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Full Length Research Paper

The place of geographic information systems (GIS) in the new geography curriculum of Turkey and relevant textbooks: Is GIS contributing to the geography education in secondary schools?

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The national geography curriculum of Turkey has undergone radical changes and new secondary school programs were introduced by the Turkish Ministry of National Education (MEB) in 2005. The new geography curriculum recommends greater incorporation of technology in geography classes, in particular, emphasizing the deep integration of the geographic information systems (GIS) into courses. In spite of having some constraints such as limited GIS background of geography teachers, contextual issues, financial conditions and inadequate infrastructure, the new curriculum advises at least 20 GIS-based course activities at all levels of secondary geography education. Similarly, the geography textbooks which were prepared by MEB also disregard these limitations. So, the responsibility to arrange required GIS software and hardware, and get necessary training in GIS completely falls on geography teachers. The essential problem is that most geography teachers have insufficient GIS background and thus do not know how to integrate GIS into the classroom or generate GIS-based activities in geography courses. Consequently, notwithstanding the existence of a set of obstacles to be eliminated, geography teaching and learning with GIS will remain as one of the prominent objectives for the new geography curriculum.

Key words: Geographic information systems (GIS), secondary geography education, geography curriculum, geography textbooks.

INTRODUCTION

A Geographic Information System (GIS) is a computer mapping system developed for capturing, storing, querying, analyzing, modifying and displaying spatial data about places existing in the universe. It can display all kinds of data related to places in different ways such as tables, charts and maps based on the information entered into the system (Rubenstein, 2005: 13; Pottle, 2001: 1).

Many studies concerning GIS reveal that it is an effective tool to promote students' geographic skills including helping students to think geographically, analyze and make inferences on spatial data, as well as provide student and teacher motivation, and adopting project-based teaching and learning (Shin, 2006; Pottle, 2001; Lemberg and Stoltman, 1999; Palladino, 1994; Audet and Abegg, 1996; GESP, 1994; Tinker, 1992). Tinker, Audit and Abegg, and Palladino were among the first who conducted research on GIS in education and emphasized the positive relationship between education with GIS and GIS skills and problem solving (Tinker, 1992; Palladino, 1994; Audit and Abegg, 1996). In a study related to the evaluation and implementation of GIS-based applications in high schools, Demirci found out that GIS increased the given students' success on geography lessons by more than 30% (Demirci, 2008a: 169). In another study, Pottle stated that GIS is a tool for learning and motivates students as they learn important skills and knowledge from geography curriculum (Pottle, 2001:2). According to the outcomes of research by Lemberg and Stoltman, GIS has been an important teaching and research tool for different

scientific fields.

They also reported that some studies found that constructivist learning materialized when students collect and process local data into maps (Lemberg and Stoltman, 1999: 63-75). The Geography Education Standards Project (GESP) assessed that geo-graphic skills such as asking and answering geographic questions, acquiring, organizing, and analyzing geographic information can be performed more rapidly, accurately and reliably with GIS (GESP, 1994: 256). In a study on using GIS to improve students' content know-ledge and map skills, Shin argued that it is not possible to claim that using GIS technology was the only, or even the best tool to teach geography, rather she suggests that using GIS can enhance student learning considering that most other tools do not (Shin, 2006: 117).

However, Bednarz asserted that there was no sufficient evidence to assume that GIS enhanced spatial skills. The optimum conditions are necessary to further expand its practice and sought if there are any better and easier methods to pursue the same goals (Bednarz, 2004: 198). Additionally, in a study intended to measure the implementation and effectiveness of GIS, Kerski concluded that although inquiry-oriented lessons with GIS did not consistently increase geographic skills, the use of GIS does reinforce standard-based skills and spatial analysis (Kerski, 2003: 135).

