

Operations Research/Management Teaching on Turkish Undergraduate Business Programs

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ABSTRACT: Operations Research is a compulsory course that taught many universities at the department of Business Management/Administration as Black Sea Region Universities in Turkey. Survey studies, and students feedback, and experience of teachers show that business students are lacking motivation in studying with mathematics-based lessons as OR. In this study, an exploratory investigation was made of Operations Research teaching on the Turkish Bachelors Programs courses of six Turkish Business Schools, which supply information for program developers, teachers and trainers. The results of research in terms of the position of Operations Research courses in the curriculum, the name assigned to this course, its objectives, contents, teaching methods, text-books used, assessment methods, prerequisites, expectations, obstacles and related lessons has been put down and commented. The comparison of Operations Research courses in different universities will be helpful to all Operations Research faculty who teach this type of courses and particularly those who are looking for ideas on how to re-design courses.

Keywords: Operations Research, Teaching, Turkish Universities

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I. INTRODUCTION

While there is no consensus on the definition of Operation Research/Operations Management (OR/OM), many different definitions have been made so far. Churchman et al. (1957) defines Operations Research (OR/OM) as the application of scientific methods, techniques, and tools involving the operations of systems to provide those in control of the operations with the optimum solutions to the problems. On the other hand, Blumenfeld et al. (2004) defines OR/OM as the science of making decision, which provides a systematic and scientific approach to various government, military, and manufacturing operations. So as a general definition, OR/OM can be defined as an analytical method of problem-solving and decision-making which is used especially in the management of business and firms. Analytical methods used in OR/OM cover mathematical application, simulation, linear programming, queuing theory, network analysis, and game theory. The importance taking decisions in an objective, scientific, and more accurate way in Operational Research in Business Management is indisputable. From this point of view, the effectiveness of businesses and countries in using these techniques is even more important in the global world where competition is very high and devastating. In developed countries such as US, Germany and Japan, OR/OM has progressed a certain advanced level but its use of in developing countries has been limited. Since OR/OM contributes significantly to the development of all countries, the development and use of OR/OM are directly related to OR/OM education and teaching. OR/OM education should involve and make emphasis of the subject application, practice the students in case exercises, provide case studies and projects with other partners Luck and others (1990). In developed countries, closely monitoring the OR education and determining the problems will contribute positively to the development of this field and hence the country. White et al. (2011) state some of the developing countries problem on OR education as follows;

- Although there are many OR/OM courses in the developing countries, those who teach these courses may not have relevant practical experience in applying OR/OM to practical problems of the developing countries
- Many academic institutions do not have a connection to business, commercial and or governmental organizations and communities.

To the best of our knowledge, although OR/OM teaching has been the topic of numerous studies in the US, UK and some other nations, e.g. Japan, United Arab Emirates, there is almost no published international article on Turkish OR/OM teaching. From this point of view and to fill this gap, this research can be seen a worthy study in the field of OR/OM. In this study, the concept of operational research will be used as a concept in quantitative methods and production management which we can broadly call as optimization and decision-making techniques.

The goals of the research were defined as make a portrait and discussions of OR/OM education in Turkey' Black Sea Region via six faculty at six different business departments, who were asked which status of OR/OM teaching at their school. The status of OR/OM education asked via a survey taken by Goffin (1998) and adapted to this study.

The main research questions of the study are the following:

- 1) How is OR/OM taught on full-time Bachelors courses at six Black Sea Region business schools in Turkey? What principals are there to:
 - i) Course content?
 - ii) Teaching methods?
 - iii) Assessment methods?
 - iv) Integration of OR/OM with other subjects?
- 2) What are the opinions of OR/OM faculty on the key difficulties they faced in teaching the subject?

II. LITERATURE REVIEW

There many research on OR/OM education for different countries while most of them were done in Europe Countries or United States of America. Since it is difficult to express all of them here, some prominent studies and their results will be given.

Belton and Scott (1998) studied on processes of education and learning in OR/OM rather than course content. They consider the use of more Independent Learning (IL) in Operational Research education and an explanation of IL. Using three case study activities that encourage IL, they encourage educators to use it in OR/OM education and show the effectiveness of IL in OR/OM.

Adeleke (2015) examined the relevance of operations research experts in the teaching of Business Education in the Colleges of Education in Nigeria by looking at the NCCE (National Commission for Colleges of Education) Business education minimum requirements structure. By giving a few examples on modelling and simulating, they want to present how the use of models can be used to stimulate students' interest into translating real business system into mathematical and schematic models and back to real life of business world. Thus, they make emphases on the importance of skills of modelling for operation research experts, as well teachers.

Yousef (2011) searched the related literature on OR/OM in the Arab world published during the last three decades. The inferences drawn from the literature survey on OR/OM in the Arab World were that publications concerned with OR/OM in the Arab world were classified into three main categories, namely, survey-type studies, real-world applications, and conceptual studies. Additionally, based on the survey of the literature, they concluded that the number of publications has increased substantially during the 1990s and 2000s.

