European Journal of Geography **2 2**: 48-61, 2011.

USING GIS-BASED PROJECTS IN LEARNING: STUDENTS HELP DISABLED PEDESTRIANS IN THEIR SCHOOL DISTRICT

Ali DEMIRCI
Fatih University, Department of Geography, 34500, Buyukcekmece, Istanbul, Turkey,
http://www.geography.fatih.edu.tr/, ademirci@fatih.edu.tr

Ahmet KARABURUN
Fatih University, Department of Geography, 34500, Buyukcekmece, Istanbul, Turkey,
http://www.geography.fatih.edu.tr/, akaraburun@fatih.edu.tr

Mehmet ÜNLÜ
Marmara University, Atatürk Faculty of Education, 34722, Kadıköy, Istanbul, Turkey,
http://aef.marmara.edu.tr/, munlu@marmara.edu.tr

Ramazan ÖZEY
Marmara University, Atatürk Faculty of Education, 34722, Kadıköy, Istanbul, Turkey,
http://aef.marmara.edu.tr/, rozey@marmara.edu.tr

Abstract

This study outlines a GIS-based project conducted in a public high school in Istanbul, Turkey with the support of the Scientific and Technological Research Council of Turkey (TÜBİTAK) in 2010. Fifteen 9th and 10th grade students worked as a group to determine how livable their district was for disabled pedestrians. The project lasted for one and a half years and students investigated the 251 kilometers of sidewalks in the district of Sisli. The students mapped all the objects that occupied the sidewalks, measured the widths and heights of the sidewalks at more than three thousand points, and located all the ramps constructed at each end of the sidewalks for those who use wheelchairs. At the end of the project, the students produced a map showing where disabled pedestrians can travel on sidewalks by themselves in the district. The project revealed that GIS is an important learning and teaching tool for schools and an important platform to bring school and other institutions together to solve social problems.

Keywords: *GIS, GIS-based projects, Project Based Learning, Geography education, Secondary education*

1. INTRODUCTION

Project-based learning (PBL) is a learning model in which students learn by completing projects. PBL focuses on teaching by engaging students in different activities, including asking and refining questions, discussing ideas, making predictions, conducting interviews, designing plans, collecting data in the field and laboratory, analyzing data, drawing

conclusions, and presenting the results to others (Blumenfeld, et al., 1991). Projects should have some certain criteria to be considered within the framework of PBL. As described by Thomas (2000), projects in PBL; (1) should be central to the curriculum, (2) should focus on questions or problems, (3) should involve students in a constructive investigation, (4) should be student-driven, and (5) should be realistic by focusing on real-life topics and activities. PBL is a beneficial and effective instructional method that enhances the quality of learning and provides students with many practical skills, such as planning, communicating, problem solving, and decision making (Thomas, 2000).

The use of technology has become an integral part of PBL in schools (ChanLin, 2008). As been one the powerful technological tools in schools, Geographic Information Systems (GIS) are used in combination with PBL to produce, store, display, manipulate, and analyze data on computers. Being a location-based system, GIS provides the opportunity for student-centered and standards-based education (Kerski, 2003), facilitates Problem-Based, Inquiry-Based, and Project-Based Learning (Johansson, 2003; Landenberger et al., 2006; Demirci, 2011), and empowers students to become active users of spatial data and active learners of geography (William, 2001). GIS has a big potential to be easily integrated into PBL. Since storing, representing, and analyzing data are the main functions of GIS, it encourages students and teachers to work on real life issues as project in their lessons.

Various methods are used in incorporating GIS into classrooms across the world, such as implementing GIS-based exercises and conducting GIS projects (Malone et al., 2003; Demirci, 2008a, b; Demirci et al., 2011). The number of examples of GIS projects in secondary schools has increased in recent years across the world (Demirci et al. 2011). For example, the Geographical Information Systems Applications for Schools (GISAS) project, completed in 2006 (Johansson, 2006), is a GIS project that is conducted in schools in seven European countries. Similar GIS-based projects have been conducted in various academic subjects at schools in many countries across the world, including the US, UK, Canada, and Singapore (Wilder et al., 2003; Wigglesworth, 2003; Shin, 2006; Milson, et al., 2012).

