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An Evaluation of Geographic Information Systems in Social Studies Lessons: Teachers' Views*

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Abstract

The aim of this study is to evaluate the applicability of Geographic Information Systems (GIS), used increasingly in primary and secondary education across the world, in social studies lessons in Turkey. In line with this aim, 14 social studies teachers working in the province of Aydın, Turkey received a 6-hour training course about GIS during the 2011-2012 academic year. The training covered theoretical information on GIS, a demonstration of ArcGIS 9.2— a GIS software widely used in the world, and the presentation of GIS-based teaching materials prepared by the researcher prepared in accordace with the Turkish national social studies curriculum for primary schools. Following the training, interviews were conducted with the teachers, during which their views were sought regarding the applicability of GIS in social studies lessons in primary education, its benefits, potential difficulties, and what action should be taken. Data were collected using a 'Teacher Interview Form' consisting of 6 open-ended questions developed by the researcher. Content analysis was used for the data analysis. The study revealed that the teachers found GIS considerably useful in primary education due to its ability to enable students to learn visually, improve their map skills, and promote retention. However, the teachers also mentioned several potential problems, including their own shortcomings in using both computers and GIS, the lack of time allotted for such activities, students' inadequate computer skills, and the level of difficulty of GIS since it has been found to be rather difficult for the students. A number of solutions to these problems have been proposed in the study.

Keywords

Geographic Information Systems (GIS), Education, Social Studies, Teachers' Views.

Today, helping students realize how to access information and then to make use of this information instead of simply teaching them increasing amounts of information has gained greater importance. Since a large portion of the information taught in today's era of radically changing education systems requires a proper awareness of the physical aspects of the world and since Geographic Information Systems (GIS) is a system in which spatial information may be stored, visualized, and analyzed, GIS finds itself as a valuable tool able to promote students' ability to comprehend and conceptualize such information.. GIS is an information system providing an integrated fulfillment of the following functions: the collection, storage, analysis, and presentation of graphical and non-graphical data obtained through location-based activities (Yomralıoğlu, 2002, p. 49).

The number of studies revealing the benefits of using GIS in education has increased in recent

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years. Among these benefits are: GIS enables student-centred learning (Audet & Paris, 1997). In student-centred approaches focusing more on individual and group work, students are motivated toward creativity, problem-solving, and producing and expressing ideas (Küçükahmet, 2000). Via GIS, students become involved in the process of obtaining information rather than being taught monotonous information and skills during their educational career. The use of GIS improves students' problem-solving and research skills (Audet & Paris, 1997; Johansson, 2003; Kerski, 2006; Malone, Palmer, & Voight, 2002; Shin, 2006; West, 1998). GIS enhances spatial awareness (Audet & Ludwig, 2000; Johansson, 2003; Lee & Bednarz, 2009; Qiu, 2006). GIS promotes students' computer skills and attitudes towards technology (Baker, 2002; Pitts, 2005).

GIS is also an important tool for aiding students to gain geographical consciousness, which can be defined as willingly having, protecting, using, organizing, planning, and saving nature and elements belonging to humans (Karabağ & Şahin, 2007). GIS helps students to realize natural and human elements. Moreover, planning and analyzing the data regarding these elements makes decision-making easier.

Limited Use of GIS in Education

The use of GIS in education has increased in parallel with technological advances. However, this increase is not at the expected level considering GIS'spotential contributions to educational goals and to students' overall awareness. The use of GIS in primary and secondary education has progressed slowly in America and England (Audet & Ludwig, 2000; Bednarz & Ludwig, 1998; Kerski, 2000). The primary reasons for this, as stated by Meyer, Butterick, Olkin, and Zack (1999) and Bednarz (2004), are as follows:

- The need for software, hardware and usable data, as well as other technical obstacles,
- The unwillingness of teachers to spend time and effort learning new technologies unless there is institutional support or an advantage to their career,
- Teachers' insufficient knowledge of how to teach using GIS coupled with the lack of curriculum-based material, and
- The lack of experience using spatial information.

The use of GIS in schools requires a long and detailed planning process as it may otherwise produce negative effects. Teachers need to organize and present information and content according to specific learning objectives. GIS may affect students' learning negatively unless teachers using GIS in classes are given preliminary information on content presentation (Baker, 2002; Bednarz, 2004).

