

RECENT REMARKABLE DEVELOPMENTS IN THE WORLD WIDE AND CONTRADICTIONS IN STATISTICS EDUCATION IN TURKEY

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Abstract

The main purpose of this paper is to present some concerns about statistics education in the higher education system in Turkey. In general, especially in faculties that teach social sciences in Turkey, we observed a tendency of decreasing the share of quantitative courses in curricula, including statistics. Also we observed that statistics departments of Faculty of Arts and Sciences have been closed because there were not enough students. On the other side, it is seen that developed nations are harvesting the benefits of mathematics, statistics and computer science. As a result, it has been understood that statistics education in Turkey has a paradox. While developed nations are more interested in quantitative literacy and quantitative education, it seems at least we are not that much.

Key Words: *Statistics education, Data Science, Technology, Quantitative Literacy.*

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Dünyada Yakın Zamandaki Dikkat Çekici Gelişmeler ve Türkiye'deki İstatistik Eğitimindeki Çelişkiler

Özet

Bu makalenin temel amacı Türkiye'de yükseköğretimdeki istatistik eğitimi ile ilgili bazı endişeleri ortaya koymaktır. Genel olarak, özellikle Türkiye'de sosyal bilimlerde eğitim veren fakültelerde istatistiğin dâhil olduğu nicel derslerin ders programlarındaki payının azalma eğiliminde olduğunu gözlemledik. Aynı zamanda, yeterli öğrenci olmadığından Fen Edebiyat Fakültelerinin İstatistik Bölümlerinin kapandığını gözlemledik. Buna karşılık, gelişmiş ülkelerin matematik, istatistik ve bilgisayar bilimlerinden faydalarından ürün elde ettiği görülmektedir. Sonuç olarak, Türkiye'deki İstatistik Eğitimi bir çelişkiye sahip olduğu anlaşılmaktadır. Gelişmiş ülkeler nicel okuryazarlık ve nicel eğitim ile daha çok ilgiliyken, en azından biz onlar kadar ilgili değiliz.

Anahtar Kelimeler: İstatistik Eğitimi, Veri Bilimi, Teknoloji, Nicel Okuryazarlık.

1. INTRODUCTION

Data is at the core of all statistical analyses. Today, the focal point of many scientists has become on so large data sets called “**Big Data**” in the light of new scientific developments. However, it is too difficult to store, share and analyze these data by using traditional data processing applications. Hard disks of desktop computers or notebooks and statistical packages that work with them are inadequate to handle such data. Now, the method of science seems to be affected by the magnitude of the data, big data (Gürsakal, 2014: 20).

Depending on the new technological changes in everyday of our lives, managing big data sets made progress and new concepts such as “**Cloud Computing**” emerged in today’s scientific world. A cloud simply stands for a data center and it is defined as a living organism which is made up of hundreds of network servers (Gürsakal, 2014: 163). Depending on these developments cloud companies raised and they started to give services to their customers by lowering their data storage prices continuously. In such world, it is unbelievable but some says that, “deleting data is more expensive than storing it”. After the word big data was first pronounced in 2000 (Gürsakal, 2014: 19), in 2010 a huge interest for big data has been grown (Gürsakal, Gürsakal and Murat, 2014). All of these changes joined in and affected our lives in some ways. Moreover, every aspect of our lives such as mobile phones, especially smart phones, mobile applications, social media, social networks and also new statistical open source software such as “**R**”

affect our lives. Facebook profiles are being used in job interviews and some says that they are more useful than our traditional personality tests. It is not a fortune telling that sooner or later education will be affected by these huge technological changes.

Besides, the technological changes that were involved of our lives, they also affect higher education systems all around the world. New educational trends were started to turn around **Massively Open Online Course (MOOC)**, open source software, big data, cloud technology and map-reduce concepts. Gürsakal, Gürsakal and Murat (2014) explained that this is a digitalized, programmed, networked world and educational activities are being served to their customers under the circumstances of new age which is called “petabyte age”. Researchers stressed two new concepts occurrence with the following words:

*“As computer and Internet technology develops, an exponential increase in the number of data was generated, achieved and manipulated. As a consequence of this change, **big data** concept has been created and a new field called **data science** has been developed.”*

Recent popular developing science branches respectively named **computational mathematics** and **computational statistics** are also taken into consideration by many scientists. Within this scope, the modernization of statistics education seems to be inevitable and it is obvious that upon these developments also the number of the statistic graduates needed to be increased. On the other hand, at the core of these changes **statistical literacy** has great importance not just for students who gets education in statistics departments of universities, but also for every high school student who will work in the business world. As it was pointed out in a report by Franklin and et al. (2007: 1) that “Every high-school graduate should be able to use sound statistical reasoning to intelligently cope with the requirements of citizenship, employment, and family and to be prepared for a healthy, happy, and productive life.” At this point, two things should be pointed out:

1. Societies should have graduates who have a statistical literacy in general.
2. Statistics education should have specific goal that is to graduate qualified “statisticians” from statistics departments.

Today, it is observed that first, second and third cycle quantitative courses such as mathematics and especially statistics gain importance in the world wide. Moreover, it is obvious that in every research area (especially in master and Ph.D. thesis, books and also in academic papers) the direction of the move shifted theoretical to theoretical plus quantitative analysis.

Computers, computer programs and quantitative analysis are thought together in the world wide. Therefore, theoretical plus quantitative analysis does not have any attraction without computers and computer programs.

Within this framework, the main purpose of this paper is to present some insights about higher statistics education in Turkey. To do so, our approach is at first to touch some key concepts of today's world such as data science, data scientist, quantitative literacy and the role of technology. Second, our approach will be to argue the value of higher statistics education in Turkey appreciatively the statistics tenderness signs of the western societies. To do so, next section presents data science, data scientist and their importance in the scientific world. Section three briefly addresses the significance of quantitative literacy and technology. Section four involves the argument about the contradictions in statistics education in Turkey. Finally, last section covers the results.