White et al. (2011) tried at providing an overall picture of the state of OR/OM in the developing countries, whether OR/OM in developing countries is different to OR/OM in the developed countries, and whether a review of OR/OM in developing countries is useful for the subject in general. They concluded that OR/OM can make important contributions to improved decision making in developing countries, but there are some of topics which should be clarified. They are the clear definition of a developing country, the definition of OR/OM in developing countries, and lastly what counts as development.

Paucar-Caceres and Pagano (2011) reviewed the development of OR/OM in business education and how much space is included to the OR/OM courses in business education of undergraduate business courses and MBA courses in the UK.

Ormerod (2010) done a research that around of the question how can the methods of OR/OM be justified? He made discussions about the justification of OR/OM methods, values and methodologies. He suggested the content of each level of the hierarchy for both OR/OM academic research and OR/OM practice and concluded that that for OR/OM academic research justification lies behind in the fields under which the researcher selects to work: mathematics, science, or social science.

Moazeni (2012) suggests five strategies to progress the teaching of OR/OM skills which are essential for students in practical fields. Teachers should use an optimal level of each of the teaching strategies considering the background of the students and their expectations from the course.

Kušen and Marinović (2013) conducted a survey to search in which measure the designed activities helped students learn OR/OM topics. They designed a set of activities to explain complex and abstract mathematical concepts of the OR/OM in a more understandable manner. Students were satisfied with their approach and the results of the computer lab class exams were evidently better than the ones in the previous two academic years.

Cochran (2009) reviewed the history of operations research pedagogy and the progress the discipline has made in improving the quality of education to college students. Also, he examined recent and current trends and ongoing activities and initiatives in OR/OM pedagogy, and took into account implications for the future of operations research.

Thanasis and others (2005) presented a new tool that serve in teaching some OR/OM topics, especially graphs algorithms. They provided the visualization of algorithms to enhance students' imagination and learning on OR/OM. They finally explained the benefits and drawbacks of the tool in OR/OM education and made suggestion on potential future work.

III. HIGHER EDUCATION SYSTEM IN TURKEY

In Turkey, the higher education system is administered by an institution called the Higher Education Council (YÖK). YÖK is an autonomous institution and is responsible for managing planning, coordination and higher education management according to higher education laws and constitution. Universities constitute their own academic calendars and the academic year usually starts in September and ends in June. Winter and summer holidays are available. Some universities also have summer schools. Opportunities offered by Turkish universities;

- * Associate degree programs
- * Undergraduate programs
- * Graduate programs
- * Post-doctorate programs

Associate degree programs: Associate degree programs last 2 years. Associate degree graduates can obtain a bachelor's degree without entering a central examination.

Undergraduate programs: Undergraduate programs are usually 4 years. Some special programs like medicine can take up to 6 years and more.

Graduate programs: Graduate programs in Turkey are very diverse. Thesis master's degree lasts for 2 years and for non-thesis graduate, it takes 18 months. Ph.D. programs last about 4 years (<http://www.yok.gov.tr/web/uluslararasi-iliskiler/turkiye-de-yuksekokretim-sistemi>)

IV. METHODOLOGY

4.1. Sample and Data Collection

The population of this study was all business schools offering a bachelor degree in business and accredited by the Higher Education Institution in the Black Sea Region of Turkey, these schools are public. Total number of accredited business schools offering a bachelor degree in business in the Black Sea Region as of 2017 was about 6 schools. These schools are located in different cities. Data for this study consists of three sections. These are institutional information, operations research course information and opinions and suggestions. Data were collected through direct contact with these schools, interviewing instructors teaching OR/OM courses. For the purpose of confidentiality, the names of the participated institutions and instructors are not revealed.

4.2. Analysis

For collecting data, a survey has prepared. This survey's questions were designed to explore the nature and scope of Operations Research teaching at Turkey's Black Sea Region Universities. Developed electronic survey tool was sent to all Black Sea Region University instructors identified as delivering an Operations Research module on bachelor degree programs. The empirical findings are based on surveys returned by 6 university Operations Research lecturers. Owing to the nature of this exploratory study, and the non-numerical data collection this study has adopted qualitative approach to analyze the collected data.

4.3. Research Limitations

This study like any other study in the social sciences suffers a few limitations. For instance, this study is based mainly on OR/OM course syllabus as a style of getting the required data. Therefore, if other modes of data collection were used, more advanced analysis techniques could be applied, and the results of the study might be enhanced. Also, this study is based mainly on the point of views of the instructors teaching OR/OM course and consequently omitting the opinions of the students taking the course.

Although the study is comprehensive in terms of coverage area, there are a lot of field which were not discovered which would add value to future studies in this field. Among the limitations of the study, the application area of the study could be expanded. However, the study was conducted in the coverage area of the Western Black Sea Regional Universities. Due to time and financial reasons it could not been expanded.

