

The Functionality of a Geography Information System (GIS) Technology in Geography Teaching: Application of a Sample Lesson

Nurettin ÖZGEN*

Abstract

A Geographic Information System (GIS) is a high performance computer-aided chain of software which enables us to understand, interpret, capture, update, map, and display natural and human-originated events on Earth and allows us to bring out such phenomena in a form of synthesis. Therefore, a GIS is an important information system in which graphical and non-graphical information, which are based upon spatial observations, are accumulated, saved, processed, and presented to the users in unity. A GIS is known to be one of the devices employed in the application of spatial analysis of geography, a scientific field that makes an analysis of the reciprocal interaction between human and the natural environment in a sustainable framework. It does not seem to be very easy to draw as much benefit as would be expected from a geography lesson in which no atmosphere of sharing and discussing is available for students, memorization is given a good deal of emphasis and only the descriptive aspect of geography is laid emphasis upon. However, a geography lesson supplied with a GIS appears to make it possible for students to access whatever information is being sought at the desired level. It also offers some very good advantages to not only students but also to teachers who may still be teaching geography in the conventional way. It is also possible to feed into a GIS every single device, numerical data, technical knowledge, and equipment used in geography teaching, as well as analysis or application of all this stuff. Therefore, if functionality of a GIS can be increased through the incorporation of various programs into it, the teaching of geography may well be easier and more productive. Besides, the enthusiasm of students for learning geography could be furthered even more, thus maximizing the level of the benefit to be drawn from teaching geography. The present study aims to encourage teaching geography with the help of a GIS in not only secondary and high schools but also in universities. With this in mind, a sample lesson on "Internal Migration" was presented. The method used in this lesson was based upon the contributions that a GIS could make to the teaching of this geography lesson so that the efficiency of a GIS in learning geography could be appreciated.

Key Words

Geographic Information System (GIS), Migration, Geography Teaching, Human Geography.

* *Correspondence:* Assist. Prof., Nurettin Özgen, Siirt University, Education Faculty, Primary Education Department, 56100 Yenimahalle-Siirt / Turkey.
E-mail: nozgen@gmail.com

A Geographic Information System (GIS) is an applied system employed by various disciplines. It keeps stimulating interest among individuals as well as institutions and organizations that are interested in spatial information worldwide. This system is also widely used in the business world with a view to providing new ideas and devising new methods of practice thanks to the benefits made available by a GIS in consideration of new developments. A GIS is a scientific term that incorporates all existing spatial knowledge systems, in addition to studying geographic knowledge. Whereas it is considered to be a computer-based tool that helps digitalize spatial knowledge by some, it may be considered a database management system that aids organization by some others. All these taken into account, the most general definition of a GIS would be like “a GIS is a broad knowledge system that is capable of performing such functions as collecting, storing, processing not only graphic but also non-graphic data and then presenting it to prospective users” (<http://www.cografya.gen.tr>: What is Geography Information Systems (Cbs/GIs): 15. 08. 2009). Furthermore, a GIS may be regarded as a tool to be made use of in helping improve such aptitudes of students as thinking skills, ability to make analysis of available data, problem solving ability, ability to access geographic data with ease, as well as geographical inquisitiveness (Kerski, 2000 cited in Şahin, & Gençtürk, 2007, p. 193). Yet, another definition is one that takes a GIS as a system in which all types of spatial data is first evaluated and then fed into the computer through digitalization (Turoğlu, 2000). Therefore, we can hypothesize that a GIS seems to be a promising system in teaching of geography thanks to the contributions it can make. As was reported by Kayakuyu and Görgeç (2004), a GIS offers a different viewpoint in evaluation of data in human geography by contributing to envisaging occurrences, as well as analyzing them.

Şimşek (2008) reports a study in which a high percentage of 1520 high school teachers (88%) surveyed by Kerski (2000) reported that a GIS could be of great benefit when asked whether or not they agreed that a GIS could be taken advantage of in teaching geography, while 1.8% believed that it would make no contributions whatsoever. Another 10% replied that they were undecided about the benefits of a GIS.

Results of a study by Özgen and Oban (2008) on a GIS-aided geography teaching seem to confirm the idea that a GIS offers good benefits in teaching geography. They stated that not only students good at the

computer but also those weak at it reported to have benefited a lot from a GIS while being taught geography in the class environment. Özgen and Oban also reported that it was statistically significant that the experimental group, who were taught geography with the help of a GIS, were observed to get far higher scores in the follow-up examinations when compared to those in the control group.