Another impediment in the use of GIS in education is the overemphasis on a specific aspect of GIS; its being an instrument for teaching geography. This leads to worries as students may focus on technology rather than on geography while adapting GIS to the curriculum which may lead to GIS becoming the actual aim in the teaching process instead of remaining a tool in it (Demirci, 2006).

In Turkey, GIS is used more in higher education as an educational and research tool in various departments of many universities. The use of GIS in secondary education is relatively new, however. Following the change in geography curriculum in secondary education made by the Ministry of National Education in 2005, GIS was introduced into geography education (Milli Eğitim Bakanlığı [MEB], 2006). GIS is not used in lessons other than geography and does not appear in the curriculum of primary education. Nevertheless, there are a number of studies revealing the benefits of using GIS in primary education (Aladağ, 2007; Baker, 2002; Baloğlu Uğurlu, 2007; Bodzin, 2011; Hagevik, 2003; Kaya, 2011; Keiper, 1996; Meyer et al., 1999; Shin, 2006; Şimşek, 2007; Wigglesworth, 2003). The development of user-friendly software, the decline in the cost of computers and software, the increase in the number and quality of computers in schools, and the increase in Internet access in schools has facilitated the use of GIS in schools. All of these advances pave the way for its use in primary education. However, detailed studies are necessary before GIS may be implemented in primary education. To date, studies have revolved around discussion on what skills GIS contributes to with there being no studies conducted on the applicability of GIS in primary schools, especially in Turkey. This study investigates the benefits of using GIS in social studies lessons, its limitations, at what class levels and topics GIS can be used, and whether teachers are willing to use GIS or not.

Method

The data were collected using qualitative research methods. The interview method was used to gather

information on the applicability of GIS in primary education. Prior to the interview, a 6-hour training session on Geographical Information Systems was given. The training provided theoretical information on GIS and the demonstration of ArcGIS 9.2, the world's most widely used GIS software. With this software, sample lessons prepared by the researcher in accordance to the social studies curriculum in primary education were introduced to the teachers. At the end of the study, an interview was conducted to determine the teachers' views on the applicability of GIS in social studies lessons in primary education. The aim of the structured interview was to discover similarities and differences between the interviewees' statements and to make comparisons accordingly (Brannigan, 1985 as cited in Yıldırım & Şimşek, 2005). In the study, 14 social studies teachers working in secondary schools in the province of Aydın, Turkey during the 2011-2012 academic year were interviewed on a voluntary basis. Nine (9) of the teachers were female and 5 were male, and their degrees were in social studies (7), history (4), and geography (3).

Data Collection Tool

The data were collected using a semi-structured interview form. While preparing the interview form, the literature on the topic was researched, and the interview form was finalized with the assistance of a team of three experts, including a curriculum developer, a geography teacher trainer, and a social studies teacher trainer. Furthermore, to eliminate shortcomings, the interview was first conducted on two social studies teachers not involved in the sample. The interview form consisted of 6 open-ended questions.

Data Analysis

During the analysis of the data collected, inductive analysis, a type of content analysis, was used. An inductive analysis is commonly carried out to discover underlying concepts of the data as well as the relationships between these concepts via coding (Miles & Huberman, 1994; Yıldırım & Şimşek, 2005). The audio recordings of the interviews were scripted and the written data were coded separately by a researcher and an academician experienced in qualitative research. In order to deterimine the study's level of reliability, the formula Reliability = Agreement / Agreement + Disagreement x 100 was used (Miles & Huberman, 1994). The agreement rate of the formula implemented through coding done by he two researchers was calculated as 84%. Therefore, the study's reliability for data analysis was successfully attained as the agreement percentage was over the required 70%.

Course Materials Used in the Study

Prior to the preparation of the teaching materials used in the study, the social studies curriculum in primary education was examined and the learning objectives suitable for teaching via GIS were determined. Materials were prepared for the objectives, which appeared in the unit called 'Life on Earth' in 6th grade social studies lesson (MEB, 2005). The computer skills curriculum of 1st–7th grades was examined and the computer skills taught to students in schools were determined. The materials were prepared in accordance with these skills. Since GIS is a program which converts numerical data into maps or other visual presentation types, it was first decided how to visualize the topics after whih data were collected. Maps and graphs were prepared for the objectives and the data necessary for the students to make maps and graphs were also collected. The materials were finalized after obtaining the views of two social studies teachers working in the province of Aydın. Moreover, the materials previously prepared in accordance to the social studies curriculum in primary education in Turkey were introduced into the study (Aladağ, 2007; Baloğlu Uğurlu, 2007).