In schools in Turkey, GIS is primarily used to implement GIS-based exercises in the classroom. Only a few examples illustrate the use of GIS as a tool to conduct projects in Turkish high schools, and many of these cases are part of doctoral studies (Karatepe, 2007; Tuna, 2008). Although many different materials, lesson plans, and digital data are available to teachers allowing them to implement GIS-based exercises in Turkish high schools, a lack of good examples prevents teachers from incorporating GIS projects into their lessons. The problem has been illustrated in a project that was initiated in 2009 in Turkey. The project, titled "Using GIS to Develop Social Sensitivity among Students: Implementation of GIS-based Projects at Secondary School Geography Lessons," identified the main obstacles to conducting GIS-based projects in schools. It lasted for 18 months from September 2009 to March 2011, and was conducted in three pilot public high schools in Istanbul, Turkey with the support of The Scientific and Technological Research Council of Turkey (TÜBİTAK).

During the first stage of the project, students from each school conducted a survey of people in their school district. The survey included 24 questions that asked about the school district's main social, economic, and environmental problems from other people's point of view. Students in each school then selected three important problems and developed solutions in cooperation with related governmental agencies that use GIS. Nine GIS-based projects were conducted in three schools. This study outlines one of the GIS-based projects, which was conducted by Sisli High School students in Istanbul in 2010, and describes its effect on students, teachers, and the school. The project, titled "How accessible is the Sisli district for

disabled people? Analyzing the sidewalks for people with wheelchair," was conducted in the Sisli district, which is located in the central part of Istanbul.

2. THE AIM OF THE GIS-BASED PROJECT IN SISLI HIGH SCHOOL

Sisli is one of the most populated districts in Istanbul and is located in the central part of the city. Rapid urbanization and population growth have resulted in many problems in the district, such as traffic congestion, lack of parking areas, air pollution, and the development of illegal housing. Although this is a serious problem for the entire community, disabled people are among those who suffer the most from these inconvenient conditions in the district. When approximately 126 students at Sisli High School conducted a survey of 1,250 people in their district, they found that the state of the sidewalks, the roadway for pedestrians, received one of the highest numbers of complaints. Many people thought that the sidewalks in the Sisli district did not have proper standards and were mainly occupied by cars, stands, billboards, and trees that make it very difficult for normal pedestrians to walk. When discussing this problem, students thought that the lack of proper sidewalks in the district may cause further stress to disabled pedestrians, especially those who use wheelchairs. To understand the extent of the problem, students visited the Association for the Visually Impaired in the district. Authorities in the association told students how unbearable the situation was for them and demonstrated the difficulties they had while walking on sidewalks (Figure 1). After the visit and a long discussion of other possible project topics, the students decided to study the sidewalks in one of their GIS-based projects to understand the extent to which they were suitable for disabled pedestrians using wheelchairs in the district of Sisli.

Fig.1 Students visited the Association for the Visually Impaired in the district of Sisli and walked with them on pedestrian ways to understand their problems

3. METHOD

A number of activities were developed for the students participating in the project (Figure 2). Students helped with planning different stages of the project. They reviewed the existing literature to understand the problem and the main concepts regarding the project topic, conducted interviews in state and private institutions, studied GIS to learn how to use it in their project, collected and stored data in computers, used GPS, analyzed data with GIS, and prepared and disseminated the results of their project through conferences, newspapers and magazines.

Before starting the project, the students walked through the streets in the district to understand the problems facing the use of the pedestrian areas. The following major problems were identified: (1) there were no sidewalks along some of the streets, (2) sidewalks were very

narrow along many streets, (3) there was no curb ramp at each end of many sidewalks, and (4) a majority of the sidewalks were occupied by objects such as trees, cars, billboards, stands, and even stone mushrooms that were built to prevent car parking.