2. DATA SCIENCE AND DATA SCIENTIST

Demir (2014) reported that, in a formal document sent to the governors by The Ministry of Health, it was pointed out that a firm receives patients' private health information from pharmacies, doctors and hospitals and sell this information to drug companies. This evidence shows us that how data is important for someone who knows how valuable it is. If you google, "Firms that sell data", you will find 134 million hits and the name of the companies that sell taxpayers' financial data, students' data for drinks and phone firms, the top 50 companies that mine and sell data and so on. Developed nations of the World are living in a Data Revolution. These new kind of data is mainly unstructured (it is not in the cells of rows and columns), so big and could not be analyzed by our traditional methods and tools. And it should be emphasized that data is money in such a world. Can we live in an isolated world that is not affected by this Data Revolution? Lai (2013:2) touches some important points about data science with the following words:

"Data science, therefore, includes high performance computing, data processing, development and management of databases, data warehousing, mathematical representations, statistical modeling and analysis, and visualization with the goal of extracting information from the data collected for domain-specific applications. Interdisciplinary graduate programs to train data scientists are being established at a number of universities, including Columbia, Stanford, New York University, and North Carolina State University. At Stanford, the MS programs in Statistics and in Computational & Mathematical Engineering will

offer a joint Data Science track, beginning in the 2013-14 academic year. The track offers courses in advanced statistical methods and models, machine learning and data mining, high-performance computing, numerical analysis and optimization, and applied and computational mathematics. In addition, PhD programs in the Departments of Statistics and Computer Science and in the Institute of Computational & Mathematical Engineering cover different aspects of research in data science.”

Nowadays The USA, and partly China have been focused on big data. Countries, sectors and firms have high hopes regarding big data. Petabyte Age brought us a new field called data science and who makes data science are called data scientists.

“What is data science? With the major technological advances of the last two decades, coupled in part with the internet explosion, a new breed of analyst has emerged.” And **data scientist** can be defined as an individual who uses current computational techniques to analyze data Langmore and Krasner (2013). Why do we need data scientist? Are statisticians not capable of analyzing data? One short answer comes from the fact that the data sphere has changed and, hence, a new set of skills is required to navigate it effectively Langmore and Krasner (2013).

This new field has close ties with statistics and computer science. And within the framework of this relation, it should be accepted that computer science is more important than statistics for data science. Besides, data science is an important emerging field that tries to produce data products like recommender systems (Gürsakal, 2014: 235-247).

The demand for data scientists also has caused an increase for the demand of statistics workforce. To be a statistician is an attractive profession in the developed world. Besides, some writers such as Davenport and Patil (2012) qualify data science as “the sexiest job”. Statistics is accepted as a substantial quantitative course in the university curricula (Tishkoyskaya and Lancaster, 2012: 2). Does statistics have a sustainable position? Competition or collaboration, which one should be thought between statistics and data science? Davenport and Patil (2012: 72) stressed the importance of data science and data scientist with the following paragraph:

“Goldman is a good example of a new key player in organizations: the ‘data scientist’. It’s a high-ranking professional with the training and curiosity to make discoveries in the world of big data. The title has been around for only a few years. (It was coined in 2008 by one of us, D.J. Patil, and Jeff Hammerbacher, then the respective leads of data and analytics efforts at LinkedIn and Facebook.) But thousands of data scientists are already working at both start-ups and well-established companies. Their sudden appearance on the

business scene reflects the fact that companies are now wrestling with information that comes in varieties and volumes never encountered before. If your organization stores multiple petabytes of data, if the information most critical to your business resides in forms other than rows and columns of numbers, or if answering your biggest question would involve a ‘mashup’ of several analytical efforts, you’ve got a big data opportunity.”

Of course there are common threads linking data science and statistics. If the new kid in our town is data science, and if statistics is a close friend of him; statistics would have benefits from this friendship. But as a necessary remainder, on the long run, he should better take care of himself. The road lies ahead of statistics seems us as if a long and winding road.

3. SIGNIFICANCE OF QUANTITATIVE LITERACY AND TECHNOLOGY

3.1. QUANTITATIVE LITERACY

We are living in a computer age and in developed countries it is expected that even ordinary citizens should have quantitative literacy. Steen (2001: 111) defines quantitative literacy as follows:

“Quantitative literacy, also called numeracy, is the natural tool for comprehending information in the computer age.”

The quantitative literacy design team (2001: 1-2) explains the importance of quantitative literacy with the following words:

“The expectation that ordinary citizens be quantitatively literate is primarily a phenomenon of the late twentieth century. ...Unfortunately, despite years of study and life experience in an environment immersed in data, many educated adults remain functionally innumerate. ...Quantitative literacy empowers people by giving them tools to think for them, to ask intelligent questions of experts, and to confront authority confidently. These are the skills required to thrive in the modern world.”

Literacy skills are prominent for **statistical literacy** because all statistical messages are conducted through written or oral texts (Gal, 2004: 4). Gal (2004: 4) outlines five aspects of the **statistical knowledge base**:

1. Knowing why data are needed and how data can be produced
2. Familiarity with basic terms and ideas related to descriptive statistics
3. Familiarity with basic terms and ideas related to graphical and tabular displays
4. Understanding basic notions of probability

5. Knowing how statistical conclusions or inferences are reached

Gal (2004: 4) refers to two interrelated following components of **statistical literacy**: (1) people's ability to interpret and critically evaluate statistical information, data related arguments, or probabilistic phenomena, which they may encounter in diverse contexts, and relevant, and (2) their ability to discuss or communicate their reactions to such statistical information, such as their understanding of the meaning of the information, their opinions about the implications of this information, or their concerns regarding the acceptability of given conclusions.

3.2. TECHNOLOGY

Schuyten and Dekeyser (1997: 207) explained the importance of computers with the following words:

“Computers provide us with the opportunity to create entirely new learning environments for our students. Computers can be used in statistics education in many ways. They can be used as an illustration component in lectures, as a computation tool, as an electronic interactive textbook, as a research tool, and as a medium for thinking.”

