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**Article**

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## GEOGRAPHIC INFORMATION SYSTEM - MODERN TEACHING METHOD IN BUSINESS ADMINISTRATION

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### Abstract

The evolution of information and communication technologies has made possible the use of new ways of teaching and learning. Geographic Information System (GIS), one of these new technologies, allows a visual learning environment, facilitates active learning and spatial thinking, and also improves students' skills on using information technologies.

The aim of this paper is to examine how GIS applications contribute to the education field but also to present the limitations of their use in the teaching process. Also, we intend to present issues associated with their use in the business administration field.

In our approach regarding the modernization of teaching methods in business administration, we conducted an exploratory research using a standard questionnaire-based methodology to identify the opinions of teachers from the Academy of Economic Studies (AES) regarding the introduction of GIS subjects and applications in business administration study programs.

The results of our research showed that most AES teachers have knowledge of GIS. However, they consider that GIS programs have an important role in business administration. Respondents also said they are open to introducing new teaching methods, in accordance with the university's position for that matter.

**Keywords:** Geographic Information System (GIS), teaching method, business administration, education.

**JEL Classification:** O33, L86, I25.

### Introduction

Nowadays, *information technologies* are developing and penetrating very quickly all economic and social fields. Within information technologies, *Geographic Information System (GIS)* is the emerging science that puts together knowledge from geography, computer science, mathematics, statistics, management, surveying and mapping science (Wei, 2011). Traditionally GIS is involved in operating and managing utilities, transportation networks, cadastral infrastructure, and natural resources, both by governments and private organizations (Jankowski, 2009).

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GIS it is also an *important industry and academic discipline* and it is being used at the university level in more than 100 different academic disciplines (Korucu, 2012). The importance of GIS to education is being recognized throughout the world and today GIS is a *powerful research and presentation tool* for students at geography, architecture, business administration, natural resource management, natural sciences, public health and medicine, engineering, law, military science, social sciences and also in ecology, urban design and planning. As GIS technology becomes integrated in an increasing number of industries increase also the need for qualified people. This is an opportunity for *introduction of Geographic Information Systems into a bachelor or master study program*.

In this context, we propose to present in the first part of this paper *the nature and characteristics of GIS and the status of GIS introduction in educational programs*. The second major section of our paper examines *the results of the research* among university teachers from Bucharest Academy of Economic Studies regarding the opportunity of introducing GIS into a business administration study program.

### 1. The current state of knowledge concerning the adoption of GIS in education

The concept of *Geographic Information System (GIS)* can be defined as „a system of hardware and software used for the input, storage, retrieval, mapping, analysis and display of geographic data” (Malpica et al., 2007, p.48). *Hardware system* consists of computer equipment and network with some external device structure, in which the computer is the host of GIS, and *software system* generally consists of five sub-system, that is data input, data preprocessing, data storage and management, spatial analysis, data output (Wei, 2011). The ability of GIS to analyze spatial data is frequently seen as a key element in its definition, and has often been used in literature as a characteristic which distinguishes GIS from other systems, according to Tomlinson (2003).

Basically, a geographic information system encompasses various data about the environment. „GIS 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, p.13). Spatial data are practically information about shape, location, geographical relationships between entities and their attributes. These data are stored in different formats depending on the type of information, such as maps photographed or scanned images, called “*raster*”, or “*vector*” data plotted in a Cartesian coordinate system (Dobrică & Colesca, 2009). GIS data are numerical representation - or model - for features or phenomena that occur on or near the earth's surface. These data may relate to *physical objects*, natural or artificial, static or mobile; *events* that occur in short periods of time (eg., earthquakes, accidents); *location* (address); a *spatial network* representing the links between objects or events; a *phenomenon* that can be measured at any given location (eg., the concentration of ozone in the air). All these entities share a location that can be captured and stored and attributes that describe it. By associating location of an object with its attributes can generate different maps, can perform spatial queries and analysis that take into account the spatial relationships between objects.

Analysis of GIS literature reveals that *Geographic Information System approaches* have changed over time reflecting how technology has evolved. Thereby, in 1979 Dueker (p.106) described GIS as "a special case of information systems where the database consists of observations on spatially distributed features, activities, or events, which are definable in

space as points, lines or polygons. A GIS manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses" and nowadays, Incekara (2012, p.83) believes that 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".