In this context, another issue is how to incorporate GIS into geography curricula emerges. A set of research reveals possible methods to integrate GIS into curricula as well as discuss the place and implementation of GIS in geography teaching and the learning process. In one of these studies, Patterson et al. (2003) indicated that it was an urgent need for institutions such as state geographic alliances to do something to improve geographic skills and backgrounds of American students since the young adults did not perform well in nationwide geography exams. Consequently, integrating GIS into curriculum as a tool and method was promoted by the organizations such as National Center for Geographic Information and Analysis (NCGIS) and state geographic alliances in American schools to enhance geography education (Patterson et al., 2003: 275-276). In the same study, two important ways to incorporate GIS technology into geography curricula were addressed:

1. Basic cooperation between high schools and GIS experienced geography professors from local universities could be established to provide the schools with a variety of GIS materials and methods.
2. Teachers involved in this kind of partnership gain fundamental GIS skills and methods that could be adapted into curricula (Patterson et al. 2003: 280).

Furthermore, Mackaness suggested that personal experience should not be omitted while embedding technology in a curriculum. Additionally, curriculum materials regarding GIS should be developed based on fundamental education goals and provide connections with workplaces (Mackaness, 1994: 567). Various studies investigated the main restraints and barriers impeding the integration of GIS into K-12 geography curriculum from different perspectives. In spite of country-based differences, the main obstacles they found are:

1. Slow implementation (implementation and learning of GIS takes a long time), limited extent of GIS in the curriculum, unclear effectiveness of GIS in teaching and learning (Kerski, 2003: 128).
2. Teachers' attitudes, perceptions and wariness of technology, negative viewpoints of authorities in education for GIS, lack of detailed curriculum including GIS and concrete learning objectives, pre-awareness status of geography and social science teachers in adapting GIS into their courses (Bednarz and Ludwig, 1997: 125-126).
3. Classroom management, allocation of limited time and balancing other demands from the school system (Shin, 2006: 117).
4. Access to appropriate hardware, lack of time to learn GIS software and insufficient time in the curriculum to better incorporate GIS (Meyer et al., 1999: 571).
5. Lack of GIS software and GIS-based resource packages, unavailability of GIS training and exposure, insufficient peer support and inadequate lesson demonstrations by experienced GIS teachers (Yap et al., 2008: 59).
6. Issues on teachers' conception of geography. Many Teachers' view geography as memorizing place, names and regional facts and thus do not need to use GIS for spatial analysis (Patterson et al, 2003: 277; Meyer et al. 1999: 572; Bednarz and Ludwig, 1997: 127).
7. Lack of necessary GIS skills, knowledge, digital data, software, lesson plans and instruction materials (Demirci, 2009a: 206).

With this range of obstacles hindering the fast and effective distribution of GIS throughout different geography education systems in the world, the place of GIS both in geography curricula and its implementation in geography courses is insufficient.

A number of studies focused on the place of GIS in the geography curricula showed that the percentage of the geography and social science teachers using GIS effectively is very low in different countries. Kerski reported that less than 2% of American high schools have adopted GIS and only 20% of teachers out of 1,520 with GIS knowledge use it in more than one lesson in more than one class. However, the number of science teachers using GIS far outpaced the number of geography teachers using GIS (Kerski, 2003: 128-129). According to a survey sent to 200 geography teachers in the Netherlands, 12% of the respondent teachers (n = 73) stated that they were using GIS in their courses. As a result of the same survey, 81% of the respondents stated

that GIS should have a greater role in teaching geography while 40% said that GIS must be a compulsory subject in geography curriculum (Korevaar and Schee, 2004: 44-46). Another survey investigating the status of GIS in Singapore schools showed that 69% of the respondent teachers were familiar with GIS while only 11.8% of them had conducted a GIS-based course before. However, 90.3% thought that GIS was suitable and relevant to geography teaching and learning (Yap et al. 2008: 54).

Demirci also investigated geography teachers' GIS background in Turkey and GIS incorporation in Turkish curriculum. As a result of the survey conducted with 79 geography teachers, 82% stated that they have no idea how to use GIS technology in their courses. However, 76% of the respondents thought that GIS was a powerful tool for geography teaching (Demirci, 2009b: 57). In another study carried out in 2005 on GIS in higher education in Turkey, Olgen assessed that there was a dramatic increase in the number of departments belonging to different disciplines using GIS and an increase in the amount of teaching hours spent focusing on GIS and the number of courses provided. He also reported that the highest teaching hours including GIS were provided by Geography and Geodesy and Photogrammetry Engineering Departments (Olgen, 2005: 10-13).