Computers and computer science are most valuable tools for statistics, but they also lie in the core of the adaptation problems. Interactive simulations are now widely available on the Web and these resources have the potential to make learning statistics easier and more fun (Lane and Peres, 2006: 5). The use of the internet in education is increasing and the word MOOC (massively open online course) is a trendy word for educational networks. Thompson (2011: 2) defines MOOC with the following definition:

“MOOC is a model for delivering learning content online to virtually any person—with no limit on attendance—who wants to take the course.”

MOOC's are open, free and massive. Peter Bruce is the manager of statistics.com and he says that our mission is to provide online education in statistics, analytics, and data science to a global audience (Piatetsky, 2014).

Over the past few decades researchers and educators have been trying to understand the challenges in learning and teaching statistics and to identify the changes that are needed in the training of future statisticians (Tishkoyskaya and Lancaster, 2012: 2). Multi-media systems may enable active independent learning tailored to student needs (Schuyten and Dekeyser, 1998: 713). Abilene Christian University Statistics Student – spring 2010 has said that school is with me everywhere I go, I like that. It is a new way of learning, all I need is my **iPhone** and I can study anywhere

(Nihalani and Mayrath, (2010: 2). Some people ask, “What does **mobile adoption** look like within education?”

Technology enables exploratory data analysis, simulation as an alternative to formal treatment doing statistics with statistical software (Schuyten and Dekeyser, 1998: 713). What is to be done in statistics education? Can be answered with following sentences:

- Computer and Web are together at the core of statistics.
- Contribute to or take part in the production, interpretation, and communication of data pertaining to problems they encounter in their professional life (Gal and Garfield, 1997: 3).
- The demands of the economy should be taken into account.
- A balance between proofs and computation should be attained.

4. COTRADICTIONS IN STATISTICS EDUCATION IN TURKEY

Cox (1998: 211) arranged the variety of statistics audiences in the following manner:

- (a) Primary school-children for whom some notion of distribution arises naturally in their early work on numeracy;
- (b) Secondary school-children, particularly those needing some statistical ideas for a project;
- (c) Undergraduate students of many kinds ranging from generalist to specialist in, for example, medicine, engineering, physics and mathematics and including students who are to some extent concentrating on statistics;
- (d) Post-graduate students of statistics preparing for research in particular fields;
- (e) Post graduate students of statistics
- (f) Continuing education or post experience students; again there are many types ranging from generalists such as those who might attend a workers educational association course to those studying for a specific purpose connected with their career.

Besides the audiences mentioned above, statistics concepts and application facilities has vital importance for today’s managers (Gürbüz and Uçan, 2005: 110). Statistics has remarkable significance in the business world that was mentioned below by various researchers. For instance, Vere-Jones (1995: 13) signifies the notable achievement of western societies with the following sentences:

“One of the most notable achievements of western societies in the last few decades has been the extension of modern education,

*including **mathematics**, to a very substantial proportion of the population... It is within this context that the movement for **statistics education** has taken root."*

Garfield and Ben-Zvi (1997: 1) expressed that quantitative information is everywhere and numerical data are increasingly presented. Moreover, the signs of the developing interests in statistics were stressed by Lohr (2009: 1) with the following heading that took place in the New York Times Technology:

"For Today's Graduate, Just One Word: Statistics."

Lohr (2009: 1) introduced Carrie Grimes, Eric Brynjolfsson, Jon Kleinberg and their opinions with the following to paragraphs:

*"Carrie Grimes was majored in anthropology and archaeology. Ms. Grimes got her doctorate in **statistics** from Stanford in 2003 and joined Google later that year. She was drawn for computer and math stuff and what she really does in Google is data analysis. She uses **statistical analysis** of mounds of data. She is an internet age statistician who found themselves increasingly in demand. She is now one of many statisticians in a group of 250 **data analysts**. She uses statistical modeling to help improve company's search technology."*

*"Eric Brynjolfsson is an economist and director of the Massachusetts Institute of Technology's Center for the Digital Business. Eric said that we're rapidly entering a world where everything can be monitored and measured. The big problem is going to be the ability of humans to **use, analyze and make sense of the data.**"*

Lohr (2009: 3) expressed that the new breed of statisticians who uses powerful computers and sophisticated mathematical models to hunt meaningful patterns and insights would tackle the problem that Eric was talking about. Jon Kleinberg mentioned about the new shift of the data with the following sentences:

*"Jon Kleinberg is a computer scientist and social networking researcher at Cornell said that it is the **size of the data sets** on the web that opens new worlds of discovery. Traditionally, social sciences tracked people's behavior by interviewing or surveying them. But the web provides amazing resource for observing how millions of people interact."*

Lohr (2009: 3) also underlines the importance of statistics with the Netflix contest which offers \$1 million to anyone who could significantly improve the companies' movie recommendation system was a battle waged with the weapons of **modern statistics**. More over Lohr (2009: 3) indicates that IBM is seeking an opportunity in data hunting services, created Business

Analytics and Optimization Services group (the expertise of more than 200 mathematicians, statisticians and other data analysts). IBM plans to retrain or hire 4000 more analysts across the company. In another sign, according to American Statistical Association an estimated 6400 people are attending the statistics profession's annual conference in Washington which was 1000 people more than in recent years (Lohr, 2009: 3).

Up to now, following recent remarkable developments in the world wide were tried to mention as far as possible:

- new concepts such as big data, cloud computing, MOOC, data science, data scientist, computational mathematics, and computational statistics were talked in the introduction part;
- data science and data scientist addressed in section two;
- the importance of quantitative literacy, statistical literacy and role of the technology in statistical education were explained in section three;
- And in the beginning of this section possible audience of statistics, the significance of statistics in the business world and the need for statistician were dealt with.

While these developments happen in the world wide, what about the Turkish education system? Are the Turkish academicians really aware of these deep, strong terminological and technological changes or not? Are they adapting their educational systems regarding to these changes or not? However, the scopes of these questions are wide and also out of the scopes of this study. These issues can be discussed in other future study.