Although GIS have been used for several years in the forestry, natural resources and environmental industries, only recently GIS applications have been adopted as useful tools by a wide range of *activities and disciplines* such as environmental planning, property management, infrastructure sitting, automobile navigation systems, urban studies, market analyses (Chen, 2007). Likewise, GIS is important for *business* because most business problems include significant spatial components and GIS enables decision makers to leverage their spatial data resources more effectively. Today, GIS-based data sources vary from satellite imagery used to validate the number of new houses in a commercial district to the individual people-point data of the consumers living in those houses. Data such as these can add significant value to an organization's database by helping to validate and extend their own proprietary resources. In business, you can make better decisions with the knowledge that spatial analyses are included, as Azaz (2011) concluded.

Although since the '90s research studies have been conducted (Landis, 1993; Crossland et al., 1995; Campbell & Masser, 1996) on the overall effectiveness of Geographic Information Systems as a decision-making tools, the manner in which GIS should be managed in a business setting and what types of problems it should be used for, only in the last few years private business organizations started to see the benefits that GIS provides and began adopting GIS technology for their own business needs. For instance, taking into account how it is presented in the literature (Harder, 1997; Boyles, 2002; Gadish, 2008), the contribution of GIS in business organizations may consist in determining where to locate commercial real estate — new shopping centers, new stores - by analysis of demographics and competition, mapping and topographical plans given spatial arrangement of potential customers, measurement and evaluation of market potential, analyze demand by location to better serve the consumers, discover efficient delivery methods for goods purchased via the Web or by phone order to homes, assign sales territories of salespeople.

Likewise, regarding the applicability of GIS in business a conceptual model developed by Mennecke (2000) provides four functions of Geographic Information Systems. The functions are derived from four unique activities for which GIS can be used to address the needs of business. These functions are *spatial visualization* (GIS capability of representing displays of data and information within a spatially-defined coordinate system), *database management* (capability of GIS to store, manipulate, and provide access to data), *decision modelling* (capability of GIS to be used to provide support for analysis and decision making), and *design and planning* (capability of GIS to be used to create, design, and plan). In addition to these specific functions, the model also represents several specific GIS applications toward which these functions can be applied for spatial data collection, automated mapping, facility management, market analysis, transportation, logistics, strategic planning, decision making, design and engineering.

But the GIS adoption process in business has proven to be lengthy and complex as there are few qualified people who understand and appreciate spatial thinking and its benefits to business organizations (Tomlinson, 2003) and it becomes apparent that there exists a gap

between business and education. This provides business administration programs with an opportunity to fill an important educational gap and business need by incorporating these applications into the curriculum. Although educational services can never fully replace the individual ability to adapt, no matter how competitive they may be (Săvoiu et. al, 2014), however the present knowledge-based society and economy and the need for highly skilled and educated people are elements that require the change of traditional teaching and learning processes in higher education (Plumb & Zamfir, 2011).

*Geographic Information Systems* can be used in the training process when there is geographic component and can be adapted to different levels or education systems. GIS can be used for teaching any material that contains spatial components such as *history, economics, natural sciences, sociology*, helping students to understand and analyze spatial concepts. GIS facilitates the learning process allowing students to assimilate information by adding spatial components and to easily understand some concepts using visual elements such as thematic maps.

There are many studies (like the one of Baloglu Ugurlu, 2008) emphasizing the contributions of GIS to teaching environment (most of these studies considering especially high school education). The attributes regarding the use of GIS in teaching environment that drawing most attention to the authors of these studies refers to the facts that GIS is a *student centred application*, by facilitating *active learning and improving spatial knowledge and skills of students* (Baker, 2001), that it *improves social learning skills* of students by *encouraging them to collaboration* (Baker, 2001), that it facilitates learning of students by providing *integrity between different disciplines* (Johansson și Pellikka, 2005; Broda și Baxter, 2003; Drennon, 2005), and that it improves *students' skills on using information technologies* (Wechsler & Pits, 2004).