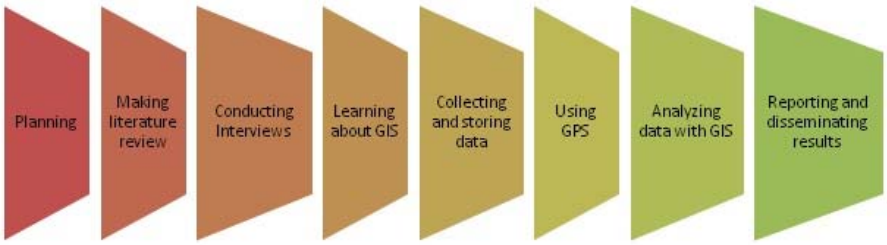

Fig.2 Activities targeted for the students in the project

Fifteen students worked on the project during their 9th and 10th grade years at the age of 14 and 15, along with their geography teachers and a project assistant who was a graduate student studying geography. All the processes in the project were discussed and organized together with the project members under the supervision of an academic council included four geographers from two universities. Twenty neighborhoods located in the southern half of the district were identified as the study area, which covered 7.8 square kilometers (Figure 3). Students obtained the maps of the study area, which came in 46 pieces at a scale of 1:1.000, from the Map Directorate of the Istanbul Metropolitan Municipality. Students then walked through all the sidewalks in the study area to identify the locations and types of objects that occupied the sidewalks. They also recorded whether the objects prevented the passage of people on sidewalks, the locations of curb ramps along the sidewalks, the heights and widths of the sidewalks at certain locations, and the locations where there are no sidewalks. Students also identified broken surfaces on the sidewalks in the study area.

Fig.3 Location of the study area

The project team collected all the data in the field over a two month period. The data collection took approximately 300 hours during April and May of 2010. The section on the sidewalks which can be walked through uninterruptedly was called a pedestrian segment in the study. A total of 3,018 pedestrian segments were studied in the study area and the total length of the sidewalks students walked through was 251,122 meters. Students first documented their findings on paper maps and then transferred them to computers (Figure 4). Basic layers of the study area, including streets and buildings, were obtained from the GIS department in the Istanbul Metropolitan Municipality in a GIS format. ArcGIS 9.3 was used for storing, manipulating, and analyzing data on the computer. Students first identified the streets that did not include properly constructed sidewalks. The objects occupying the sidewalks were classified with different symbols on GIS (Figure 5). Students also identified whether the objects prevented the passage of a person with a wheelchair by measuring the distance between the object and each end of the sidewalks. After locating the broken surfaces and curb ramps on GIS, students produced the final map of the study, which indicates the sidewalks through which disabled people can pass with their wheelchair. Students then produced the project report in an MS Word document and presented their findings at a conference organized by their schools.

Fig.4 Students collecting data in the field and transferring them into GIS environment

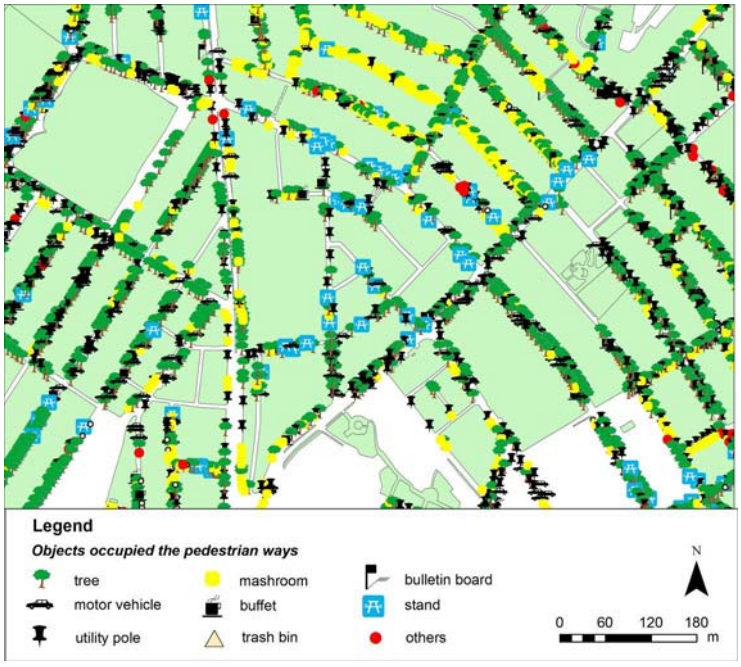

Fig.5 Objects occupied the pedestrian ways were shown on GIS with different symbols

4. RESULTS

4.1. What did students find out from their project

The project provided an in-depth analysis of the sidewalks in the Sisli district for disabled people using wheelchairs. As identified in the Figure 6, 26.7% of the pedestrian segments did not have proper sidewalks dedicated to walking. The total length of these segments is 67,075 meters.