Finally, since its first inception in the beginning of the 1990's, the diffusion, adoption and implementation of GIS was slow in the education sector. This is the reason why some countries initiated various programs involving secondary school geography such as NCGIA Core Curriculum developed in the USA which provides support to secondary education and GISAS (The Geographical Information Systems Applications for Schools) including 7 European countries: Belgium, France, Greece, Hungary, Italy, Latvia and Sweden. The project was funded by the European Commission and aimed at finding out ways through which GIS technology can be made a widespread tool in secondary schools and teacher training (Bednarz and Schee, 2006: 192).

METHOD

This is a qualitative study aiming at better understanding the place of GIS in the new secondary geography curriculum in Turkey and related textbooks to understand the curriculum connections of GIS. Reviewing the literature, the new curricula were examined in terms of the radical changes it brought regarding geography education and GIS in Turkey including philosophy, technology use, teaching methods and skills.

Then, a subject-based review of GIS within the new curricula and textbooks in use was done. In this process, the role of GIS in the new curricula and related geography textbooks, the relevance of GIS with concrete learning objectives and acquisitions, the contents that GIS will enable students to learn, the ways in which GIS will be used in classrooms and the educational materials related to GIS to support education with GIS were questioned.

The short history and developments of GIS in education was explored to point out the present state of GIS in Turkey. In this context, the developments and incorporation of GIS was assessed both in the private and public sector, including educational institutions. This provided inferences about whether GIS is a common tool in high schools in Turkey. In conclusion, the remaining gaps in the adaption of GIS into secondary geography curriculum and the steps to be taken to make GIS a widespread teaching tool and method in teaching and learning geography were addressed.

Where is Turkey in terms of GIS use: A short history of GIS in Turkey and Turkish education

The inception of GIS can be traced back to the 1960's with the launch of the Canada Geographic Information System (CGIS) which used GIS for the first time to analyze Canada's natural inventory (Yomralioglu, 2000: 15). Almost fifty years later from its first inception, GIS became a common tool for many sectors related to space including regional planning, land use, urban planning, environmental protection, security, transportation, agriculture, forestry and education. However, the adoption of GIS by Turkey's public and private sector started in the 1980's, 20 years later than its first inception in North American countries. The integration of GIS into the education sector was even slower than other public and private sectors (Table 1).

The adoption of GIS into higher education (Geodesy and Photogrammetry Departments) started in 1990's by a few master's thesis aimed at investigating the capacity of GIS in Turkey. Then the departments providing the GIS courses increased dramatically between 1990 and 2004 (Olgen, 2005: 10, Yomralıoglu, 2002: 839). The first GIS course and GIS education laboratory at graduate level in geography departments can be traced back to 1998. After this year, the number of geography departments providing GIS education, GIS courses and GIS teaching hours increased slowly. Today only six geography departments out of 36 either in Art and Science Faculties (n = 26) or in Education Faculties (n = 12) have a GIS laboratory (Demirci, 2009b: 60).

The integration of GIS into geography courses in secondary schools was slower than its integration in higher education. The GIS activities in secondary school geography courses first appeared in the 2005 geography curriculum, thus GIS was first introduced to high school geography teachers with the 2005 program. After the inception of the 2005 program, the steps intended for the adoption of GIS into secondary schools intensified by GIS conferences, GIS workshops, GIS course materials, GIS based projects in high schools and in-service GIS trainings for geography teachers (Table 1).

The new geography curriculum of 2005: Theory and practice

Turkey has a quite central education system governed by Ministry of National Education (MEB). MEB has the single authority to introduce and revise the teaching programs all over the country. However, almost no discretion is given to schools over the creation and modification of curricula.

The Turkish education system underwent an educational reform starting in 2002; correspondingly, the secondary geography curriculum has been radically changed by MEB to be put into action within the educational year 2005 - 2006. This curriculum was first applied in 2005 to grade 9 students, having the age of 15 and naturally abolished the previous geography curriculum four years later from its first inception in 2009. The new curriculum introduced in 2005 brought about striking changes in organization and content, teaching methods, teaching hours and course materials based on a constructivist approach.

The geography program of 2005 which is activity-based rather than objective-based emphasizes the adoption of technology, geographic skills, active learning process and effective evaluation and

Table 1. Milestones of GIS in Turkey.

