of geography textbooks that include U.S.-based datasets. The textbook includes a free ArcGIS desktop version for 1 year, with data in the appendix DVD. Four textbooks complete the series: Napoleon and Brook (2008) for primary schools, Palmer et al. (2008a, 2008b) for junior and senior high schools, and Keranen and Kolvoord (2008) for universities.

Itochiri and Geo Link Datasets are available on the websites "Itochiri[18]" and "Geo link,[19]" providing data compatible with MANDARA or Google Earth to senior high school teachers. Teaching materials for geographic and Earth scientific experiments in junior and senior high schools with satellite data (mentioned in Sect. 15.3.2.1) provides population density maps, green coverage maps, heat island maps, and some basemap data such as roads or rivers. These can be used in Chizutaro, Google Earth, and QGIS.

The GIS Forum for Education[20] Datasets for Google Earth are provided in the "Google Earth data Bar[21]" web page. They also operate the web page "Data for class[22]" linked on Google Earth data Bar.

Government Datasets The urban planning department in the Fujisawa City government provides GIS data (e.g., roads, rivers, and aerial photos) for schools in the city (Fujisawa City 2007).

15.3.2.4 Training Videos GIS Operations

Data served over web GIS is the easiest technology for classroom use, given that schools have broad-bandwidth internet connections. Without web GIS, teachers would need to use more complex GIS software with prepared datasets. In the absence of internet access and teacher GIS skills, one potential solution is to demonstrate GIS functions with videos. Examples are already posted on the website, YouTube. For example, "Itochiri channel[23]" and "Google Earth geography[24]"

[18] http://itochiriback.seesaa.net/. Accessed 31 July 2012. (J)

[19] http://itcz.web.fc2.com/geolink.html. Accessed 31 July 2012. (J)

[20] https://sites.google.com/site/egisforum/. Accessed 31 July 2012. (J)

[21] https://sites.google.com/site/egisforum/home/detabar. Accessed 31 July 2012. (J)

[22] https://sites.google.com/site/egisforum/home/data4class. Accessed 31 July 2012. (J)

[23] http://www.youtube.com/user/itochiri001?feature=watch. Accessed 31 July 2012. (J)

[24] http://www.youtube.com/playlist?list=PLE20B0B2857CCA840&feature=view_all. Accessed 31 July 2012. (J)

provide videos on the function and steps of operations in Google Earth and Chizutaro. Another is eDesign,[25] where a group of students majoring in GIS at universities have developed "tour" files that operate within Google Earth.

15.4 In-service Teacher Training for GIS

Teachers can learn GIS independently using practice texts written by GIS specialists. Moreover, they can attend training courses taught by GIS specialists, using a manual and datasets.

15.4.1 Practice Texts

Practice texts include GIS exercises, including analysis and mapping skills. Goto et al. (2004) supplied these exercises for use within MANDARA, which address topics such as mapping convenience store distributions and analyzing heat islands. ArcGIS Desktop exercises were furnished by Sadohara et al. (2005) for freshmen to search suitable housing locations within a given distance from railway stations, convenience stores, parking, and highway interchanges. Ito (2010) developed exercises compatible with Chizutaro, MANDARA, and Google Earth, on topics of agricultural trade, plant distribution, and changes of store distribution.

15.4.2 Training with Manual and Datasets

Itoh (2003) delivered in-service MANDARA training for senior high school teachers in 2002. Teachers came from two prefectural research societies for geography education. There were ten teachers, two teaching assistants, and one lecturer in attendance. The training took place over five consecutive weekday nights in the computer room at a university. Since 2002, the Fujisawa City education and culture center has operated in-service Chizutaro training for primary and junior high school teachers twice annually. The exercises focus on developing a disaster prevention map of the school surroundings. The author serves as a lecturer, and other lecturers are teachers who have previously attended the training.

[25] https://sites.google.com/site/edesignt/. Accessed 31 July 2012. (J)

MLIT provides in-service teacher training to promote the educational use of national geographic information, such as National Land Numerical Information,[26] Digital Japan,[27] and Base Map Information.[28] These have been implemented in four prefectures, using Chizutaro, MANDARA, Google Earth, and QGIS to fit the teaching style, facilities, and budget of each prefecture. The exercises are based on mapping disaster prevention around the school. The author and other GIS specialists participated as lecturers, manual writers, and dataset developers. These manuals are available online at "The GIS training program for primary, junior and high school teachers" on the MLIT website.

A number of lessons were learned from these training workshops. First, a majority of teacher questions, approximately 80 %, were attributable to their lack of computer skills. For example, queries included how to double click, where downloaded files can be saved, and how to unzip files. Second, only 10 % of trained teachers used GIS in the classroom, and they required a tremendous effort to prepare the datasets. Therefore, simpler ways to demonstrate and use GIS are essential.

15.5 Conclusions

This chapter described the role of GIS specialists in supporting GIS use in schools. These specialists assist schools in GIS selection that fits teaching styles, available facilities, and budgets. They also provide training workshops.

The experiences point to some commonalities across regions in the teaching of GIS: (1) Reading GIS maps is a higher priority than editing them; (2) delivering datasets via web GIS is the easiest method, as long as the school internet can support the bandwidth; and (3) GIS training videos are an alternative to demonstrate how to create GIS maps in a classroom without the internet.

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[26] http://nlftp.mlit.go.jp/ksj-e/index.html. Accessed 31 July 2012.

[27] http://portal.cyberjapan.jp/site/mapuse/index.html. Accessed 31 July 2012. (J)

[28] http://www.gsi.go.jp/kiban/ Accessed 31 July 2012. (J)

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