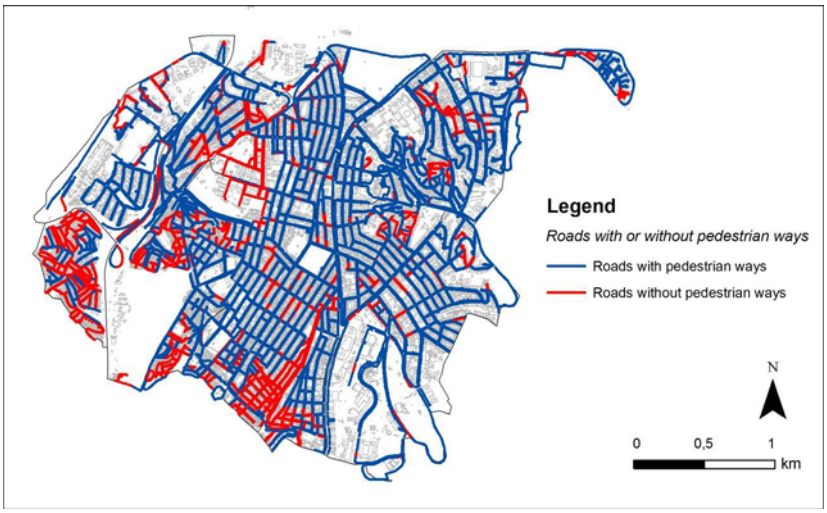

Fig.6 Streets with and without sidewalks

Obstacles on sidewalks can make walking difficult and even impossible especially for people using wheelchairs and crutches. A total of 14,594 objects were identified on the sidewalks in the study area. As shown in the Table 1, 46% of these objects were trees. Almost 24% and 16% of the objects were electric poles and mushrooms, respectively. Mushrooms are the small mushroom-shaped stones that are built on sidewalks to prevent car parking. Various types of motor vehicles, such as cars and motorcycles, accounted for 7.9% of all the objects on the sidewalks.

Table 1. The objects occupying the pedestrian ways in the study area

Objects on the pedestrian ways	Number	%
Tree	6719	46
Electric pole	3453	23,7
Mushroom	2365	16,2
Motor vehicle	1152	7,9
Stand	391	2,7
Billboard	120	0,8
Buffet	101	0,6
Trush Bin	36	0,3
Others	257	1,8

The objects were also analyzed to understand whether they create obstacles for passage on sidewalks. 2,904 objects (19.9% of all the objects) were found to obstruct people's passage on the sidewalks. The pedestrian segments, along with the objects that create obstacles for people's passage, are presented in the Figure 7.