Milestones of GIS	Year
The first use of GIS by a private company	1981
The first use of GIS by general command of mapping	1986
The use of GIS by public sector such as general directorate of land registry and cadastre, Turkish statistical institute, and state meteorological service	1990
The first use of GIS in higher education	1991
The first national conference on GIS	1994
The first use of GIS by municipalities (Metropolitan Municipality of Bursa)	1996
The first GIS course in a geography department	1998
The first GIS education laboratory in a geography department	1998
The first national GIS conference organized by a geography department	2001
The first GIS for teachers workshop	2004
The first national geography curriculum including GIS-related activities	2005
The first international conference on GIS organized by a geography department	2008
The first GIS course materials (books, CDs, and course activities) for secondary schools	2008
The first GIS-based civil involvement project concerning secondary school students aiming at integration GIS-based activities into geography courses	2009

Source: Developed based on Yomralioglu (2002: 835-839) and Demirci (2009b: 60-61).

and assessment methods. In this new context, the active participation of students in teaching and the learning process is necessitated and the integration of GIS into courses is suggested at a maximum level (MEB, 2005). The new geography program has a constructivist base and spiral structure. Attainment is examined consecutively. Content foreseen by the attainment is provided (Yasar and Seremet, 2009: 174). The main components of the 2005 geography curriculum are stated as the following:

Skills

It is one of the most prominent aims of the new program to enhance the fundamental geographic skills including map skills, observation skills, field trip skills, geographic inquiry skills and other skills related to perception of time, change and continuity; and using evidence. Every attainment and activity example is linked to one or more geographic skills in the program.

Concepts

Concepts is another component of the new curriculum making up the structure and content of geography. In this regard, concept maps are provided about key concepts in geography including region, location, environment, movement, environmental problems and ecosystem.

Values and attitudes

The 2005 program also aims at improving the values and attitudes related to space, social development and citizenship. These values and attitudes are solidarity, tolerance, scientific thought, love, respect, involvement, patriotism, peace, aesthetic and responsibility.

Learning modules

Geography curriculum consists of different learning modules. Learning modules comprise themes and subjects that were organized to set up links among knowledge, skills, concepts, values and attitudes. These modules contain: 1) Natural systems, 2) human systems, 3) environment and society, 4) global environment: regions and countries, 5) a spatial synthesis: Turkey and 6) geographic skills and practices (Table 2). The curriculum was organized around the same learning modules in all grades from 9th to 12th with an emphasis on developing geographic literacy and skills of students (MEB, 2005: 19-38).

In the new program, there is abundant information and materials for evaluation and assessment in geography education addressing the main tools and methods to make evaluation and assessment. It is possible to find information about the main objectives, mission and vision, principles, program approaches and explanation about the implementation of the program in the MEB geography course program of 2005 (MEB, 2005: 39-76).

Educational reforms in nature take time to take effect. It is impossible to say that a nationwide education reform will change the whole system in a short period. A fundamental change will take at least a decade or longer (AAAS, 1989: 210-211). In any kind of reform approach there are two broad inherent reasons that can be responsible for the slow penetration of the reform into an education system:

1. The problem of scale: Formal education in Turkey is an enormous system having 67,284 schools and 17,723,985 students, employing 778,139 educators at all levels (8,475 schools, 196,713 teachers and 3,837,164 students in secondary formal education) and expending almost 28 billion TL a year (equals 10.64% of the central government budget in 2009) (MEB, 2009: 7-8). So, it will take a long time to see the full integration and feel the impacts of the new curricula in Turkey.
2. Teachers' and school administrators' attitudes to a new reform: Since every educational reform necessitates fundamental changes in attitudes, beliefs, perceptions and even teaching methods, the adoption process will be slow even if the teachers and school administrators think that the new program will do good. It is always very difficult to change the attitudes and habits of teachers and administrators (Linkaitytė, 2000: 285-286; AAAS, 1989: 211-212).

Table 2. Learning modules and content of 2005 geography secondary school curriculum.

