EMPLOYERS` EXPECTATIONS OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) SKILLS OF GEOGRAPHY GRADUATES: A CASE OF TURKEY

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Abstract - This study aims at examining what kind of GIS competencies geography graduates should have for finding a position in GIS or GIS related sectors when they graduated from their geography programs from an employer`s perspective. Keeping this objective in mind, a 43-item questionnaire is prepared as a main data collection tool in 5-likert scale and applied to employers, managers, directors who are authorized to employ people in public and private GIS job sector. Results indicated that the GIS skill sets including Internet and GIS, Data Management and Data Production are the most favorite ones among the respondents respectively. More specifically, "Map presentation skills by using ready templates on the Internet", "Using map services, Web-Map, and Web Feature server information on the Internet", "Transferring present data to databases", and "Data analysis with inquiry transaction (attribute and spatial query) and report generalization" are the most required skills by the GIS job market. However, the skills including "Basic information about geoids", "Ellipsoids used to present the globe", and "Construction plan information" were the skills that participants considered less important.

Index Terms - GIS skills, work place, employers, geography graduates.

I. INTRODUCTION

Geographic Information Systems (GIS) can be defined as a comprehensive mapping system designed for capturing, storing, analyzing, synthesizing, querying, editing, retrieving, manipulating and displaying spatial data obtained from earth's surface in the form of charts, tables, 3D images and maps based on the diversity of the information entered into the GIS database [1]. This up-to-date technology contributes to the emergence of new employment areas in the world and Turkey. However, it cannot be said that the geography departments in Turkey are making use of this opportunity at a required level. The underlying reasons of this restrain includes but not limited to lack of awareness about GIS, insufficient infrastructure of the departments about GIS, lack of GIS and Remote Sensing labs, lack of GIS education for geography faculties. Additionally, low integration of GIS into geography courses and teaching programs are among the most significant failures in front of an effective use of GIS in geography departments. Moreover, these emerging problems result in low GIS skills development of the geography graduates who seeks positions in GIS job market.

Until now, the feedback acquired both employers and employees who graduated from geography departments have revealed that these graduated haven't been equipped with key GIS skills at the sufficient level. The fundamental objective of this study is finding out what kind of GIS and geography competencies geography graduates should have for finding a position in GIS or GIS related sectors when they graduated from their geography programs. By this study, it will be revealed that to what extend especially Geography and other geography departments in Turkey are successful to prepare their graduates for job who want to work in GIS sector. Additionally, it is expected that the research results will propose an idea for educational institutions and businesses providing GIS education and training about how to establish and develop a GIS program along with to which key knowledge and skills they must give extra attention in the GIS programs.

II. BACKGROUND OF THE STUDY

A. The Use of GIS

The studies about the history of GIS show that computer-based GIS is in use since 1960s. North American Countries were first to use this technology. By the time, it has been evolved to a comprehensive and the most useful system of mapping [2]. Recently, GIS is being used in various sectors including environmental protection, urbanization planning, engineering, remote sensing, municipal services, transportation, forestry, and all levels of education. However, the integration of GIS into education sector is quite slow [1]–[3]. Additionally, the reference [1] indicated that the limited time, curriculum problems, teacher education issues, lack of in-service training and insufficient software and hardware in schools are among the factors that result in the slow integration of GIS into education. Although more than a decade has passed since the first educational GIS lab established, the number of such education and research labs are not more than the fingers of one hand.

B. Status of GIS in Turkey

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 [4]. GIS was first used by a public institution (General Command of Mapping) in Turkey in 1986 while it found a place in higher education first time in 1991. However, the municipalities started using GIS in 1996.

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

Table I. Five phases in the adaptation of GIS. Source: Adapted from [5].

The first national geography course curriculum at secondary level introduced in 2005 [6]. Reference [4] indicated that Turkey has already passed the "pre-awareness" stage and now in "awareness" stage in terms of incorporating GIS into school geography. So, key question in this phase is "What is GIS?" (Table I). 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 [7]–[8]. 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.