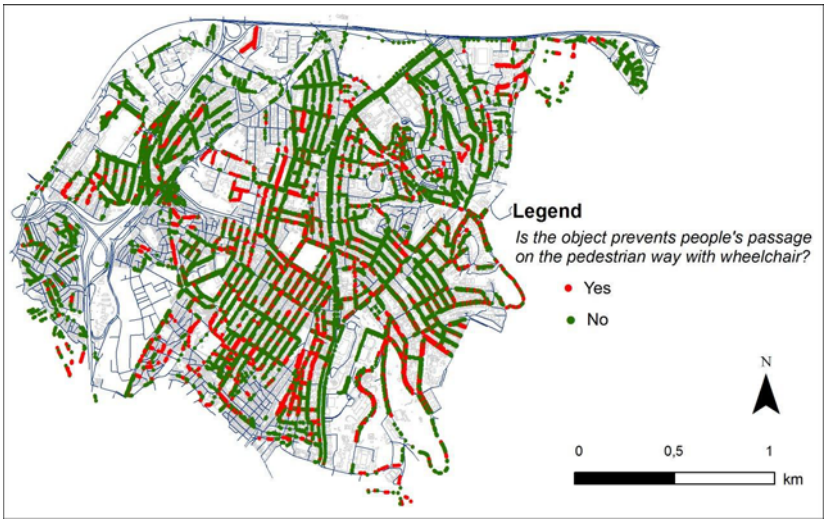

Fig.7 The pedestrian segments including objects that prevent people's passage

The widths of all the pedestrian segments were measured from 3,183 points in the study area. The classification of the pedestrian segments according to their width is given in the Table 2. As can be seen in the table, 82.4% of the pedestrian segments were less than two meters wide. As identified in some studies, two meters is accepted as the ideal width in Turkey for the sidewalks; it should be at least 3 meters at bus stops and 3.5 meters in front of stores (BÖİB, 2010; ÖZIDA, 2008). Only 17.6% of the sidewalks are more than two meters in width in the study area. Students also detected broken surfaces on the sidewalks. They identified 299 locations that needed maintenance in the study area (Figure 8).

Table 2. The width of the pedestrian segments in the study area

Width (m)	The number of pedestrian segments	%
0 - 2	2485	82,4
2 ve üzeri	533	17,6

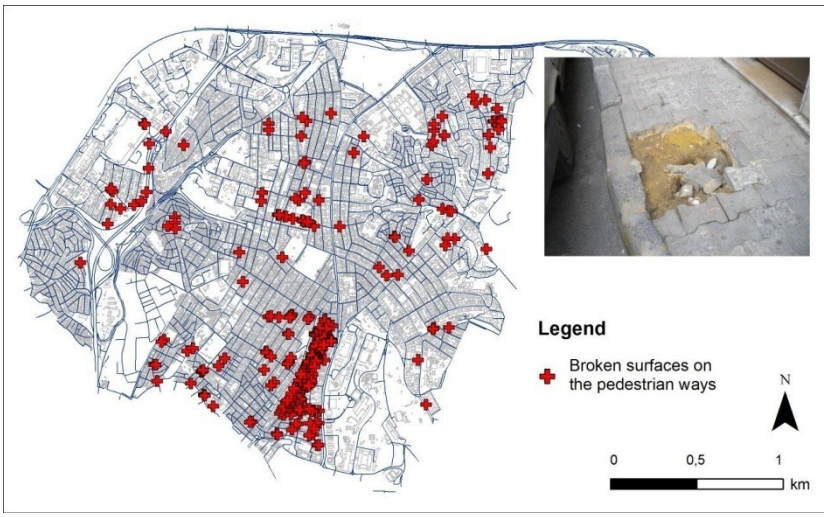

Fig.8 The broken surfaces on the sidewalks that needed maintenance

One of the most important features of sidewalks is whether they have a curb ramp properly constructed at each end. All the ramps on the sidewalks in the study area are shown in the Figure 9. A total of 264 curb ramps were identified. Only 9 out of 3,018 pedestrian segments included a ramp at each end.

The final map (Figure 10) produced for the project indicated the sidewalks on which disabled pedestrians can move by themselves with wheelchairs. It was produced using two criteria: 1) whether objects found on the sidewalks prevented passage and 2) whether there were two curb ramps, one at each end of the sidewalks. The study revealed that only two pedestrian segments out of 3,018 had curb ramps at both ends that were properly constructed. The total length of the sidewalks through which disabled pedestrians can move by themselves with wheelchairs is only 273 meters in the study area (the approximate length of the whole pedestrian ways is 251 kilometers).