Teacher Training and Interview

In the study, GIS was introduced to the social studies teachers during a 6-hour training session and their views on its applicability in social studies lessons were gathered. Since GIS is not used in the social studies teaching department at the undergraduate level, it was assumed that the teachers had received no previous information on GIS and were therefore initially given a training course on GIS. The training included two components; the first being a 3-hour theoretical information course on GIS including information on the components and functions of GIS, data types, and the use of GIS in education. This first part aimed simply to raise awareness among the teachers, rather than teaching them GIS on a user basis. In the second 3-hour component of the training session, the course materials prepared for the study were presented. In addition, the sample course materials prepared previously in Turkey were shown to the teachers. The teachers received this training in their own schools by an

appointment system. Following the training, the interview was conducted. The training took place in IT classrooms or in classrooms with projectors. The interview was conducted after the 6-hour training and recorded with the teachers' consent using a recorder.

Findings

The benefits of using GIS according to the teachers' views are as follows: All of the teachers agreed that the use of GIS enabled visual learning. The other views on the benefits of the use of GIS in classes are: improving knowledge about maps (9), promoting retention (8), making the learning process fun (6), enabling easy access to numerical data (5), making the learning process easier (5), improving creativity (3), achieving hands-on learning (3), making a comparison among various data (2), developing critical thinking (2), enabling spatial analysis (1), and increasing active participation in classes (1). To give an example, Teacher 1 said, "*It is good because it is visual and reveals children's creativity. Anyway, I really liked it.*"

The potential disadvantages of the use of GIS according to the teachers' views are as follows: The majority of the teachers stated that their handicap in regards to their ability to use GIS would be their inadequate computer skills (8). The other views are: teachers' inadequate knowledge of GIS (6), teachers' inadequate time (4), students' lack of computer skills (4), the level of the GIS program since it is rather difficult for students (3), the time-consuming preparation stage (3), moving away from objectives (3), the lack of data (2), the lack of GIS programs in schools, (2) and the lack of the necsesary technical infrastructure in schools (2). To give an example, Teacher 5 said, *"First, the teacher must know how to use a computer in order to project something to the students, I mean. Also, how will we get the data while using this program?"*

The class levels suitable for using GIS according to the teachers' views are as follows: All of the teachers agreed that 6th grade was suitable for using GIS. The other views on this subject are: 7th grade (12) and 8th grade (2) are suitable for the use of GIS. During the time when the study was carried out, 5th grade students were being taught social studies lessons by their classroom teachers. The teachers interviewed in the study stated that 4th and 5th grades are suitable for using GIS since, although they did not teach them, they knew the content taught in social studies lessons. Eight (8) of the teachers stated that 4th grade was suitable and 5 stated that 5th grade was suitable. To give an example, Teacher 2 said, *"It is very important for the natural resources of our country [Turkey] to be covered in 6th grade. I think it can also be used in 4th and 5th grades. The students can use it on their own easily."*

The topics suitable for GIS according to the teachers' views are as follows: The majority of the teachers (8) thought GIS would be useful for the topics related with population. The other views are: knowledge of maps (scale, legend) (7), geographical features (7), agriculture (6), climate (6), underground resources (4), economics (4), history (3), and local time (1). To give an example, Teacher 3 said, "*History and geography. It can be very useful, especially for the ancient civilizations like Mesopotamian civilizations covered in 6th grade, showing their photographs on the maps. Visual and written materials become very easy to remember when used together.*"

The skills improved by using GIS according to the teachers' views are as follows: Most of the teachers (8) thought that using GIS would improve the students' map skills. The other views are: reading graphs and tables (7), decision-making (4), research skills (3), computer skills (3), problem solving (2), spatial analysis (3), making comparisons (2), and producing ideas (1). To give an example, Teacher 11 said, *"It is useful for computer skills, map skills, decision-making, and knowledge retention."*

As for the teachers' demand for in-service training about GIS, all of the teachers except for one stated that they would like to receive in-service training about GIS.