III. METHODOLOGY

This study investigates what kind of skills, knowledge and abilities the geography graduates need to have in recruitment process of GIS-related jobs from employers' perspectives. Additionally, it aims at determining how much the GIS related departments in Turkey are able to prepare their graduate and undergraduate students for workplace. It is thought that the study will contribute to the construction and development of GIS curriculums and teaching plans of education and training institutions offering GIS education or education with GIS by disseminating the research results to relevant institutions. Keeping all these aforementioned aims, objectives, and scopes in mind, a survey has been prepared and conducted to examine the perceptions and attitudes of administrative personnel including project managers, directors, etc. who are authorized to employ GIS personnel in the public and private GIS companies within four different cities of Turkey. The 109 people attended the survey voluntarily. The main data collection tool was an assessment survey of 43 items which were prepared in two sections as follows:

1. Personal (demographic) questions: This section included questions about gender, age, position held, whether the sector is public or private, and the city in which the companies located.
2. GIS skills questions: This section included questions about specific GIS skills which are required for using GIS actively. These questions are grouped under four main skill sets including "Basic map skills and cartography", "Data management", "Data Production", and "Internet and GIS".

In preparing the GIS skills set, the four GIS experts from universities and GIS companies have been consulted. And thus, all GIS skills have been aggregated in 38 items and four main skill sets have been determined.

A. Specific Research Activities

Problem statement: Here the general GIS problems in the world, coming down to Turkey were discussed. In this section, some experts' quotations were included using a as a taping information center. The problems of GIS in education and GIS education in the world were derived from library research while for Turkey they were sourced from the as well as via a site visit through conducting face-to-face questionnaires and interviews in GIS utilized work places and companies. Literature search and review: This basically refers to the information obtained from related and reliable journals, textbooks, theses, Ph.D. dissertations, and international reports from public and private foundations. Similarly, internal reports from www.meb.gov.tr; the Department of Publication and Documentation Center of the Turkish Council of Higher Education where the biggest thesis, dissertation and also abstract database in Turkey are documented on this site: www.yok.gov.tr/web4/ tezmerkezi.html.Selection of appropriate research methods and techniques: In the research, a reconnaissance survey (site visit) of the four main cities was conducted so as to ascertain certain problems of GIS. Face-to-face interview were conducted during the site visits. Additionally, a 43-item questionnaire were used for the study. Study implementation: Questionnaire research was conducted during the site visit while interviews were carried out during the site visits too. In this research the four biggest provinces including Istanbul, Ankara, Izmir, and Bursa have visited to acquire data from the

GIS employers about general, geographic, and GIS skills. Data analysis: The research activity here consists of analyzing data using charts and tables to find out what the employers are thinking about the general, geographic, and GIS skills those the students should have in a GIS related workplaces and companies. Data interpretation and explanation: Here, categorization, examination, interpretation, tabulation, and discussion of data collected in GIS companies were conducted. Identification of secondary research results: The gaps in the research were to be presented in this section so as to help future researchers know which gaps are to be filled. That is to say, the future direction part of the research process will be provided in the concluding remarks. In this section, future research directions are identified and explained. Dissemination of research results: The main areas where this research is to be disseminated are: any departments of universities training their students in GIS. Also geography departments educating their students with GIS or teaching them GIS. And to the Ministry of Education; to serve as a blueprint to the government on how to improve GIS education and education with GIS at the universities and informal education institutions. The published products will also serve as a store for researchers and students.

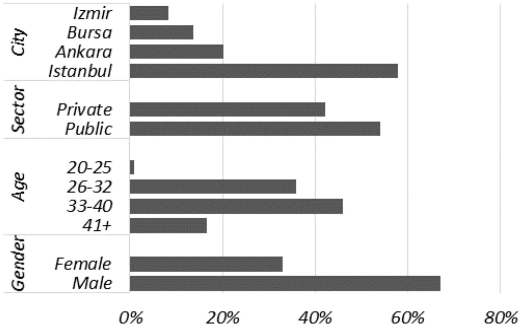

Figure 1. Demographic features of the respondents.