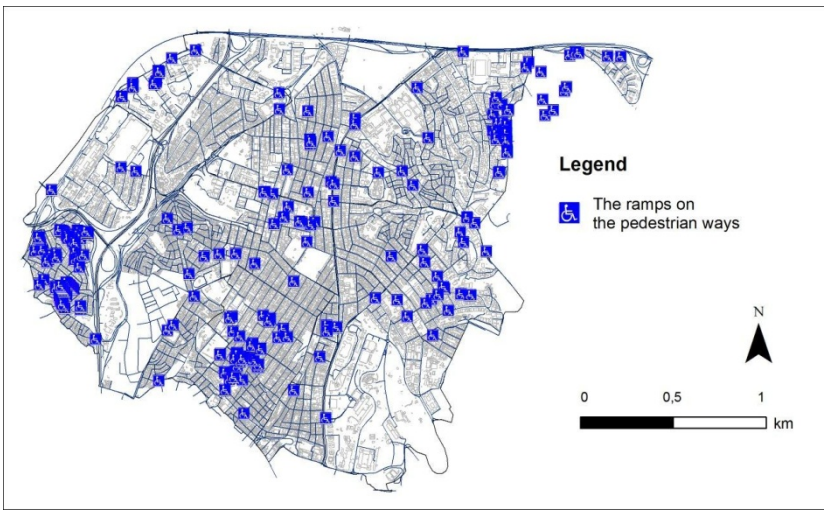

Fig.9 Ramps on the sidewalks

Overall, the project revealed that the sidewalks in the study area were not suitable for the needs of the disabled pedestrians who used wheelchairs. It confirmed that reconstructing all the sidewalks to meet certain standards was impossible, particularly in the places where the streets were very narrow. Some of the main streets, however, which crossed the study area

from south to north, could be modified to better serve disabled pedestrians. Buyukdere, Halaskargazi, and Cumhuriyet streets were the most important streets in the study area connecting Mecidiyekoy and Taksim. The sidewalks on both sides of these streets were at least two meters wide and contained no objects that prevented the passage of people. These streets could be made suitable for pedestrians using wheelchairs by constructing ramps at each end of their sidewalks. The survey showed that disabled pedestrians would then be able to walk approximately six kilometers by themselves using sidewalks.

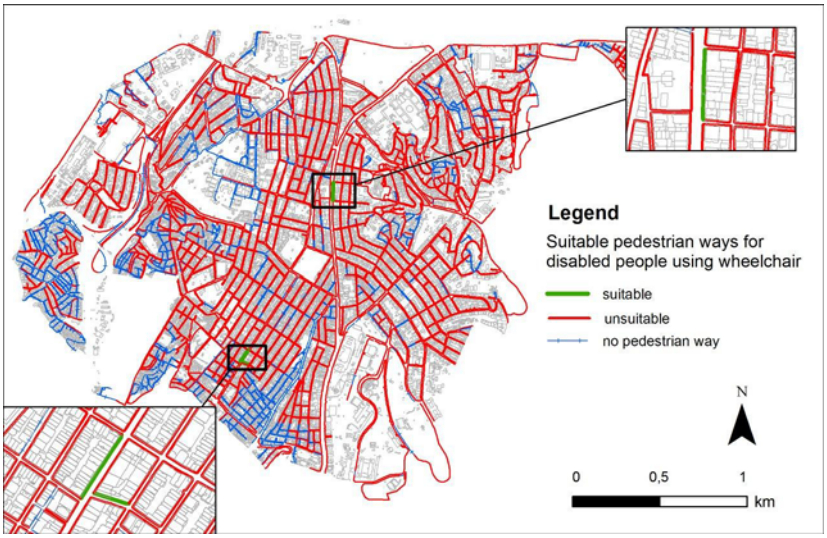

Fig.10 The sidewalks disabled pedestrians with a wheelchair could navigate by themselves

4.2. Effects of the project on students, teachers, and schools

The GIS-based project conducted in the district of Sisli was the first project in which GIS was used in Sisli high school. The project had many positive effects on students, teachers, and the school. It provided students with opportunities to experience activities such as conducting a survey and interviews, visiting government agencies, collecting data in the field, using GPS and GIS and giving presentations at conferences and meetings.

Through these activities, students gained an appreciation for the importance of geographic studies for society. They learned how to use GIS to solve social problems. Before the project, the students had only an abstract understanding of the usefulness of GIS. The project provided them an opportunity to learn how to use the main tools of GIS to produce, manipulate, analyze, and visualize data for specific purposes. The project was also useful for the students' personal development. Students experienced increased confidence in their ability to communicate with people from different segments of society and to achieve something that improves society. The manager of the school and geography teacher who involved in the project in the school explained that the project changed the attitudes of students towards geography lessons and school in a positive way by considering the results of many interviews with the students. As they commented further, the project motivated students to participate in other school activities and to give further consideration to their post-graduation plans.