Under the above developments and especially the statistics tenderness signs of the western societies, now our approach is going to take the reader's attention to the value of higher statistics education in Turkey. So, we focus on the statistics courses that are taught in Business Administration and Economics departments of Faculty of Economics and Administrative Sciences and also statistics departments of Faculty of Arts and Sciences. Therefore, it was tried to answer the following questions respectively:

1. What are the statistics educators' opinions about the number of statistics courses that should be taught in Business Administration and Economics departments of Faculty of Economics and Administrative Sciences in Turkey?
2. Does the actual number of statistics courses in Business Administration and Economics departments of Faculty of Economics and Administrative Sciences in Turkey match the statistics educators opinions or not?

3. Are the Turkish statistics departments of Faculty of Arts and Sciences in Turkey come into prominence or do not while they gain importance in the abroad?
4. Are the Turkish statistics departments of Faculty of Arts and Sciences in Turkey losing power or are not while they gain strength in the abroad?
5. Are the Turkish statistics departments of Faculty of Arts and Sciences in Turkey under the closing risk?

To answer such questions, we begin with a recent quantitative research that was performed by Gürbüz and Uçan (2005). Researchers surveyed Turkish academics who give statistics courses in Business Administration and Economics departments of Faculty of Economics and Administrative Sciences in both Turkish Private and Government Universities. The number of replies of the survey is 50 out of 78 Universities. 100 percent of the academics (50 academics) who replied survey declared that statistic courses must be taught in the Business and Economics departments. Some other more remarkable results are as follows: Out of 50 academic members 16 replied that statistics courses should be taught four semesters, 10 replied that statistics courses should be taught three semesters, 23 replied that statistics courses should be taught two semesters and 1 replied that statistics courses should be taught one semester. Most of the academics replied that statistics courses should be taught two or more than two semesters in Business and Economics Departments. 52 percent of the respondents declared that statistics courses should be taught more than two semesters (three or four). This is a remarkable result that explains academics point of view which gives value to statistics greatly. Based on the statistics educators respond Gürbüz and Uçan (2005) concluded that statistics courses should be taught in three semesters in Business and Economics Departments in Turkey (the average value of respondents was 2,82 semesters). Gürbüz and Uçan (2005) also reported that the importance of statistics for economics and business administration is questionable.

In the direction of our research's main aim it would be better to compare Gürbüz and Uçan's (2005) findings with the number of semesters that statistics courses taught in Department of Economics and Department of Business Administration in Turkish Universities at the present time. Following two tables respectively present the number of semesters that statistics courses taught in Department of Economics and Department of Business Administration in some of the well-known Turkish Universities.

Table 1. Statistics Courses Taught in Department of Economics in Turkish Universities

No	University	Faculty	Course Name	Course Name
1	Abant İzzet Baysal	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
2	Adnan Menderes	Nazilli Faculty of Economics and Administrative Sciences	Statistics	-
3	Afyon Kocatepe	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
4	Aldemir	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
5	Aksaray	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
6	Anadolu	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
7	Ankara	Faculty of Political Sciences	Statistics 1	Statistics 2
8	Balıkesir	Bandırma Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
9	Balıkesir	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
10	Bartın	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
11	Bağkent	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
12	Cebeli Bayır	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
13	Cumhuriyet	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
14	Çukurova	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2 (Selective)
15	Doğuz Eylül	Faculty of Business Administration	Statistics	-
16	Ege	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
17	Eskişehir Osmangazi	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
18	Fırat	Faculty of Economics and Administrative Sciences	Statistics	-
19	Gazi	Faculty of Economics and Administrative Sciences	Introduction to Statistics and Prob. 1	Introduction to Statistics and Prob. 2
20	Giresun	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
21	Hacettepe	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
22	İstanbul	Faculty of Economics	Statistics 1	Statistics 2
23	İstanbul Aydın	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
24	Karadeniz Teknik	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
25	Kırıkkale	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
26	Kırklareli	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
27	Kocaeli	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
28	Marmara	Faculty of Economics	Statistics 1	Statistics 2
29	Muğla Sıtkı Koçman	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
30	On Dokuç Mayıs	Faculty of Economics and Administrative Sciences	Statistics for Economics 1	Statistics for Economics 2
31	Sakarya	Faculty of Economics and Administrative Sciences	-	-
32	Seğülük	Faculty of Economics and Administrative Sciences	Statistics	-
33	Tatlıca	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
34	Uludağ	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
35	Van Yüzüncüyıl	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
36	Yıldız Teknik	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2

Note: This table was created by visiting the web cites of the related universities (data accessed: 10.10.2014).

Table 2. Statistics Courses Taught in Department of Business Administration in Turkish Universities

No	University	Faculty	Course Name	Course Name
1	Abant İzzet Baysal	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
2	Adnan Menderes	Nazilli Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
3	Afyon Kocatepe	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
4	Ardahan	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
5	Ardahan	Alanya Faculty of Business Administration	Statistics 1	Statistics 2
6	Aksaray	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
7	Anadolü	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
8	Ankara	Faculty of Political Sciences	Statistics	-
9	Balıkesir	Burdur Faculty of Economics and Administrative Sciences	Management Statistics	-
10	Balıkesir	Faculty of Economics and Administrative Sciences	Management Statistics	-
11	Bartın	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
12	Baskent	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
13	Bilkent	Faculty of Business Administration	Introduction to Prob. And Statistics 1	Introduction to Prob. And Statistics 2
14	Bogaziçi	Faculty of Economics and Administrative Sciences	Management Statistics 1	Management Statistics 2
15	Cebeli Bayir	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
16	Cumhuriyet	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
17	Göküröva	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
18	Doğuz Eylül	Faculty of Business Administration	Statistics	-
19	Ege	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
20	Eskişehir Osmangazi	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
21	Firat	Faculty of Economics and Administrative Sciences	Statistics	-
22	Gazi	Faculty of Economics and Administrative Sciences	Statistics	-
23	Giresun	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
24	Hacettepe	Faculty of Economics and Administrative Sciences	Management Statistics 1	Management Statistics 2
25	İstanbul	Faculty of Economics	Statistics 1	Statistics 2
26	İstanbul Aydın	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
27	Karadeniz Teknik	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
28	Kırıkkale	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
29	Kırıkkale	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
30	Kocaeli	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
31	Marmara	Faculty of Business Administration	Statistics	-
32	Mıgla Sıtkı Koçman	Faculty of Economics and Administrative Sciences	Management Statistics 1	Management Statistics 2
33	On Doğuz Mayıs	Faculty of Economics and Administrative Sciences	Statistics for Management 1	Statistics for Management 2
34	Sakarya	Faculty of Business Administration	Statistics	-
35	Seğuk	Faculty of Economics and Administrative Sciences	Statistics	-
36	Sinop	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
37	Trafiya	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2
38	Uludağ	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2 (Selective)
39	Van Yüzüncüyıl	Faculty of Economics and Administrative Sciences	Statistics	-
40	Yildiz Teknik	Faculty of Economics and Administrative Sciences	Statistics 1	Statistics 2

Note: This table was created by visiting the web sites of the related universities (data accessed: 10.10.2014).