IV. FINDINGS FROM DATA ANALYSIS

A. Demographic Data

The demographic data indicated that totally 109 people joined this questionnaire and while 67% of them were male (n=73), 33% of them were female (n=36). 45.9% of these participants were aged between 33 and 40, 35.8% of them were 26-32, 16.5% of them were 41 and older, and only 0.9% percent of them were between 20-25 years old. In this survey, 54.1% of participants work in public sector while 42.2% of them work in private sector. The survey was conducted in four metropoles in Turkey including Istanbul, Ankara, Bursa, and Izmir. 57.8 % of the participants were from Istanbul, 20.2% of them were from Ankara, 13.8% of participants were from Bursa, and remaining 8.3% of participants were from Izmir. In this survey, different job positions have been determined according to the answers. Some of these positions are including manager, assistant manager, chief, chief assistant, director, project manager, area manager, coordinator, and expert.

B. Analysis of GIS Skills

In this section, the comments of employers about 38 specific GIS core competencies were analyzed. These 38 specific GIS skills were grouped into 4 skill sets including "basic map skills and cartography", "database management", "data production", and "Internet and GIS".Research results indicated that the specific skills including:

- Transferring present date to databases,
- Data analysis with inquiry transaction (attribute and spatial query) and report generalization,
- Map presentation skills by using ready templates on the Internet, and

GIS skills		Level of importance			
		Very important/ important	Neutral	Unimportant/ Not at all important	Total
Data production					
Production of spatial objects using coordinate data acquired through field studies	n	101	6	1	108
	%	93.6	5.5	0.9	
Production of attribute data of spatial objects	n	101	6	1	108
	%	93.6	5.5	0.9	
Data analyses with inquiry transaction (attribute and spatial query) and report generalization	n	103	4	1	108
	%	95.4	3.7	0.9	
Preparing flowcharts of performed spatial analysis	n	97	8	1	106
	%	91.8	7.3	0.9	
Coordinating raster data	n	98	9	1	108
	%	90.8	8.3	0.9	
Raster data segmentation processes	n	98	9	1	108
	%	90.8	8.3	0.9	
Digitizing raster data	n	98	7	2	107
	%	91.8	6.4	1.8	
Production of TIN and DEM data	n	91	13	2	106
	%	86.3	11.9	1.8	
Calculations of cut-and-fill volumes on TIN data	n	88	15	3	106
	%	83.5	13.8	2.7	
Three-dimensional visualization of vector data using elevation information	n	98	9	1	108
	%	90.8	8.3	0.9	
Topology concept	n	100	6	2	108
	%	92.7	5.5	1.8	
Creating topologic rules to control the location-based relations between the data and controlling the data based on these rules	n	100	7	1	108
	%	92.7	6.4	0.9	
Linear referencing (data storage in given distances on linear objects) data model	n	91	13	1	105
	%	87.2	11.9	0.9	
Production of network data sets from network data structure and linear information. query and realizing analyze processes	n	97	8	1	106
	%	91.8	7.3	0.9	
KML-KMZ data type	n	94	13	1	108
	%	87.2	11.9	0.9	
Conversion of different commercial software data formats to each other	n	100	6	1	107
		93.6	5.5	0.9	
Internet and GIS					
Map presentation skills by using ready templates on the Internet	n	101	4	1	106
	%	95.4	3.7	0.9	
Using map services, Web-Map, and Web Feature server information on the Internet	n	103	4	1	108
	%	95.4	3.7	0.9	

Table II. The opinions of respondents about "Basic map skills and cartography" and "Data management".