Only one geography teacher actively participated in the project at Sisli high school. The teacher did not have sufficient GIS knowledge, skills, and experience before the project started. For this reason, the role of the teacher was restricted to organizing, communicating, and motivating students to conduct different activities in the project. The project was useful for the teacher in many ways. It helped the teacher understand the role and potential of GIS in

his lessons and also to recognize his lack of knowledge and skills about GIS. One of the most important benefits of the project for the teacher was that he realized the importance of GIS as an effective teaching tool for his geography lessons. The teacher coordinated the activities and connections between students, the school manager, and other project partners such as the municipality, Governor of Sisli, and Fatih University. All his activities and meetings with these partners increased the visibility and credibility of his geography lessons both inside and outside the school.

The project was also useful for the school. Two conferences have been organized at Sisli high school to disseminate the results of the project. The governor of Sisli district, deputy mayor of the district, district director of national education, district police chief, researchers from two major universities in Istanbul, managers of the schools in the district, students, teachers, parents, and some journalists participated in these conferences. The project was useful for promoting the school and publicizing the needs of the school to related institutions. The GIS-based project brought together the school, public-private institutions and society and proved that schools can play an important role in society to solve problems and create unity. The project was also an opportunity to highlight inadequacies in the school. At the beginning of the project, there were no project rooms in the school where students could work together collaboratively. A room was eventually dedicated to this project's activities at the school.

The project received very positive feedback from different segments of society. The students who worked on the project received their certificates from the Deputy Director of Istanbul Provincial Directorate of National Education at a conference held at Fatih University (Figure 11). The findings from the project have also been covered in some newspapers.

Fig.11 Student conference presentation and receiving their certificates from Ahmet Sait Güler, Deputy Director of Istanbul Provincial Directorate of National Education

5. CONCLUSION

GIS can be regarded as a new subject for secondary schools in Turkey. It found a place in the secondary school geography curriculum in 2005 (Karabag, 2005). Different activities were carried out in the country over the last seven years to make GIS a common educational tool in schools, such as publishing the book "GIS for Teachers" in Turkish and providing teachers with GIS software, digital data, and lesson plans (Demirci, 2008b). The facilities and support for using GIS in schools are better now compared to previous years. Teachers can easily find GIS software, digital data, and lesson plans to use in their lessons. The number of teacher training programs using GIS has increased. Despite all of these positive developments, however, the number of schools in which GIS is used in classroom situations is far from satisfactory. This is why it is important to implement additional GIS projects that make teachers aware of GIS and motivate them to incorporate it into their lessons.

The GIS-based project conducted in Sisli high school is a good example of how GIS can bring students, schools, and society together to solve problems. In the project, students identified one of the most important problems in their society and worked as a group to develop a solution using GIS.

The GIS-based project showed that GIS is a versatile tool in education for teachers, students, the school and society. It motivates teachers to learn how to use GIS effectively in their lessons. In addition to being an efficient learning tool, GIS helps students realize the importance of geography and the role of GIS in this science. Because it encourages students, schools, and different public and private institutions to work together to solve social problems, GIS is an important and effective tool for societal improvement.

A number of obstacles continue to hinder the use of GIS-based projects in schools. In this project, schools were provided with GIS software, GPS, digital data, and all the necessary technical assistance. These resources, however, are not available to all schools. The biggest challenge for this project was the teachers' lack of GIS knowledge and skills. Further, the school manager's lack of interest and support for the project, a lack of time at the school for teachers to organize students for field work, a lack of PBL activities in lessons, and low levels of student interest in learning new things were among the main obstacles faced by the school while conducting this project.

Conducting similar GIS-based projects at secondary schools is crucial. Teachers should be the primary means by which GIS-based projects are introduced into schools. Organizing teacher training programs for existing teachers, developing more efficient curricula for teacher education programs at universities, motivating teachers to spend extra time learning GIS and conducting GIS-based projects with their students, convincing school managers to change their attitudes towards geography lessons and the use of GIS in education, and encouraging decision-makers to take bold steps to develop more effective strategies for bringing GIS into schools are some of the steps that should be taken in order to incorporate GIS into geography lessons more successfully in schools. Whole segments of society should understand that GIS is not a luxury but a necessity to create a better world.

Acknowledgment

The project outlined in this paper was supported by TUBİTAK (The Scientific and Technological Research Council of Turkey) with the project number 109K271.