A GIS has also been found to play a significant role in easier access to scientific information as well as in a better utilization of this information by students. For an effective teaching of geography aided by a GIS, students need to be more active and contributing during the lesson than does the teacher. However, it should not be forgotten that the teacher is not supposed to provide the data itself in GIS-aided geography lessons; rather, the teacher is supposed to only guide the students in accessing the necessary data on their own.

As Saban (2004 cited in Özgen, K., 2007) reports the most significant task expected of the modern schools and teachers to be cooperating towards graduating imaginative and broad-minded individuals who are mature enough to assume responsibility for their own learning and capable enough to make healthy decisions. With this in mind, more responsibilities would be expected of teachers for a more productive teaching-learning environment. According to Descy (1999 cited in Şimşek, 2008), it was determined that using contemporary teaching technologies within the classroom provided a more productive teaching environment for teachers and stressed them out even less.

Such developments as mentioned above are of utmost importance for a science like geography, which studies the relationship between humans and space. Karabağ (2007, p. xv) defined geography as one of the most eligible lessons as regards information and communication technologies on account of its content as a field of science. The fact that a GIS, one of today's important information systems, derives from geography seems to have increased the importance of information-communication technologies in geography teaching.

In geography teaching, student-centered teaching methods aided by a GIS have been shown to provide very good results in favor of students, the degree of which increased or decreased depending upon how actively students got engaged during the lesson. Thus, Brooks and Brooks (1999) report that it is vital that a suitable environment where students are as active as possible should be prepared for successful lessons.

It is possible to integrate a GIS into the systems varying from planning of education to teaching processes. It is now possible to take advantage of a GIS in various fields of science, primarily geography, as regards cause-effect, distribution and synthesis principles. For instance, a large number of geography departments present in various universities in the USA (95%) have managed to draw attention by using a GIS (Taş, 2004, p. 8).

Although it was stated that a GIS would be used in geography lessons in the curriculum issued in 2005 in Turkey, no solid evidence has been reported as to its having been used anywhere across the country. According to Şimşek (2008), reasons for the failure of using a GIS in geography lessons in Turkey are the limited number of teachers trained for using a GIS, the cost of the software, poor physical conditions of schools, and the insufficient amount of time allocated for this lesson.

Pedagogues have called attention to several reasons for the application of a GIS as a significant teaching aid in schools. Among these reasons are the fact that a GIS facilitates learning for students during their academic life via computers, and that it bestows them with good advantages in favor of getting a job, as well as enabling students to assess conditions in which a GIS can be applied to different fields of study, thus acquiring problem-solving ability depending on varying conditions (Lemberg & Stoltman 2001). However, some researchers warn that the real purpose of a GIS, which is supposed to be merely a teaching aid, should not be emphasized more than the lesson itself in which a GIS is to be used (Chen, 1997; King, 1991; Lemberg, & Stoltman, 2001; Palladino, 1994; Sui, 1994; White, & Simms, 1993).

It is also essential that some demonstrations that will introduce the fundamentals of a GIS be carried out in order that students can acquire the necessary basic skills with which they can use the program software of a GIS. Moreover, it is necessary that students be given explanations as to what the content of this software is. Otherwise, students are likely to be confounded by details, thus failing to reach whatever goals that have been set (Wier & Robertson cited in Ergün, & Ayday, 2006, p. 76). Problems of these kinds and other likely ones can be avoided or coped with if they exist as long as carefully-designed educational materials and lesson plans are prepared and presented via a GIS in primary and secondary schools (Demirci, 2006, p. 3).

In the event that a GIS-aided education model in geography teaching is used, students may draw very good benefits while comprehending the subject being taught and also be able to access scientific data relevant to the subjects they have learned with more ease. The present study aims to argue that students could be more successful in geography lessons in which a GIS-aided teaching model is applied through an example of how migration can be taught using a GIS in geography lessons.

As is known, migration is moving from one place to another in the search of a more comfortable life or a better job, in addition to being able to draw benefits from diverse social and economic opportunities to be offered in the new location. Teachers who use conventional teaching methods tend to simply define what migration is in a geography lesson and often mention possible reasons for such a relocation movement without using much equipment to aid teaching. In a lesson in which students are not expected to get actively involved, students cannot be expected to pay as much attention to what is being taught as those who are welcome to get actively engaged in the lesson. Therefore, a GIS could contribute a good deal to a lesson in which students are encouraged to do brainstorming in an environment where they can discuss and analyze possible causes of migration, thus accessing necessary information through their own efforts. For instance, students may be able to achieve the desired goal of accessing information about migration in Anatolia by superposing its historical periods (layers) with the help of a GIS, thus being able to analyze the direction of movement, apart from causes and effects of migration in Anatolia throughout history in sufficient detail.