In spite of its useful characteristics in teaching environment, there are a few reasons that limit the use of GIS in educational institutions, as shown in various studies (Baloglu Ugurlu, 2008). Among the problems identified by teachers are *inadequate technical and pedagogical knowledge of teachers* about GIS software (Johansson, 2003; Bartha, 2005; Demirci, 2009), and the fact that *learning and implementation of GIS takes a long time* (Kerski, 2003) and while seeking to balance the needs of the education system *the teachers do not have enough time for preparing and for integrating this technology with classroom activities* (Meyer et. al, 2003; Kerski, 2003; Shin, 2006). Also, some studies (Bednarz & Ludwig, 1997) have shown that there are problems regarding *the attitudes and perceptions of teachers about technology* and *the lack of awareness about the benefits of GIS*, and other studies (Yap et. al, 2008) mention *the difficulties faced by teachers in having access to GIS training, demos, lessons and support* provided by experienced GIS teachers and experts in the field. Besides, several problems can arise to establish *technical infrastructure for performing GIS applications* in educational institutions, like *inadequate hardware for GIS usage* in schools (Kerski, 2003; Walker, 2004), *high-costs of GIS software* (Wiegand, 2001; Johansson, 2003), and having *difficulties in getting appropriate basic maps and databases* (Wiegand, 2001). Especially in recent years, available open source geographic information systems (open GIS) lowered the costs related to their use in schools and universities.

Today, hundreds of universities around the world offer *certification programs in GIS* (such as the University of Leeds, Kingston University (London), Paris Lodron University (Salzburg), Rheinische Friedrich-Wilhelms-Universität Bonn (Bonn), University of Redlands, University of Southampton, University of Pennsylvania, etc.) and in many

master's programs in business administration are studying subjects strictly related to the applicability of GIS in business.

## **2. Research methodology**

Our research was based on a *standard methodology* that is applied in the questionnaire based surveys.

*The purpose* of the research was to identify the views of teachers from the Academy of Economic Studies (AES) in regards to the introduction of GIS (Geographic Information System) disciplines and applications into the study programs in business administration.

*Research objectives:*

- highlighting the level of knowledge about GIS programs of teachers in AES;
- determining the degree of importance of GIS within the subjects in business administration;
- knowing the attitudes of the respondents and the perception of the university about modern teaching methods;
- perception of the interviewees in relation to the contribution of GIS to improve the educational outcomes of students.

*The hypothesis* into account when starting the research were:

- the majority of teachers in AES are knowledgeable of GIS programs;
- interviewees believe that GIS programs have an important role in the disciplines of business administration;
- AES as an institution and its teachers are open to modern teaching methods;
- respondents consider that GIS applications will improve the professional performance of students.

*The collectivity* that we studied consisted of the teachers from AES. The method of data collection was the use of a questionnaire. It was posted on Google Docs and respondents were invited by e-mail to the Intranet ASE to complete the questionnaire. As such, the questionnaire was self-administered.

*The questionnaire* consisted of 3 sections. The first two parts consist of content questions and the third part consists of identification questions. The questionnaire consists of 21 questions, with single option of a response. The first part of the questionnaire illustrate general questions relating to awareness of GIS programs, their importance in the training of specialists in business administration and the main barriers to introducing GIS in teaching subjects. The second part measures the respondents' opinions to the university and teachers behavior in relation to modern methods of teaching and to the usefulness of GIS programs to increase student performance. The third part contains questions related to gender, age, academic degree and managerial position occupied by respondents.

*The sample* used in the survey was 168 people, which represents about 21% of all AES teachers and were those who responded to the request to complete the questionnaire. Given the structure of the respondents and the sample size, we cannot say that was a representative sample. As such, our research was exploratory.

*The period* of administration of the questionnaire was 31 January - 27 February 2014.

In analyzing the results, we used diversified instruments: mediums, structural analysis, measuring the degree of association between variables using test  $\chi^2$ , Pearson correlation coefficient, scores method, tables and graphs. To this end, data processing was performed with SPSS 20.

### 3. Results and discussion

Below, we present results of processing the data collected. These will be presented in the structure, each of the three sections of the questionnaire, and correlated between variables in the same section, but also from different sections.

In the surveyed sample the proportion of those that heard of GIS, as well as those already using it is 87.5%, which shows that in a significant measure, the views of respondents are based on knowledge in the field (see table no. 1).