Learning modules	Content
Geographic skills and practices	Map skills, use of primary and secondary information resources, critical thinking, use of ITC, field trips, and GIS
Natural systems	Natural patterns, relationships, and processes: landforms, weather and climate, water, soil, and vegetation
Human systems	Human patterns, relationships, and processes: population, settlement, economy, transportation and communication, politics, culture, and tourism
A spatial synthesis: Turkey	The environment, region, and country in which we live: spatial analysis, near environment and regional analysis, natural and human systems of Turkey, global and regional connections of Turkey
Global environment: Regions and countries	Global relationships and organizations: continents and oceans, international economic, politic, and cultural alliances, relationships, and patterns, global connections and patterns
Environment and society	Use of natural resources, natural hazards, environmental problems, management and planning, environmental change

Source: Geography course curriculum (9th, 10th, 11th and 12th grades), MEB (2005: 38).

In addition to these common problems in the application of the new curriculum, there are also other issues intrinsic to Turkey:

1. Restrictions to physical infrastructure (inadequate information technologies (IT), large class-sizes) and insufficient presentation of the new curriculum to the teachers (Demirci, 2008b: 115).
2. Insufficient teaching hours and too many class activities, inconformity with OSS (Student Selection Exam) and lack of teachers background related to application of the new curriculum (Tomal and Şenol, 2007: 95-96).
3. Lack of teaching materials, inadequate financial resources for designing course activities, insufficient teacher preparedness to implement the new curriculum (Incekara, 2006: 170-171).

FINDINGS

GIS in the 2005 geography curriculum

The 2005 program is the first geography teaching program of Turkey in which the term “GIS” and the adoption of GIS into geography courses are mentioned. Under the title “The explanations concerning the application of the new program” in the 2005 program, it is stated that the program supports the maximum use of IT in geography courses. GIS applications are also suggested for some attainments of the program depending on the technical and physical infrastructure of schools. Teachers may develop GIS applications or analyze the existing ones in their courses (MEB, 2005: 11). GIS also appears in “Geographic Skills and Applications” learning module of the new geography curriculum along with map skills, critical thinking, use of IT and field trips.

It has been found that there are 21 GIS-related activities in the new geography curriculum. These 21 GIS-related course activities are related to 27 attainments belonging to different grades and learning modules and each attainment includes two or more skills. A few points can be underlined concerning GIS in the new program:

1. The number of GIS-related activities and attainments are irregularly distributed from ninth to twelfth grade (five activities in grade 9, nine activities in grade 10, three activities in grade 11 and four activities in grade 12), (six attainments in grade 9, ten attainments in grade 10, five attainments in grade 11 and six attainments in grade 12).
2. Tenth grade includes the highest number of GIS-related activities (9 activities) and attainments (10 attainments) in the secondary school program.
3. “Human systems” and “A spatial synthesis: Turkey” learning modules have the highest number of GIS-related course activities suggested (seven activities), however, “Environment and society” learning module has no GIS-related course activity suggested during the four years of secondary geography education (Table 3),
4. Each GIS-related activity and attainment are linked to two or more skills including map skills, observation skills, field trip skills, critical thinking skills, skills to produce tabular data (tables, diagrams and figures), skills related to perception of time, change and continuity and skills to use evidence.

The subject-based distribution of GIS-related activities in each grade is also irregular. Natural and human systems in Turkey, population characteristics, maps, international economic, politic and cultural alliances, relationships and

Table 3. Distribution of suggested GIS-related activities, attainments and learning modules by grades in the 2005 secondary school geography curriculum.

Activities, attainments and learning modules	Grades				Total
	9th	10th	11th	12th	
Number of GIS-related activities suggested	5	9	3	4	21
Number of related attainments	6	10	5	6	27
Number of GIS activities in learning modules					
Natural systems	3	1	-	-	4
Human systems	-	5	2	-	7
A spatial synthesis: Turkey	2	3	-	2	7
Global environment: regions and countries	-	-	1	2	3
Environment and society	-	-	-	-	-

Source: Geography course curriculum (9th, 10th, 11th, and 12th grades) (MEB, 2005: 79-134).

Table 4. Subject-based distribution of GIS-related activities in the new geography curriculum.