Teaching aids are essential to achieving teaching. As was reported by Yaşar in (2005), teaching aids play a central role in enabling learners to acquire desirable behaviors with the help of some extreme functions of these aids. Teaching aids are also taken advantage of achieving teaching within the expected period, as well as providing a permanent and healthy environment for learning.

Migration could be regarded as a relocation process undertaken by people. In actuality, migration has been considered as a relocation movement, whether discussed with respect to its geographical, cultural, or social impacts (Yalçın, 2004, p. 177). Internal migration is defined as the movement of people from one place to another within the same country due to varying reasons, or is defined as the difference between

people's birth place and the final destination they end up inhabiting. Cases of internal migration in Turkey are currently on increase, notably due to political and social unrest, accompanied by socioeconomic factors. When migration movements in Turkey are examined on a regional basis, one encounters a clear distinction between places which keep losing population and those which keep receiving population from other places in a continuous trend. Regions losing their population to others are the East, the South-east and the Black Sea, while regions continuously receiving new population are Marmara and West Anatolia regions. The cities that are increasingly receiving new population are either industrial cities such as Istanbul, Izmir, Bursa and Kocaeli, or cities with a favorable climate such as Muğla and Antalya located across the Mediterranean Sea (<http://www.gocsempozyumu.org>: international migration symposium: 12. 08 2009 and Özgür, 1998).

Students will learn about various developing regions, which are the centers of attraction for migration in Turkey, as well as learning about the causes of migration using an inquiry approach by means of a GIS under the guidance of the teacher. As Keleş (1993) reports, the causes of the urbanization movement are defined as economical, technological, political, and psycho-sociological factors. Keleş also reports that these factors are so closely interrelated that it is impossible to distinctly tell one from another. According to Lee (1969), there are known to be attractive as well as unattractive factors affecting places where people are living already and where they are considering moving into. Migration might result from economic and socio-cultural factors, apart from the problems confronted the neighborhood people live in or simply familial problems ignited in the places which people move out of (Kleiner, 1986, ed. Ira A. Glazier And Luigi De Rosa; p. 307 cited in Yalçın, 2004). All these reasons taken into account, locations observed to have been favored the most by those immigrants are split into different groups and given different colors on the map and afterwards the characteristics of these inviting centers are discussed thoroughly via a GIS in the classroom. Students will be able to remember whatever learned in the classroom this way for much longer periods, now that they have accessed this new information through practice aided by a GIS. Also, Kaptan (1998, p. 25) reported that if students can learn skills of taking advantage of learning aids, they can better acquire the ability to apply whatever they have learned in real-life situations.

Accordingly, transferring the migration subject by means of a GIS-aided constructivist teaching method can provide the following benefits for students:

- Development of geographical skills and ability to use the inquiry method
- Being able to incorporate the studies they made and the experience they had while going through the inquiry process into relevant fields
- Being able to make use of and enhancing geographical knowledge and terms
- Being able to form a relationship between physical and human geographies

An Applied Sample Lesson with a GIS

Subject: Population movement and migration in Turkey

Objective: Enable students to understand factors affecting the distribution of population with respect to geographical regions and provinces on a cause-effect relationship basis, as well as helping students comprehend developments triggered by presenting the curious relationship between these factors and migration

Students are expected to draw the following benefits: Students will hopefully

- Be aware of the problems concerning migration in Turkey
- Be able to inquire the problem they notice
- Be able to achieve self-evaluation within the classroom
- Be able to appreciate the relationship between migration and natural environmental conditions
- Be able to understand how migration varies in relation to regional and local distributions
- Be able to figure out how density of population can be mapped in consideration of the regional distribution
- Be able to work out how population-related activities occurring in geographic locations could be shaped by migration

- Be able to assess how different regions could be developed via geographic planning considering the movement of population to be expected in these regions
- Will be able to plan what they can towards their learning life in the future

Estimated duration: 2 lesson hours (100 minutes)

Lesson equipment and materials:

- Computer (PC)
- A GIS-based program (e.g. Map Info)
- Population and migration data (official data from the State Planning Organization (SPO) Turkish Statistical Institute (TurkStat))
- Political map of Turkey

It is necessary that every single student be allocated a personal computer within the classroom, and that these computers be installed with the GIS-based Map Info program. Besides, it is necessary that students be explained the content of this program and how it works in advance. Once the students have had information about how to use the GIS-based program, they can begin to find out about what the nature of the distribution of migration is across Turkey, thus being able to create thematic maps based upon a cause-effect relationship. The procedures to be undertaken by the students have been summarized respectively as follows;

- How to display the map of Turkey on the screen?
- How to recover the Turkish map layer indicating regional and provincial borders?
- How to open the population table designed for cities?
- How to zoom in and out the map?
- How to display or change the necessary data by using the icon for “search”?
- How to create a heterogeneous structure by superposing different layers?
- How to create a thematic map with respect to the categories required?