GIS skills		Level of importance			
		Very important/ Important	Neutral	Unimportant / Not at all important	Total
Basic map skills and cartography					
Basic information about geoids	%	57	47	5	109
	%	52.3	43.1	4.6	
Ellipsoids which are used to present the globe	n	61	40	8	109
	%	56	36.7	7.3	
Datum and datum which is used in Turkey, and datum conversions	n	95	12	2	109
	%	87.2	11	1.8	
Map projections	n	102	6	1	109
	%	93.6	5.5	0.9	
Map projections which are used in Turkey and their conversion to each other	n	96	12	1	109
	%	88.1	11	0.9	
Map section concept and production of map section indexes	n	95	13	1	109
	%	87.2	11.9	0.9	
Base map information that is created by means of topographic and photogrammetric survey	n	101	7	1	109
	%	92.7	6.4	0.9	
Construction plan information	n	86	22	1	109
	%	78.9	20.2	0.9	
Cadastral map information	n	90	18	1	109
	%	82.6	16.5	0.9	
Numbering information	n	103	5	1	109
	%	94.5	4.6	0.9	
Metadata information	n	103	5	1	109
	%	94.5	4.6	0.9	
Required cartographic procedures for printing out the different scaled maps (coloring and symbology)	n	102	6	1	109
	%	93.6	5.5	0.9	
Data management					
General information about databases (Oracle, SQL Server, MySQL, PostGreSQL)	n	103	4	2	109
	%	94.5	3.7	1.8	
Spatial database server software information (ArcSDE, Oracle, SDO)	n	100	7	2	109
	%	91.8	6.4	1.8	
Fundamental information about SQL and its use	n	102	5	2	109
	%	93.6	4.6	1.8	
Production of essential tables and connections in databases to store map layers	n	103	4	2	109
	%	94.5	3.7	1.8	
Transferring present data to databases	n	104	4	1	109
	%	95.4	3.7	0.9	
Multiuser architecture and version information for data management in databases	n	92	15	2	109
	%	84.4	13.8	1.8	
Updating data in multiuser environment	n	103	5	1	109
	%	94.5	4.6	0.9	
Data exchange processes between remote databases (Database replication process)	n	94	11	3	108
	%	87.2	10.1	2.7	

Table III. The opinions of respondents about "Data production" and "Internet and GIS".

- Using map services, Web-Map, and Web Feature servers information on the Internet were the skills which the employers were most likely considered important or very important with the percent more than 95.
- However, less than 4% of them had the neutral perspective to these skills.
- Additionally, less than 1% of the employers supported the notion that these skills are either unimportant or not at all important (Table II and III).

Research findings also suggested that the skills regarding:

- Numbering information,
- Metadata information,
- General information about databases (Oracle, SQL server, MySQL, PostGreSQL),
- Production of essentials tables and connections in databases to store map layers,
- Updating data in multiuser environment were among the skills that the participants attributed special importance at 94.5%. In addition that less than 4.7% of respondents were neutral about these GIS skills while 1.8% and lesser thought that these skills are both unimportant and not at all important (Table II).

In addition to aforementioned findings of the research, the support of the employers was high to the skills about following issues at 93.5%:

- Map projections,
- Required cartographic procedures for printing out the different scaled maps (coloring and symbology),
- Fundamental information about SQL and its use,
- Production of spatial objects using coordinate data acquired through field studies, and
- Conversion of different commercial software data formats to each other (Table II and III).

Moreover, the skills regarding "base map information that is created by means of topographic and photogrammetric survey", "spatial database server software information", "preparing flowcharts of performed spatial analysis", "coordinating raster data", "raster data segmentation process", "digitizing raster data", "three-dimensional visualization of vector data using elevation information", "topology concept", "creating topologic rules to control the location-based connections between the data and controlling the data based on these rules", and "production of network data sets from network data structure and linear information, query and realizing analyze processes" were among the ones which had the high support from employers at between 90 and 93% (Table II). Additionally, the skills related to conversion the map projections to each other, cadastral map information, multiuser architecture and version information for data management, database replication processes, production of TIN and DEM data, calculations of cut-and-fill volumes on TIN data, KML-KMZ data type, and linear referencing are the skills which the employers considered important or very important with the percent between 80 and 88%

(Table II and III). However, the skills regarding:

- Basic information about geoids,
- Ellipsoids used to present the globe, and
- Construction plan information were the subjects that participants attributed less importance compared to the others.