The above two tables tell us that statistics courses neither in Department of Economics nor in Department of Business Administration are taught in three semesters. Simply, statistics courses are taught at most in two semesters in Department of Economics and in Department of Business Administration in Turkey. This finding does not match with the finding that “statistics courses should be taught in three semesters in Business and Economics Departments in Turkey” which was found in the study by Gürbüz and Uçan (2005). This can be interpreted as statistics educators’ opinions do not match with the number of semesters that statistics courses taught in Department of Economics and Department of Business Administration in Turkish Universities at the present time.

Another thing that the above two tables tell us that in some Faculties of Universities statistics courses are taught in one, less than one or none semesters. For instance, in the first table statistics courses taught just one semester in Economics Departments of Adnan Menderes, Dokuz Eylül, Fırat, Selçuk and Çukurova (Statistics 2 is selective course in Çukurova) Universities. Also, Sakarya University does not teach any statistics courses. Another example, in the second table statistics courses taught just one semester in Business Administration Departments of Ankara, Balıkesir, Dokuz Eylül, Fırat, Gazi, Marmara, Sakarya, Selçuk, Van Yüzüncü Yıl and Uludağ (Statistics 2 is selective course in Uludağ) Universities.

Although foreign societies put emphasis on statistics and Turkish statistics educators opinions are on the way that “statistics courses should be taught in three semesters in Business and Economics Departments in Turkey”, there exists a paradox in Turkish education system as we consider that statistics courses are taught in one, less than one or none semesters in Department of Economics and Department of Business Administration in Turkish Universities at the present time. At this point, intuitively, we ask ourselves that if more and more social courses take place in Turkish curriculums in place of some quantitative courses, what kind of effects does this create in the Turkish education system and what will be its reflections to the Turkish productive systems? These should be critical issues to be considered in minds for the competitiveness of our economy against opponent economies.

The above results that Gürbüz and Uçan (2005) made out all depend on the opinions of statistics educators. Gürbüz and Uçan’s (2005) research can be interpreted as statistics educators give great value to the statistics education in their point of view. On the other hand, what about the demand of the possible audiences, namely the students? Do they give great value as do educators? To answer this question; at first the contingents of formal and

evening educations between 2010 and 2014 years were considered, then the number of registered students was evaluated for 2012 and 2013 years.

Following two tables below present these contingents for the statistics departments of Faculty of Arts and Sciences in Turkey between 2010 and 2014 years. In the first table, it is observed that for the formal education nearly most of the number of contingents for the statistics departments Turkish statistics departments of Faculty of Arts and Sciences in Turkey decreased in 2014. Worse than this, six universities (Başkent in 2011, Marmara in 2012, and Ufuk in 2013, İstanbul Aydın, İstanbul Ticaret, and Azarbeycan in 2014) stopped to admit students to their statistics departments of Faculty of Arts and Sciences. These six Universities are composed of 3 private (Ufuk, İstanbul Aydın and İstanbul Ticaret) and 3 government (Başkent, Marmara and Azerbaycan) Universities. In the second table, far worse than these, it is observed that all the evening statistics education of Faculty of Arts and Sciences stopped in Turkey in 2014. Unfortunately, all (thirteen) universities stopped to admit students to their statistics departments.

Table 3. First Degree Formal Education ÖSYM Student Contingents

No	University	Faculty	Department Name	2010	2011	2012	2013	2014	Mini Graph
1	Afyon Kocatepe University	Faculty of Arts and Sciences	Statistics	52	57	62	62	11	
2	Amasya University	Faculty of Arts and Sciences	Statistics	-	-	-	41	11	
3	Anadolu University	Faculty of Sciences	Statistics	82	88	93	93	62	
4	Ankara University	Faculty of Sciences	Statistics	62	67	72	72	52	
5	Bartın University	Faculty of Sciences	Statistics	-	-	-	-	11	
6	Baskent University	Faculty of Arts and Sciences	Statistics and Computer Sciences	35	-	-	-	-	
7	Bitlis University	Faculty of Arts and Sciences	Statistics	-	-	-	-	11	
8	Cumhuriyet University	Faculty of Sciences	Statistics	-	-	-	41	11	
9	Çukurova University	Faculty of Arts and Sciences	Statistics	72	77	82	82	53	
10	Dokuz Eylül University	Faculty of Sciences	Statistics	67	72	77	77	41	
11	Ege University	Faculty of Sciences	Statistics	72	77	82	82	82	
12	Eskişehir Osmangazi University	Faculty of Arts and Sciences	Statistics	72	77	82	82	57	
13	Firat University	Faculty of Sciences	Statistics	62	67	72	52	11	
14	Gazi University	Faculty of Sciences	Statistics	93	93	98	98	82	
15	Giresun University	Faculty of Arts and Sciences	Statistics	41	47	52	31	11	
16	Hacettepe University	Faculty of Sciences	Statistics	103	103	108	108	82	
17*	Istanbul Aydın University	Faculty of Arts and Sciences	Statistics	55	40	40	25	-	
18*	Istanbul Ticaret University	Faculty of Arts and Sciences	Statistics	30	30	25	15	-	
19	Karadeniz Teknik University	Faculty of Sciences	Statistics and Computer Sciences	41	47	52	52	52	
20	Kırıkkale University	Faculty of Arts and Sciences	Statistics	47	52	57	57	12	
21	Marmara University	Faculty of Arts and Sciences	Statistics	41	47	-	-	-	
22	Minar Sinan Güzel Sanatlar University	Faculty of Arts and Sciences	Statistics	62	62	67	67	67	
23	Muğla Sıtkı Kayman University	Faculty of Sciences	Statistics	52	57	62	62	32	
24	Necmettin Erbakan University	Faculty of Sciences	Statistics	-	-	-	41	11	
25	Öndokuz Mayıs University	Faculty of Arts and Sciences	Statistics	72	72	77	77	31	
26	Orta Doğu Teknik University	Faculty of Arts and Sciences	Statistics	47	47	52	52	41	
27	Selçuk University	Faculty of Sciences	Statistics	82	88	93	93	31	
28	Sinop University	Faculty of Arts and Sciences	Statistics	41	47	52	-	11	
29*	Ufuk University	Faculty of Arts and Sciences	Statistics	20	25	25	-	-	
30	Yıldız Teknik University	Faculty of Arts and Sciences	Statistics	82	88	93	93	72	
31	Yüzüncü Yıl University	Faculty of Sciences	Statistics	-	-	-	-	11	
32	Azerbaycan Devlet İktisat University	-	Statistics	20	20	20	20	20	