GIS-Aided Learning Activities

Engage

It could be very useful to get students watch a short film or a presentation prepared with photographs in order that what students already know about migration can be revealed in the lesson of “Human and Economic Geography of Turkey”, which is a primary and secondary school lesson issued in the curriculum devised for departments of Social Sciences in education faculties in Turkey. Afterwards, the causes of population movements will be analyzed diligently based upon a cause-effect relationship, as well as with respect to distribution and synthesis. Finally, students will be encouraged to reveal whatever knowledge and experience they have had up to then concerning the subjects taught to them via a GIS, such as geomorphologic units, climate, hydrographical units and socioeconomic fluctuations and natural disasters, all of which make up the issue of population and migration. In view of that, several questions need to be directed at students, which appear below as follows;

- In what regions is the population scarce and why?
- What regions in Turkey keep losing and receiving population all the time?
- What are the natural-human environment characteristics of migration-receiving district in Turkey?
- What are the natural and human characteristics of the regions losing population to other regions in Turkey?

A brief introduction is made before the lesson begins so that the knowledge and experience levels of the students regarding densely-populated regions, districts, and locations in Turkey can be determined. Next, the term “migration” will be defined according to the answers to be given to the abovementioned questions via a catechetical method. Finally, the distribution of population is questioned according to whether it occurs in a city or provincial region. As all of these processes are arranged in the GIS environment/ with the GIS program, an ideal environment can be said to have been created, in which a GIS can be helpfully employed for teaching geography.

Explore

At this stage, the teacher is expected to get students think over situations that they have observed and analyzed (Yurdakul, 2005, p. 59) for the purpose that students can improve their skills of creating workable solutions and that they are able to guess what measures needed to be taken in order to prevent the same problems from coming up again. The main objective of this study is to enable students to discover problems on the strength of whatever knowledge and experience they have as well as the observations they have made in geography lessons, and enable to them come up with workable solutions.

One of the most significant tools assisting all these studies is the information technologies. Furthermore, a geographical information system is one of the best examples of these technologies. Various data are written/ added and thematic maps are created by means of layers added to the map of Turkey created with the Map Info operating system (GIS). In this way, migration is scrutinized in that regional distribution of places losing population and those receiving population in terms of regional distribution. The following questions are supposed to be answered:

- What are the main characteristics of densely populated provinces in Turkey?
- Which factors affect the distribution of population in Turkey?
- Which human factors affect the distribution of population in Turkey?
- Which regions in Turkey keep losing population heavily and why?
- Which regions in Turkey keep receiving intense populations?
- How can new alternative urban environments/ localities be created in Turkey?

Explain

Under the teacher's guidance, students work up their program in consideration of the way in which to reflect how they perceive and define migration or migration-related problem(s) that they observed in and outside of the school, as well as the migration-related problems that they themselves could think of. In such a classroom as that in which the teacher corrects any misconceptions held by the students regarding their own observations or self-fabricated scenarios through brainstorming, while at the same time, asking them open-ended questions in order

that these students can assess different situations from different perspectives and approaches.

As it is known, the movement of a population from one location to another due to various reasons such as in order to lead a better life in the new location constitutes the main focus of the definitions of migration. Fitcher (1991, p. 155) classifies migratory actions into voluntary and involuntary migrations. Petersen (1996, p. 11) defines migration with respect to its direction as international migration (overseas) and internal migration and also denotes that migration occurs due to attractive and detractive factors based upon its structural characteristics and reasons, classifying migration into four types (cited in Birel, Özgen, & Boz, 2007): (i) Primitive migration, (ii) involuntary migration, (iii) free migration, and (iv) mass migration. On the other hand, Tümertekin (1968, p. 35) classifies migration into two main groups as internal and international and categorizes internal migration itself into four types: (i) rural-urban, (ii) urban-urban, (iii) rural-rural, and (iv) urban-rural.