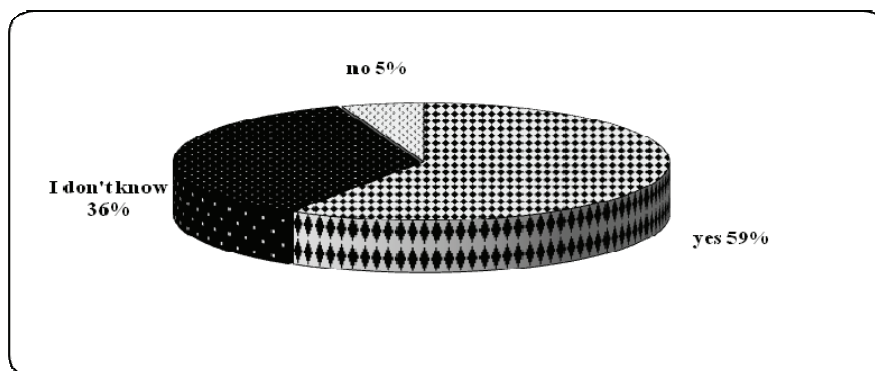
**Table no.1: Level of knowledge in the GIS field**

Choice	Frequency	Percentage
I have not heard of GIS	21	12.5
I have heard of GIS	99	58.9
I am using GIS	48	28.6
<b>Total</b>	<b>168</b>	<b>100.0</b>

Only 5.4% of all respondents stand against the introduction of GIS in the programs of study in business administration, while 58.9% of respondents see fit this endeavor, 35.7% of respondents are undecided (see figure no. 1).

102 respondents, i.e. 60.7% of the total respondent already teach one discipline in business administration programs.

Regarding obstacles that would involve the introduction of GIS in curricula most frequently mentioned were lack of training teachers (51 subjects, representing 30.4%) and lack of software and manuals (33 respondents, 19.6%). Also, a significant proportion of individuals in the sample (17.9%) indicated as the main obstacle the lack of computers and appropriate space (see figure no. 2).



**Figure no.1: Opinions of the respondents regarding the opportunity of introducing GIS**

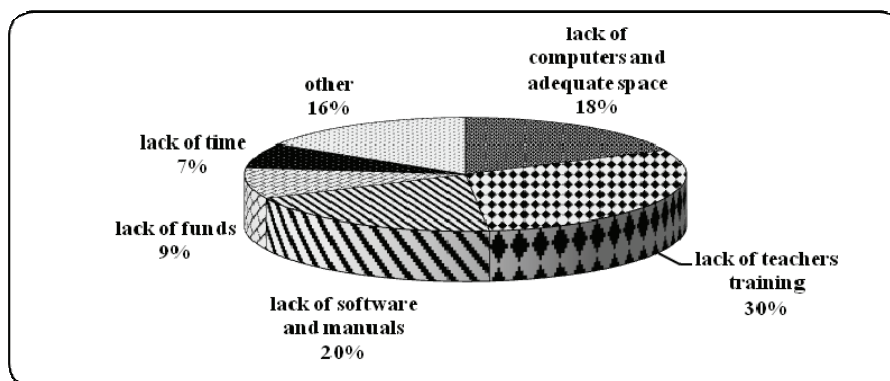


Figure no. 2: Opinions of the respondents about obstacles in introducing GIS

The second part of the questionnaire contains 12 questions seeking the opinion of respondents to a number of lines of action, on a scale from 1 (strongly disagree) to 5 (strongly agree): computer software knowledge level, university's orientation and concern regarding new educational technologies, teachers' attitude towards new teaching methods, interdisciplinary oriented, and results obtained by students in using GIS.

The highest scores were obtained by the following statements (see table no.2): in addition to textbooks, I often use supplementary materials for my disciplines (score 4.48 - almost total agreement); I want to introduce more complex educational methods – 4.30; Often use themes and interdisciplinary examples in my classes – 4.29; I encourage my students to adopt research-based ways of learning – 4.16.

Table no. 2: Scores of respondents' opinions

Statements	Valid responses	Missing responses	Average
I am proficient in the use of common software (Word, Excel, graphics programs, and Web browsing).	168	0	4.02
My university has modern computers.	168	0	3.27
My university is investing in new educational technologies.	168	0	2.93
GIS is easily incorporated into my subjects.	168	0	3.16
I don't have enough time to learn new educational technologies.	168	0	2.11
I encourage my students to adopt research-based learning methods.	168	0	4.16
In addition to textbooks, I often use supplementary materials within my subjects.	168	0	4.48
I want to introduce more complex educational methods.	168	0	4.30
GIS improves students' ability to solve problems.	168	0	3.38
GIS enhances spatial thinking of the students.	168	0	3.79
GIS will be an integral part of economic education in the near future.	168	0	3.45
I often use interdisciplinary examples and themes.	168	0	4.29



The survey sample was composed of 46.4% male and 53.6% female, most of which are under 44 years old (64.3%). Most respondents were lecturer and senior lecturer and only 14.3% had a management function (see table no. 3 and table no. 4).