REFERENCES

BÖİB. 2010. Yerel yönetimler için ulaşılabilirlik temel bilgiler teknik el kitabı. Ankara: T.C Başbakanlık Özürlüler İdaresi Başkanlığı.

Blumenfeld, P.C., Soloway, E., Marx, R.W., Krajcik, J.S., Guzdial, M., and Palincsar, A. 1991. Motivating Project-Based Learning: Sustaining the doing, supporting the learning. *Educational Psychologist*: 26 (3&4): 369 – 398.

Milson, A.J., Demirci, A., and Kerski, J.J. 2012. *International perspectives on teaching and learning with GIS in secondary schools*. (eds.) New York: Springer.

ChanLin, L.J. 2008. Technology integration applied to project-based learning in science. *Innovations in Education and Teaching International*: 45 (1): 55 – 65.

Demirci, A. 2011. Using Geographic Information Systems (GIS) at schools without a computer laboratory. *Journal of Geography*: 110 (2): 49 – 59.

Demirci, A., Karaburun, A., Ünlü, M., and Özey, R. 2011. How does GIS mobilize students to work for society? Conducting GIS-based projects in geography lessons. *In the proceedings of the IGU-CGE Istanbul Symposium*, eds. A. Demirci, L. Chalmers, Y. Arı, J. Lidstone, 13-22. Istanbul: Fatih University Press.

Demirci, A. 2008a. Evaluating the implementation and effectiveness of GIS-based application in secondary school geography lessons. *American Journal of Applied Sciences*: 5 (3): 169–178.

Demirci, A. 2008b. *Öğretmenler için CBS: Coğrafi Bilgi Sistemleri*. Istanbul: Fatih University Press.

Johansson, T. 2006. *GISAS project: Geographical information systems applications for Schools*. (ed.) Finland: University of Helsinki.

Johansson, T. 2003. GIS in teacher education-facilitating GIS applications in secondary school geography. *ScanGIS'2003*: On-line Papers, 285-293.

Karabag, S. (ed.), 2005. *Coğrafya dersi öğretim programı*. Talim ve Terbiye Kurulu Başkanlığı, Gazi kitabevi, Ankara.

Karatepe, A. 2007. The use of Geographic Information Technologies in geography education. Unpublished doctoral dissertation, Marmara University, Institute of Education Sciences, Istanbul.

Kerski, J.J. 2003. The implementation and effectiveness of geographic information systems technology and methods in secondary education. *Journal of Geography:* 102 (3): 128–137.

Landenberger, R.E., Warner, T.A., Ensign, T.I. and Nellis, M.D. 2006. Using Remote Sensing and GIS to teach inquiry-based spatial thinking skills: An example using the GLOBE program's integrated Earth systems science. *Geocarto International*: 21 (3): 61 – 71.

Malone, L., Palmer, A. M., and Voigt, C. L. 2003. *Mapping our world; GIS lessons for educators*. Redlands, CA: ESRI.

ÖZIDA. 2008. Özürlüler Kanunu ve İlgili Mevzuat. Ankara: T.C. BAŞBAKANLIK Özürlüler İdaresi Başkanlığı Yayınları, 43.

Shin, E.K. 2006. Using Geographic Information System (GIS) to improve fourth graders' geographic content knowledge and map skills. *Journal of Geography*: 105 (3): 109–120.

Thomas, J.W. 2000. A Review of research on project-based learning. The Autodest Foundation, http://www.ri.net/middletown/mef/linksresources/documents/researchreviewPBL_070226.pdf,

Tuna, F. 2008. Taking the advantages of Geographic Information Systems (GIS) to support the project based learning in high school geography lessons. Unpublished doctoral dissertation, Marmara University, Institute of Education Sciences, Istanbul.

William J.L. 2001. Integrating GIS into the undergraduate learning environment. *Journal of Geography*: 100: 158-163.

Wilder, A., Brinkerhoff, J. D., and Higgins, T. 2003. Geographic information technologies + project-based science: A contextualized professional development approach. *Journal of Geography*: 102(6): 257-261.

Wigglesworth, J. 2003. What is the best route? Route-finding strategies of middle school students using GIS. *Journal of Geography*: 102(6): 282-291.