Upon brainstorming on the topic being taught and an effective application of a GIS, students will be able to explain both the structural characteristics and causes of migration by showing/ marking migrations with respect to their structural characteristics on the map of Turkey created in an environment supported by a GIS. As is known, the teacher and the textbook have formed the basis for multimedia teaching in education for a long time. However, audio-visual media comes to fore in the modern multimedia-related learning. In this sense, in order to achieve permanent learning, many more of audio-visual aids to appeal to more sensory organs should be supplied, which appears to be a constant need (Yaşar, 2004).

Elaborate

In a GIS-aided constructivist teaching, students can scientifically synthesize their knowledge and experience with the help of new information, perspectives, and analysis. If students become inquisitive about the relationship between the topics and so try to figure it out in an environment supplied with a GIS, their learning could be enhanced to a large extent. Bevenino, Dengel, and Adams, (1999) pointed out that the constructivist approach enables students to make what they have learned in the classroom even more meaningful through an inquiry-based approach (cited in Kızılcı, 2005). Accordingly, students will be

enabled to inquire the causes of migration movement by transferring the population growth within their own settlement or migration to thematic map by means of a GIS and generate various solutions for post-migration problems. Providing students with an opportunity to notice for themselves the reasons for migration from the east of Turkey to the west of the country in Turkey, particularly to the west and south coasts, will boost their enthusiasm for accessing new information.

If students are required by their departments of study to carry out research into topic they are held responsible for and to study the regions affected by migration by taking advantage of such technology as a GIS, they could find themselves drawing pleasure from a GIS while learning.

The causes and results of migration are discussed in the classroom once students have studied the population and migration movement of a more local area. However, the causes of migration are put on a list before discussions can be commenced in the classroom. Afterwards, various solutions to the questions regarding topics under discussion are begun to be given consideration. For instance, the most probable reasons for the migration occurring in the district of Bismil can be listed as below:

- Drought and water shortage
- Desertification
- Insufficient industrial activities
- Wishes of the local people to receive better education in other parts of the country
- Nationalized lands (for dams and other public works)
- Attraction to the popular culture
- Wishes of the local people break way from the feudal structure existing in their homeland

Students will be able to reach a sound conclusion under the guidance of a teacher by inquiring the dominant geographical factors likely to have had an impact upon the fact a significant amount of the population of Bismil has been draining away, on condition that students can take the statistical data issued for the ongoing of migration that started in 2000 in Bismil. Building thematic maps in a GIS environment with regard to such characteristics of Bismil district as the arithmetic population density, migrating and population-receiving villages and land use according to the administrative units of the district will also reinforce teaching.

Evaluate

In the last part of the presentation entitled “Population movements and migrations in Turkey” in the classroom, the teacher is supposed to be making impartial evaluations after having allowed the students to voice their opinions freely. The teacher prepares a piece of paper in which the level of attendance by the students has been recorded, as well as the opinions voiced by the students who used a GIS in order to access the necessary information about migration so that whether or not students were able to reach the target set for them using a GIS could be determined accurately.

During all these processes, the teacher remains mostly passive, while the students stay active. Students are expected to reveal their skills of inquiring and analyzing migration with the help of a GIS-aided teaching method because they are more actively engaged than is the teacher. As the assessor of the evaluation group made up of the students and the teacher, the teacher evaluates the participation, questioning, and inquiry skills of the students regarding the relevant topic. Accordingly, considering the evaluations of the students with respect to their levels of analysis of the situation, the teacher goes on to ask the opinions of the students in the evaluation group in order to know if the students do agree with his or her evaluations.

Evaluations made by the board will determine if the students proved successful or not, depending on how successfully they answered the following questions.

- How can a comprehensive definition of migration be made?
- What are the human and natural reasons for migration in Turkey?
- Since some migration movements result from regional development differences, what kind of conflicts may arise due to these differences?
- What are the reasons for the fact that migration tends to occur towards particularly the west and the south regions of Turkey?
- What other regional and local differences cause permanent and temporary migration movements besides seasonal factors?
- What are the main reasons for migration particularly from the Black Sea, East and Southeast Anatolian regions?
- What kinds of traumas occur following the involuntary migrations in the southeast?

- How successfully those migrating to other regions can adapt to their new life?
- What kind of risks do those newcomers pose for the regions they move to in terms of social problems?
- What could be the role of a weak local/national administration in the rise in migration?
- What kind of workable plans should be devised in order to keep the phenomenon of migration under control?

In conclusion, based upon the abovementioned questions regarding the movement of population and migration, the success level of students could be determined more accurately.

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