According to the analysis, slightly more than 50% of respondents indicated that the skills "having basic information about geoids and ellipsoids used to present the globe" are both important and not at all important. Similarly, around 37-43% of the participants were neutral about these skills. However, the percentage of respondents was under 8 who thought that these skills are either unimportant or not at all important (Table II).

DISCUSSION AND CONCLUSION

Research outcomes suggested that GIS as an emerging technology and tool provides a diverse set of job opportunities for geography graduates in Turkey. However, it cannot be stated that the geography departments and graduates have been benefiting these opportunities at a required level in Turkey. The slow integration of GIS into high schools, the insufficient provision of GIS courses at university level, infrastructural problems of geography departments including the lack of hardware and software and GIS labs, the status of GIS in Turkey, in-service staining related problems are among the factors result in low spread of GIS. It would be a good starting point for any kind of educational institution or business planning to offer GIS training to know what kind of core GIS competencies and GIS skills GIS their graduate should have. The only way to learn that is making connection with the businesses employing GIS workers in their workplaces. This study provides the insights for these institutions providing GIS education about how they should develop and improve their teaching agendas with by making connections with almost all companies in Turkey using GIS.

The data collecting process indicated that there are two important critics of GIS job market about the institutions as the following:

1. There is an important problem for finding qualified GIS work force,
2. They spend important amount time and effort to train their new employees in required GIS skills.

In this context, it is obvious that the use of outcomes of the study has an important potential to solve the quality and recruitment problems of the GIS business at least to some extent by revealing what the critical GIS skills are from employers` point of view. The research results suggested that employers are assessing the GIS competencies as a whole and there are small differences between their selections among the diverse set of skills. However, "data base management" especially transferring present data to databases, "data analysis" with inquiry transaction, "map presentation skills by using ready templates on the Internet" and "using map services, Web-Map, and Web Feature server information on the Internet" are the most favorite skills that the employer`s indicated. It is obvious that anyone who wants to join GIS work force must start to develop his/her skills with data creation and analysis and GIS-Internet relationships. Numbering information, metadata info, different databases, creating attribute tables and map layers, and updating data in multiuser environment are other skills that have high selection rates among the employers. The educational institutions providing or projecting to provide GIS education should consider these results to train their students with up-to-date skills. However, "having basic information about geoids" and "ellipsoids which are used to present the globe" are the two skills that were least favorable among the employers.

This study is developed around three important research gaps and voids as follows.

- The one of the most important restraints in the study was finding similar studies about GIS skills. Unfortunately, there were no studies conducted specifically on the core GIS competencies that geography graduates should have from an employer`s perspective. It is strongly believed that this study will be open the doors for such studies on student skills by providing an important source to the literature.
- There was a lack of information for geography departments and graduates that what kind of specific GIS skills they should have for job markets. The study fills that gap with the perspectives of employers.
- The concerns about what a good starting point would be to establish and develop a GIS education program in an educational institution or a business? And how to design a teaching program for such education were critical in terms of training high quality graduates according to needs of GIS sector. This study providing enough insights and outcomes to resolve these concerns to some extent. However, the followings can be considered in relation with the future research direction of the study.

1. Solving infrastructural problems to provide better GIS education.
2. Opening and developing their GIS certificate programs for GIS sector.
3. Opening and developing GIS internship programs in geography departments.
4. Organizing and increasing the numbers of GIS conferences for making connections between GIS and academia.

It is should not missed that any kind of initiative about enhancing the students GIS competencies

requires the industry and education cooperation at a maximum level.

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