Source: www.osym.gov.tr

Notes: “*” symbol implies that the University is Private University. Here, Universities numbered 17, 18 and 29 are private.

Table 4. First Degree Evening Education ÖSYM Student Contingents

No	University	Faculty	Department Name	2010	2011	2012	2013	2014	Mini Graphs
1	Afyon Kocatepe University	Faculty of Arts and Sciences	Statistics	52	57	62	-	-	
2	Ankara University	Faculty of Sciences	Statistics	62	67	72	72	-	
3	Çukurova University	Faculty of Arts and Sciences	Statistics	72	77	82	72	-	
4	Dokuz Eylül University	Faculty of Sciences	Statistics	67	72	77	77	-	
5	Ege University	Faculty of Sciences	Statistics	72	77	82	82	-	
6	Eskişehir Osmangazi University	Faculty of Arts and Sciences	Statistics	72	77	82	82	-	
7	Firat University	Faculty of Sciences	Statistics	62	67	72	-	-	
8	Gazi University	Faculty of Sciences	Statistics	93	93	98	98	-	
9	Kırıkkale University	Faculty of Arts and Sciences	Statistics	47	52	57	-	-	
10	Muğla Sıtkı Koçman University	Faculty of Sciences	Statistics	-	57	62	52	-	
11	Ondokuz Mayıs University	Faculty of Arts and Sciences	Statistics	72	72	77	41	-	
12	Selçuk University	Faculty of Sciences	Statistics	-	88	93	41	-	
13	Sinop University	Faculty of Arts and Sciences	Statistics	-	47	52	-	-	

Following two tables presents the number of contingents and registered students for Statistics Departments in 2012 and 2013. This enabled us to make comparison between 2012 and 2013 years.

In the first table below, it is observed that out of 24 universities 15 universities statistics departments' contingents were fulfilled for the formal education in 2012. Students registered to all available contingents. On the other hand, out of 24 universities 9 universities statistics departments' contingents (Afyon Kocatepe, Fırat, Giresun, İstanbul Aydın, İstanbul Ticaret, Kırıkkale, Sinop, Ufuk Universities and Azerbaycan) were not fulfilled for the formal education in 2012. In the total 256 contingents of statistics formal education of Faculty of Arts and Sciences were unregistered in 2012.

In the first table below, it is observed that out of 25 universities 10 universities statistics departments' contingents were fulfilled for the formal education in 2013. Out of 25 universities 15 universities statistics departments' contingents (Afyon Kocatepe, Amasya, Cumhuriyet, Çukurova, Eskişehir Osmangazi, Fırat, Giresun, İstanbul Aydın, İstanbul Ticaret, Kırıkkale, Muğla Sıtkı Koçman, Necmettin Erbakan, Ondokuz Mayıs, Selçuk University and Azerbaycan) were not fulfilled for the formal education in 2013. In the total 523 contingents of statistics formal education of Faculty of Arts and Sciences were unregistered in 2013.

In the second table below, it is observed that out of 13 universities 5 universities statistics departments' contingents were fulfilled for the evening education in 2012. 8 universities statistics departments' contingents (Afyon Kocatepe, Çukurova, Fırat, Kırıkkale, Muğla Sıtkı Koçman, On Dokuz Mayıs, Selçuk and Sinop Universities) were not fulfilled for the evening education in 2012. In the total 446 contingents of statistics evening education of Faculty of Arts and Sciences were unregistered in 2012. On the other hand, none of them fulfilled out of 9 in 2013. In the total 365 contingents of statistics evening education of Faculty of Arts and Sciences unregistered in 2013.

Table 5. First Degree Formal Education ÖSYM Student Contingents and Registered Students for Statistics Departments

No	University	2012			2013		
		Contingent	Registered	Difference	Contingent	Registered	Difference
1	Afyon Kocatepe University	62	42	20	62	5	57
2	Amasya University	-	-	-	41	1	40
3	Anadolu University	98	93	0	93	93	0
4	Ankara University	72	72	0	72	72	0
5	Cumhuriyet University	-	-	-	41	-	41
6	Çukurova University	82	82	0	82	53	29
7	Dokuz Eylül University	77	77	0	77	77	0
8	Ege University	82	82	0	82	82	0
9	Eskişehir Osmangazi University	82	82	0	82	81	1
10	Firat University	72	24	48	52	6	46
11	Gazi University	98	98	0	98	98	0
12	Giresun University	52	9	43	31	3	28
13	Hacettepe University	108	108	0	108	108	0
14*	Istanbul Aydın University	40	10	30	25	11	14
15*	Istanbul Ticaret University	25	13	12	15	12	3
16	Karadeniz Teknik University	52	52	0	52	52	0
17	Kırıkkale University	57	45	12	57	5	52
18	Mimar Sinan Güzel Sanatlar University	67	67	0	67	67	0
19	Muğla Sıtkı Kocman University	62	62	0	62	27	35
20	Necmettin Erbakan University	-	-	-	41	5	36
21	Ondokuz Mayıs University	77	77	0	77	24	53
22	Orta Doğu Teknik University	52	52	0	52	52	0
23	Selçuk University	93	93	0	93	25	68
24	Sinop University	52	3	49	-	-	-
25*	Ufuk University	25	3	22	-	-	-
26	Yıldız Teknik University	93	93	0	93	93	0
27	Azerbaycan Devlet İktisat University	20	-	20	20	-	20
Total		1595	1339	256	1575	1052	523

Source: Çelikoğlu (2013).