**Table no. 3: Distribution of respondents by gender and managerial positions**

<div> <div>Gender</div> <div>Managerial position</div> </div>			Do you have a managerial position within the university?		Total
			yes	no	
Gender	male	Frequency	21	57	78
		Percentage	12.5%	33.9%	46.4%
	female	Frequency	3	87	90
		Percentage	1.8%	51.8%	53.6%
Total		Frequency	24	144	168
		Percentage	14.3%	85.7%	100.0%

**Table no. 4: Distribution of respondents by age and academic degrees**

Age \ Academic degrees			What is your academic degree?				Total
			Assistant	Lecturer	Senior Lecturer	Professor	
What is your age?	25 - 34 years	Number	9	33	6	0	48
		Percentage	5.4%	19.6%	3.6%	0.0%	28.6%
	35 - 44 years	Number	6	18	27	9	60
		Percentage	3.6%	10.7%	16.1%	5.4%	35.7%
	45 - 54 years	Number	0	3	12	15	30
		Percentage	0.0%	1.8%	7.1%	8.9%	17.9%
	after 55 years	Number	0	0	6	24	30
		Percentage	0.0%	0.0%	3.6%	14.3%	17.9%
	Total	Number	15	54	51	48	168
		Percentage	8.9%	32.1%	30.4%	28.6%	100.0%

Between the academic rank of the respondents and their age there is a direct and strong correlation, Pearson coefficient having a value of 0,706 at a significance threshold at 1%. Between the academic degree and management position is an average association ( $\chi^2$  values calculated is 32.89, while the values of Phi and Cramer's are 0.442) (see table no. 5).

**Table no. 5: The value and measure of  $\chi^2$  test**

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.890	3	.000
Likelihood Ratio	37.344	3	.000
Linear-by-Linear Association	28.181	1	.000
N of Valid Cases	168		

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Phi	.442	.000
	Cramer's V	.442	.000
N of Valid Cases		168	

At the same time, the two variables are inversely related and the intensity is average ( $r = -0.411$ , at a significance level of 1%). Although professors and lecturers together represent 59% of all respondents, only 14.3% of them have a leading position. These are shown in table no. 6.

**Table no. 6. The correlation between age, academic degree and managerial position**

		Age	Academic degree	Managerial position
Age	Pearson Correlation	1	,706**	-,242**
	Sig. (2-tailed)		,000	,002
	N	168	168	168
Academic degree	Pearson Correlation	,706*	1	-,411**
	Sig. (2-tailed)	,000		,000
	N	168	168	168

\*\* . Correlation is significant at the 0.01 level (2-tailed).

There is a direct moderate correlation ( $r = 0.409$  at a significance level of 1%) between the level of knowledge in GIS and the significance of GIS subjects in the taught disciplines. Of the 58.9% of respondents who have heard of GIS, 98.2% believe that the importance of GIS will be the same or increase. Most of those using GIS consider that its importance will increase in the coming years, and no one believes it will decrease the importance of GIS in the taught disciplines (table no. 7 and table no. 8).

**Table no. 7: Highlighting the link between knowledge and importance of GIS**

			In the next five years do you find that the importance of GIS for your subjects will be:			Total
			Lower importance	About the same	Greater importance	
What is your knowledge level of GIS?	I have not heard of GIS	Number	6	12	3	21
		Total Percentage	3.6%	7.1%	1.8%	12.5%
	I heard of GIS	Number	3	66	30	99
		Total Percentage	1.8%	39.3%	17.9%	58.9%
	I use GIS	Number	0	18	30	48
		Total Percentage	0.0%	10.7%	17.9%	28.6%
Total		Number	9	96	63	168
		Total Percentage	5.4%	57.1%	37.5%	100.0%

**Table no. 8: The correlation between the knowledge level and importance of GIS**

		In the next five years do you find that the importance of GIS for your subjects will be:
What is your level of knowledge in GIS?	Pearson Correlation	.409**
	Sig. (2-tailed)	.000
	N	168

A direct and strong correlation ( $r=0.751$  at a significance level of 1%) occurs between those who believe that the university has modern computers and those who believe that the university invests in educational technologies. This indicates a consistency in their assessments to the institution's involvement in acquiring the most modern teaching methods (table no. 9).