Subjects	Grades				Total
	9th	10th	11th	12th	
Maps and map components	3	-	-	-	3
Natural and human systems in Turkey	2	3	-	1	6
Landforms	-	1	-	-	1
Population	-	4	-	-	4
Economy	-	1	1	-	2
Settlements	-	-	1	-	1
International economic, politic, and cultural alliances, relationships, and patterns	-	-	1	1	2
Global and regional connections of Turkey	-	-	-	1	1
Regions and countries	-	-	-	1	1
Total	5	9	3	4	21

Source: Geography course curriculum (9th, 10th, 11th, and 12th Grades) (MEB, 2005: 79-134).

patterns, and settlements are the subjects that cover more than one GIS-related activity in the new program. However, there are no suggested GIS activities for the following units: soil, water, vegetation cover and tourism. The subjects relevant to environmental issues such as natural resources, natural hazards, environmental problems and environmental change which make up the "Environment and society" learning module were also totally ignored (Table 4).

GIS in the related textbooks in Turkey

Officially, MEB determines the physical characteristics and content of the textbooks in Turkey. MEB has been providing the textbooks and workbooks of some courses free of charge to primary school students since the 2003 - 2004 academic year as a government policy. Secondary school students also started to receive some free textbooks and workbooks in the 2006 - 2007 academic year. As another condition of this project, the textbooks may be written by an individual or a commission appointed by the ministry and published by either a public (MEB Publishing House) or a private company. MEB has not yet granted permission for the geography textbooks prepared and published by private companies to be used in secondary schools. Rather, they are being used as supplementary textbook in geography courses. The free textbooks project excludes private schools and these schools can buy the textbooks from public or private book sellers. The geography textbooks of 9th to 12th grades are also provided free of charge by MEB and were written by a commission consisting of mainly geography teachers. The books were edited by an academician specialized in geography. The selection of related textbooks approved by the Turkish government at primary and secondary schools is creating some criticism due to lack of involvement of the public sector.

To determine the place of GIS in geography textbooks in Turkey, the four textbooks which are in use for secondary school geography were analyzed. According to this analysis, it is found that there are just three GIS-related

Table 5. The place of GIS-related activities in geography textbooks.

Textbook	Type of activity	Subject	Place
9th grade	Providing information about GIS	Map projections	Information Box, p. 18
	Analyzing a GIS-based map on the Internet	Contour lines	Performance assignment, p. 33
10th grade	Drawing a map using a computer (not specified whether a GIS program will be used)	Plate tectonics	GIS activity box, p. 19
11th grade	-	-	-
12th grade	-	-	-

Source: Oruç et al., 2007: 18-33; Gultepe et al., 2007a: 19; Gultepe et al., 2007b; Gultepe et al., 2008 (Geography textbooks, grade 9, 10, 11 and 12).

course activities suggested in the geography textbooks including two activities concerning 9th grade and one activity concerning 10th grade (Table 5).

Map projections, contour lines and plate tectonics are the subjects that include related GIS activities in the geography textbooks. Nevertheless, there are not any GIS activities in 11th and 12th grade geography textbooks (Table 5).

DISCUSSION AND PROSPECTUS FOR TURKEY

It is vital to understand the insights about the 2005 reform made in education to discern the nature of GIS in Turkey's secondary education system. In spite of providing a constructivist approach which necessitates greater integration of technology into courses, student-centered education, active learning process, modern evaluation and assessment methods, activity-based courses and incorporation of GIS into geography courses at a maximum level, there are challenging issues to be addressed in the effective application of this new program. These issues are addressed in many studies including large class sizes, lack of technological infrastructure, insufficient seminars, courses and in-service training to help teachers better understand the new program (Kaya et al., 2008: 55-56); insufficient teaching hours, lack of geography classrooms and laboratories (Alim and Altaş, 2005); and weak background of teachers to implement the new program, insufficient course hours and lack of course materials (Tomal and Şenol, 2007: 95-96). These issues directly affect the adoption of GIS into geography courses.