Notes: "*" symbol implies that the University is Private University. Here, Universities numbered 14, 15 and 25 are private.

Table 6. First Degree Evening Education ÖSYM Student Contingents and Registered Students for Statistics Departments

No	University	2012			2013		
		Contingent	Registered	Difference	Contingent	Registered	Difference
1	Afyon Kocatepe University	62	1	61	-	-	-
2	Ankara University	72	72	0	72	65	7
3	Çukurova University	82	59	23	72	4	68
4	Dokuz Eylül University	77	77	0	77	36	41
5	Ege University	82	82	0	82	64	18
6	Eskişehir Osmangazi University	82	82	0	82	16	66
7	Firat University	72	-	72	-	-	-
8	Gazi University	98	98	0	98	65	33
9	Kırıkkale University	57	2	55	-	-	-
10	Muğla Sıtkı Koçman University	62	24	38	52	-	52
11	Ondokuz Mayıs University	77	14	63	41	1	40
12	Selçuk University	93	10	83	41	1	40
13	Sinop University	52	1	51	-	-	-
Total		968	522	446	617	252	365

Source: Çelikoğlu (2013).

5. RESULTS

It is clear that education will be changed by the technological tsunami. There is a new event called data revolution and a new kid in town called data science for statistics. Quantitative literacy and data revolution are very important concepts for developed countries. On the contrary, these signs can't be found in Turkey. Less statistics courses at the Business Administration and Economics Departments of Faculty of Economics and Administrative Sciences and the closure of statistics departments can be interpreted as a downgrade in the importance of statistics and this is a paradox for statistics education in Turkey. All the developed nations of the world, for their educational activities and for empowering their technological levels and competency are focusing on topics like big data, statistics, data and text mining, machine learning, network science, software like R and Python. On the contrary, in Turkey we are observing statistics department closures and trimming the quantitative parts of the curricula in higher education. Some of the specific results that can be concluded are ordered as follows:

1. Statistic courses must be taught in the Business and Economics departments (Gürbüz and Uçan, 2005).
2. Depending on the research by Gürbüz and Uçan, (2005) statistics courses should be taught in three semesters in Business and Economics Departments in Turkey.
3. Statistics educators' opinions in Gürbüz and Uçan's (2005) study do not match with the number of semesters that statistics courses taught in Department of Economics and Department of Business Administration in Turkish Universities at the present time.
4. Although foreign societies put emphasis on statistics and Turkish statistics educators opinions are on the way that "statistics courses should be taught in three semesters in Business and Economics Departments in Turkey", there exists a paradox in Turkish education system as we consider that statistics courses are taught in one, less than one or none semesters in Department of Economics and Department of Business Administration in Turkish Universities at the present time. Statistics courses taught just one semester in Economics Departments of Adnan Menderes, Dokuz Eylül, Fırat, Selçuk and Çukurova (Statistics 2 is selective course in Çukurova) Universities. Also, Sakarya University does not teach any statistics courses. Statistics courses taught just one semester in Business Administration Departments of Ankara, Balıkesir, Dokuz Eylül, Fırat, Gazi, Marmara, Sakarya, Selçuk,

Van Yüzüncü Yıl and Uludağ (Statistics 2 is selective course in Uludağ) Universities.

5. The formal education nearly most of the number of contingents for the statistics departments Turkish statistics departments of Faculty of Arts and Sciences in Turkey decreased in 2014.
6. Six universities (Başkent in 2011, Marmara in 2012, and Ufuk in 2013, İstanbul Aydın, İstanbul Ticaret, and Azarbeycan in 2014) stopped to admit students to their statistics departments of Faculty of Arts and Sciences.
7. All the evening statistics education of Faculty of Arts and Sciences stopped in Turkey in 2014.

These results (5, 6 and 7) conclude that the demand for the Turkish Statistics Departments of Faculty of Arts and Sciences is decreasing. Therefore, the numbers of statistics department of Faculty of Arts and Sciences contingents compulsorily were reduced and some of the departments were closed (6 departments for the formal education, 13 departments for the evening education) in Turkish Universities. Çelikoğlu (2013) detected the troubles that statistics departments will face in the close future and he made some suggestions in the 8th International Statistics Congress in Antalya, Turkey with his presentation. Some of his suggestions were: (1) Evening educations should be closed urgently. (2) Formal education contingents should be decreased. (3) New statistical departments shouldn't be constituted.

1. In the total 256 contingents of statistics formal education of Faculty of Arts and Sciences were unregistered in 2012. In the total 523 contingents of statistics formal education of Faculty of Arts and Sciences were unregistered in 2013.
2. In the total 446 contingents of statistics evening education of Faculty of Arts and Sciences were unregistered in 2012. In the total 365 contingents of statistics evening education of Faculty of Arts and Sciences unregistered in 2013.

In general, these results indicate that Turkish Statistics Departments were not given value deservedly by the possible audiences or students in Turkey. There can be several reasons why the Turkish Statistics Departments were not preferred by the Turkish possible audiences. These issues are out of the scope of this study. However, intuitively we may say that if individuals (especially students) continue to look at the numbers like enemies; do they know what kind of costs will they face on the short and the long run? On the other hand, when it is compared to other courses at the department of social sciences, statistics courses rely on more graphical and symbolical

representations. Unfortunately, a large part of this population prefers verbal information (Schuyten and Dekeyser, 1998: 714). This emphasizes the importance of learning skills that will affect verbal and non-verbal students.