**Table no. 9: Correlation between computers and educational technologies**

		My university is investing in new educational technologies
My university has modern computers	Pearson Correlation	.751**
	Sig. (2-tailed)	.000
	N	168

Between the use of additional material and introducing complex teaching methods are direct and strong correlation –  $r = 0.621$  at a significance level of 1%. Also, such a correlation appears between GIS assessment that enhances students' ability to solve problems and their spatial thinking ( $r = 0.685$  at a significance level of 1%).

Variables regarding the use of GIS to improve students' ability to solve problems and the need to introduce GIS in business administration degree programs are inversely correlated, with an average intensity of the relationship ( $r = -0.451$  at a significance level of 1%). This is determined by the average appreciation of students' ability to solve problems using GIS (average score 3.38), while the majority of respondents consider it appropriate to introduce GIS curricula of business administration (table no. 10).

A high intensity association ( $\Phi = 0.695$ ,  $\chi^2$  calculated at 81.208 with 6 degrees of freedom) occurs between the question about the use of additional materials and the question relating to encourage students to research. The two variables are directly correlated with average intensity ( $r = 0.463$  at a significance level of 1%). This result is due to the fact that although most respondents are in total agreement that the additional use of teaching materials (93 of them, representing 55.4% of total), only 66 (i.e. 39.3% of total) express the same degree of appreciation for the research orientation of students (table no. 11).

**Table no. 10: Correlation between capacity to solve problems, spatial thinking and opportunity to introduce GIS into curricula**

		GIS enhances students' spatial thinking.	Consider it appropriate to set GIS in Business Administration study programs??
GIS improves students' ability to solve problems.	Pearson Correlation	.685**	-.451**
	Sig. (2-tailed)	.000	.000
	N	168	168

**Table no. 11. The value and measure of  $\chi^2$  test**

	Value	df	Asymp. Sig. (2-sided)		
Pearson Chi-Square	81.208	6	.000		
Likelihood Ratio	94.520	6	.000		
Linear-by-Linear Association	35.843	1	.000		
N of Valid Cases	168				
Symmetric Measures					
		Value	Asymp. Std. Error <sup>a</sup>	Approx. T <sup>b</sup>	Approx. Sig.
Nominal by Nominal	Phi	.695			.000
Interval by Interval	Pearson's R	.463	.081	6.735	.000 <sup>c</sup>
N of Valid Cases		168			
a. Not assuming the null hypothesis.					
b. Using the asymptotic standard error assuming the null hypothesis.					
c. Based on normal approximation.					

Given the above results we conclude that the first three hypotheses (namely, the majority of teachers in AES are knowledgeable of GIS programs, interviewees believe that GIS programs have an important role in the disciplines of business administration and AES as an institution and its teachers are open to modern teaching methods) were confirmed. The fourth hypothesis regarding the fact that respondents consider that GIS applications will improve the professional performance of students is disproved. Most teachers are knowledgeable of GIS programs and its applications and appreciate their importance in the taught disciplines in business administration. Likewise, they are open to new teaching methods, based on research and interdisciplinarity. However, they don't consider that GIS applications can be useful in increasing the professional performance of the students. Therefore, should be acted upon teachers in increasing awareness of the role of GIS to improve the educational outcomes of students.

## Conclusions

Our research has enabled us to emphasize that is necessary to introduce GIS programs and applications within study programs in the field of business administration from the AES. They are designed to help increase the interdisciplinarity of the studied subjects and to a better understanding of concepts such as product traceability, tracking vehicles during transport etc. Programs and GIS applications can be introduced both as stand-alone discipline and as parts in different courses and seminars in various disciplines.

Particular attention should be given in training teachers about the skills necessary for working with GIS. As shown in the obtained data, the lack of teachers training is most commonly given as an obstacle to the introduction of GIS to the curriculum in business administration. In addition, a specific focus should be on emphasizing the importance of GIS to improve students' results.

The main limitation of our research is driven by non-representativeness of the sample. Its structure does not correspond to the current AES didactic staff, in terms of the distribution

by academic degree and gender. However, the results are very useful in outlining courses of action to modernize teaching methods in business administration.

Both teaching with GIS and teaching about GIS are important elements for integrating new technologies in business administration programs. GIS has now become a fast growing industry and as such, this area offers many employment opportunities for both graduates and for those who are following retraining programs. At this point, however, in the world there is a growing gap between demand for staff with knowledge on GIS and number of specialists available, due in part to the lack of study programs at university level in this area.

In this context, a program of business administration from Romania that would adopt GIS will have a competitive edge over other higher education institutions and will be able to address business needs by educating future business leaders to think and to make decisions in terms of location and time.

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