Conclusion and Recommendations

According to the primary school teachers studied, the use of GIS in social studies lessons would be beneficial. The teachers stated that the benefits of GIS would be enabling visual learning, improving map skills, promoting retention, making the learning process fun, enabling easy access to numerical data, facilitating the learning process, developing creativity, achieving hands-on learning, making a comparison among various data, developing critical thinking, enabling spatial analysis, and increasing active participation in classes. These results support the studies carried out by Aladağ (2007), Baloğlu Uğurlu (2007), Baker (2002), Berglund (2005), Keiper (1996), Kerski (2000), Shin (2006), Şimşek (2007) and Weller (1993).

Apart from the benefits of GIS, the social studies teachers mentioned a number of potential disadvantages. These are: the teachers' inadequate knowledge of GIS and their lack of computer skills, not having adaquate time to implement GIS into the curriculum, students' lack of computer skills, the level of GIS program since it is rather difficult for students, the time-consuming preparation stage, moving away from the objectives, the lack of data the lack of GIS programs in schools, and the lack of the necessary technical infrastructure in schools. These potential problems show a similarity with the problems stated by American teachers in the study by Kerski (2000) and those of Finnish teachers in the study by Johansson (2003). The current study also supports the results found by Meyer et al. (1999), Artvinli (2009), Demirci (2009), and Taş, Özel, and Demirci (2007). The literature research revealed that the lack of technical infrastructure in schools was one of the biggest obstacles impeding the use of GIS in schools. In this study, however, this obstacle appeared at the bottom of the list. Instead, teachers emphasized their own inadequate knowledge of GIS and their lack of computer skills as well as those of the students, rather than the lack of technical infrastructure. The reason for this may be the number of years which have passed between studies. Regarding technological advances, even a single day is crucial and there is a large time gap between these studies. In the meantime, the lack of technical infrastructure in schools may have been improved to some extent or access to technology may have increased. In addition, in his study, Demirci (2011) discovered that effective learning can be achieved when GIS-based course materials are shown to students via only one computer in an ordinary classroom instead of in a computer laboratory. This result partially eliminates the prejudice a computer laboratory must exist in order to use GIS.

Similar problems have been experienced in the countries such as America, Finland, and Canada where GIS is widely used in education. Supplying tablets to students and equipping classrooms with smart boards may be effective in overcoming the lack of hardware, which is an obstacle in the implementation of GIS in schools. Regarding software, projects can be created to develop materials for primary and secondary education with the available GIS programs. An R&D study in which GIS software suitable for primary and secondary education was developed should help to decrease the cost of the software for schools. The numerical data belonging to government agencies (e.g. Turkish Statistical Institute, The General Command of Mapping, General Directorate of Mineral Research and Exploration, etc.) can be simplified so as to be used in education and made accessible to the Ministry of National Education. The available data are both too detailed and costly. In addition, online platforms can be created for teachers to share their materials. Universities can offer teacher training. The Ministry of National Education must particularly support the removal of red tape and the application of GIS in schools.

The teachers stated that GIS could be used in social studies lessons, especially in 6th and 7th grades. In addition, a number of teachers thought that GIS could be used in 4th, 5th and 8th grades as well. They pointed out that GIS could be used in primary education, especially in 4th grade. Shin's (2006) study reveals that GIS improves 4th grade students' geographical knowledge and map skills. At what class level GIS can be used does not only depend on students' level of growth, but also on many factors, such as teachers' technological competence, software and hardware problems, program, etc.

The teachers stated that using GIS would be effective in topics like population, knowledge of maps, geographical features, agriculture, climate, underground resources, economics, history, and local time. When the applications of GIS in Turkey and the world are examined, similarities are found among teachers' views (Aladağ, 2007; Baloğlu Uğurlu, 2007; Johansson, 2003; Keiper, 1996; Shin, 2006; Şimşek, 2007). An interesting result of the study is that the teachers believed that GIS could also be used in history topics. However, although spacial awareness is extremely important in understanding and conceptualizing historical events, all of the GIS applications in Turkey are for geography topics. Therefore, GIS would be useful in history education.

The teachers thought that GIS would improve students' map and graph reading skills mostly in primary education. Apart from these, skills like decision-making, researching, using a computer, problem solving, spatial analysis, making comparisons, and producing ideas would improve according to the teachers. These results support the previous studies carried out by Bednarz (2004), Demirci (2008), Johansson, (2006), Lee and Bednarz (2009), Lloyd (2001), Patterson, Reeve, and Page (2003), and Shin (2006). Thirteen (13) of the teachers demanded in-service training on GIS, showing that social studies teachers have positive views on the applicability of GIS in primary education.

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