GIS is quite a new technology especially for secondary schools. As with any new technology, it will take a long time and much effort for GIS to diffuse and become a common tool in geography teaching and learning (Bednarz and Ludwig, 1997: 125; Dooley, 1999: 36). The existence of some uncertainties and impediments for its use are related to the unclear extent and effectiveness of GIS in teaching and learning, technical support, instructional and pedagogical challenges. Moreover, issues regarding professional development of teachers result in the slow adoption of GIS in Turkey. Insufficient technological facilities are among the most common factors that impede the use of technology and GIS in geography courses (Demirci, et al. 2007, 38; Alim and Dumlu, 2007: 227).

It seems that there is adequate inclusion of GIS activities in terms of quantity in the new program, but the quality of these GIS-related activities needs some serious criticism. For example, 21 GIS-related activities are suggested in the program, but no information was provided about how to find a GIS program, how to conduct a GIS program and how to develop course material using GIS. Just one note stating "a GIS activity may be done, applied or developed" appears in parenthesis at the end of a list of related course activities. The only exception to this is seen in the 11th grade "Human Systems" learning module in an activity entitled "Urbanized world". This GIS activity suggests classifying the world cities in terms of population characteristics, areas of influence and given city functions. After doing so, these cities are marked on the world map and students evaluate these cities based on different characteristics.

Furthermore, each activity in the program is linked to more than two broad skills and attainments, but which GIS-related activities and attainments are related to which specific geographic skills and broad learning objectives need to be clarified. The broad definitions concerning the reasons why to incorporate GIS into courses to persuade and encourage teachers are completely ignored in the new program. Providing adequate "know how" in the program is expected to increase better and increase adoption of GIS by geography teachers.

Also, the GIS-based activities are poorly placed in the geography textbooks which are in use today. It is an inconsistency for four textbooks to have just three activities related to GIS, despite the program suggesting 21 GIS-related activities. Moreover, it is a big void that GIS was not mentioned anywhere in the 11th and 12th grade geography textbooks. So, it is an urgent necessity to diversify the GIS-based activities in terms of distribution among grades and variety of subjects in the geography textbooks. There are huge gaps relevant to the contents that GIS will enable students to learn. There is no GIS activities related to the subjects such as vegetation cover water, soil, water, tourism and the topics

Table 6. Five phases in the adaption of GIS.

Phase		Key Questions
Phase 1	Pre-awareness	-
Phase 2	Awareness	What is GIS?
Phase 3	Understanding	How can I teach geography with GIS?
Phase 4	Guided practice	How do I do GIS?
Phase 5	Implementation	-

Source: Adapted from Bednarz and Ludwig, 1997: 126.

concerning environmental issues such as natural resources, natural hazards, environmental problems and environmental change. So, it is an urgent need to develop new GIS-based activities concerning these missing topics.

The biggest problem facing teachers is what GIS methods and course materials can be used. While some individual efforts are being made to fill these gaps by providing teachers with necessary software, training and GIS-based course activities, it is impossible for these rudimentary efforts to involve a huge educational staff in Turkey. So, to make GIS a common tool in high schools in Turkey, nationwide perspectives and approaches are needed. The only solution to this problem is for MEB to ensure system-wide provision of GIS related software, training and course materials. But, when taking into consideration, the financial share allocated to national education and the financial burdens of such a solution, there is no doubt that such action plans will remain on the wish list of the ministry and secondary school geography program for a long time.

CONCLUSION

This study reveals that Turkey has already passed the "pre-awareness" stage and but has not yet passed the "awareness" stage in terms of incorporating GIS into secondary school geography according to the Bednarz and Ludwig's four stages in adaptation of educational innovation (Table 6). So, the key question in this phase is "what is GIS?" The answer to this question will enhance the understanding of what GIS is and the reasons for its necessity in geography courses. To shift to the next step "understanding", teachers must ask themselves "how can I teach geography with GIS?" This requires the integration of existing efforts to make GIS a common teaching tool and method in secondary school geography.

Finally, responsibility to find GIS software, training and data to integrate GIS into courses fully falls on geography teachers. So, it is clear that for GIS to become a wide spread teaching and learning tool, the desire and determination of geography teachers is essential. The answer to the question of "is GIS enhancing geography teaching and learning in secondary school geography?" is basically "not yet". To get a satisfactory answer to this question, issues regarding insufficient technology in schools, unawareness of GIS, financial problems, lack of training and underestimation of the efficiency of GIS as a tool for geography teaching and learning need to be mitigated.

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