In this context, Gal (2004: 6) assesses this issue in a positive point of view with following words:

*“Certain beliefs and attitudes influence individuals’ critical stance and willingness and ability to take action in response to statistical information. Adults should develop a positive view of themselves as individuals capable of statistical and probabilistic reasoning as well as a willingness and interest to **think statistically.**”*

It is important for people who work at universities, industry and public to use statistical thinking (Gürbüz and Uçan, 2005: 111). Simply, statistical thinking enables people to cope with real world problems by using statistical methods. Statistical computer package supports the component mental activities of statistical thinking (Schuyten and Dekeyser, 1998: 716). In addition to this, project-like work has a better impact on students’ attitude toward scientific quantitative research (Schuyten and Dekeyser, 1998: 716).

REFERENCES

- Cox, D. R. (1998), “Some remarks on statistical education”, *The Statistician*, 47(1), s. 211-213.
- Çelikoğlu Can Cengiz, (2013), “İstatistik Bölümlerinin Bugünü ve Geleceğe İlişkin Öneriler”, **8. Uluslararası İstatistik Kongresi**, 27-30 Ekim, Göynük, Antalya.
- Davenport, Thomas H., and Patil D.J. (2012), “Data Scientist: The Sexiest Job of the 21st Century”, *Harvard Business Review*, The Magazine, s. 70-76.
- Demir, Ali Mehmet. (2014), “Eczanede Casus var”, *Vatan Gazetesi*, 28 Nisan Pazartesi.
- EPSRC Report. (2010), Subfield of Mathematical Sciences. *International Review of Mathematical Sciences Report*, 5-10 December.
- Franklin Christine, Kader Gary, Mewborn Denise, Moreno Jerry, Peck Roxy, Perry Mike, and Scheaffer Richard, (2007), “Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report”, *American Statistical Association Report*.
- Gal, Iddo, (2004), “A Brief Look at Statistical Literacy”, *Math Practitioner*, 10(2), s.4-8.
- Gal, Iddo and Garfield, John. (1997), “Curricular Goals and Assessment Challenges in Statistics Education”, in Gal, Iddo and Garfield John (Eds.), *The Assessment Challenge in Statistics Education*, s. 1-13.

- Garfield Joan and Ben-Zvi Dani. (2007), “The Discipline of Statistics Education”, in ***Developing students' statistical reasoning: connecting research and teaching practice***. Emeryville, CA: Key College Publishing (in press).
- Gürbüz, Esen and Uçan, Okyay (2005), “İşletme ve İktisat Bölümlerinde İstatistik Eğitiminin Verilme Düzeyi: Türkiye Üniversiteleri Araştırması”, ***Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakülte Dergisi***, 19(2), s. 109-125.
- Gürsakal Necmi , (2014), ***Büyük Veri***, Genişletilmiş 2. Baskı, Dora Yayınları, Bursa.
- Gürsakal Necmi, Gürsakal Sevda and Murat Dilek. (2014), “Statistics and the Others”, ***9th International Statistics Day Symposium***, 10-14 May, Antalya, Turkey.
- Lai Leung Tze. (2013), “Data science, statistical modeling, and financial and health care reforms”, ***Notices of the International Congress of Chinese Mathematicians (ICCM)***, 1, s. 47–57. doi: 10.4310/ICCM.2013.v1.n2.a6.
- Lane M. David, and Peres Camille S. (2006), “Interactive Simulations in the Teaching of Statistics: Promise and Pitfalls”, ***Proceedings of the 7th International Conference on the Teaching Statistics***, Salvador, Brazil.
- Langmore Ian and Krasner Daniel. (2013), “Applied Data Science”, Columbia University Applied Data Science, Free book, Erişim Tarihi: 28.09.2014, <http://columbia-applied-data-science.github.io/appdatasci.pdf>.
- Lohr Steve, (2009), “For Today’s Graduate, Just One Word: Statistics”, ***New York Times Technology***, August 5.
- Nihalani Priya, and Mayrath Michael. (2010), “Mobile Learning: Evidence of Increased Learning and Motivation from using an iPhone App.”, ***Mobile Learning Equity Report***, August.
- Piatetsky, Gregory. (2014), “Exclusive Interview: Peter Bruce, President Statistics.com”, ***KDnuggets***, April 16, Erişim Tarihi: 28.09.2014, <http://www.kdnuggets.com/2014/04/exclusive-interview-peter-bruce-president-statistics-com.html>).
- Schuyten Gilberte and Dekeyser Hannelore. (1997), “Computer Software in Statistics Education: Students views on the impact of a computer package on affection and cognition” In: J.B. Garfield, G. Burvill (Eds.), ***Research on the Role of Technology in Teaching and Learning Statistics***, s. 207-217, Voorburg, The Netherlands: International Statistical Institute.
- Schuyten Gilberte and Dekeyser Hannelore. (1998), “An Electronic Learning Environment for Applied Statistics: Quality Care and Statistics Education in Higher Education”, ***Proceedings of the 5th International Conference on the Teaching Statistics***, Singapore.
- Steen, Arthur Lynn (2001), Embracing Numeracy, in Steen Arthur Lynn (Ed.), ***Mathematics and Democracy: The Case for Quantitative Literacy***, The National Council on Education and the Disciplines, USA, p.p. 107-117.
- The Quantitative Literacy Design Team, (2001), The Case for Quantitative Literacy, in Steen Arthur Lynn (Ed.), ***Mathematics and Democracy: The Case for***

Quantitative Literacy, The National Council on Education and the Disciplines, USA, p.p. 1-23.

Thompson, Kelvin. (2011), "7 Things You Should Know about MOOCS", *Educause Learning Initiative (ELI)*, Erişim Tarihi: 28.09.2014, <http://net.educause.edu/ir/library/pdf/eli7078.pdf>.

Tishkovskaya Svetlana and Lancaster A. Gillian. (2012), "Statistical Education in the 21st Century: a Review of Challenges, Teaching Innovations and Strategies for Reform", *Journal of Statistics Education*, 20(2), s. 1-56.

Vere-Jones, David. (1995), "The coming of age of statistical education", *International Statistical Review*, 63(1), s. 3-23.

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