It could be transformed into a quantitative data analysis survey with a questionnaire prepared in a different format and the study could be modeled by the content analysis approach. In the study, qualitative research method has been adopted in terms of research type. In terms of analysis, a descriptive analysis approach was also preferred.

V. RESULTS

5.1. In Terms of the Name and Compulsory of Lesson

When examining the data of the study, it is understood that some of the OR/OM courses taught in the business departments of the relevant universities are compulsory. This situation prevents students from forming a common sense.

Table. I Name and Compulsory Information of the Course at the Relevant Universities

Institution	Name of Lesson	Compulsory	Be compulsory
1	Operational Research	✓	✓
2	Operational Research	✓	✓
3	Numerical Methods		
4	Quantitative Decision Making		
5	Operational Research		✓
6	Operational Research	✓	✓

As seen in Table I, the name of the course is % 67.7 Operational Research and % 33.3 other names. In addition, it is stated that Operational Research courses are % 50 compulsory and % 50 elective in terms of current requirement. Again, in Table I, in response to the question that this course is (must be compulsory; 67.7% answered yes and 33.3% answered no).

5.2. Course Objectives

The Business Administration departments of the universities mentioned in the study have different specific aims. Table II summarizes the objectives of OR/OM course as assigned by different universities offering this course.

Table. II Information about the Aims of the OR/OM Course for the Related Universities

Institution	To provide the theoretical knowledge required by the course	To gain practical curriculum of OR/OM	Mainly provide computer aided education in OR/OM	Focus on the history and practice of OR/OM training
1	✓			✓
2	✓	✓	✓	
3	✓	✓		✓
4	✓		✓	
5	✓	✓		
6	✓	✓		

When Table II is examined carefully; it is clear that all the universities have a common aim to provide the curriculum required by the steering research. 66.7% of the relevant universities both agree that they need to know in detail the applications of operational research only. In addition, 33.3% of the relevant universities advocate that computer-aided operational research training should be provided, while 33% insists on focusing on the history and applications of the operations research.

5.3. Course Contents

When the data obtained from the point of view of the subjects covered in the OR/OM course are examined, it is seen that some of the common subjects were mainly studied in the operating departments of the relevant universities. This common behavior is very promising in terms of students and OR/OM education.

Table III. OR/OM Course Contents

Institution	Decision theory	Linear prog.	Simplex method	Duality and sensitivity	Assignment and transportation problems	Integer prog.	Target prog.	Game theory	Simulation	Queuing theory
1	✓	✓	✓	✓	✓			✓	✓	
2	✓	✓	✓	✓		✓		✓		✓
3	✓	✓	✓	✓	✓	✓	✓		✓	✓
4	✓	✓	✓	✓	✓			✓		
5	✓	✓	✓	✓	✓	✓			✓	✓

6 ✓ ✓ ✓ ✓ ✓ ✓ ✓

According to table III; decision theory, linear programming and simplex methods are taught throughout the business departments of universities in the Western Black Sea Region. This might be due to the fact that those techniques are widely used in practice to solve a variety of problems whether in manufacturing or in-service organizations. Additionally, those techniques are appropriate for the problems in developing countries. In addition, 83.3% of the issues on duality-sensitivity, assignment and transportation are covered. Integer programming, game theory and simulation topics are taught in 50% of the relevant universities. While the theory of queuing is taught in 66.7% of the relevant universities and only 33.3% of the goal programming subjects are taught.

5.4. Teaching Methods

Different teaching methods are used in teaching OR/OM course at different universities in Black Sea Region offering this course.

Table IV. OR Course Teaching Methods

Institution	Lecture Method	Case Study	Videos	Speakers	Games	Technical Visits	Presentations
1	✓	✓					✓
2	✓	✓	✓				
3	✓	✓	✓				✓
4	✓					✓	
5	✓			✓			✓
6	✓						✓

Table IV presents teaching methods used in teaching OR/OM courses. It seems that lectures are still using the active teaching method in OR/OM course in relevant universities. This is because lecture is still considered as the most appropriate method for presenting both quantitative and qualitative aspects of the topics covered in this course. In addition, among the different methods of teaching; case studies are 50%, videos 33.3%, speaker calls 16.7%, technical trips 16.7%, presentations 66.7%.

5.5. Text-book Used

Table V presents text-books adopted in OR/OM course at Black Sea Region University Business Sections offering this course. As it is obvious from the information presented in Table V, different text-books are used for OR/OM course at relevant universities offering this course. But, by examining the relevant books these text-books almost cover the similar subjects.

Table V. Text-book Used for OR/OM Course

Institution	Mehpare Timor OR/OMBook	Ahmet Öztürk OR/OMBook	Hamdy Taha OR/OMBook	Lieberman OR/OM Book	Wayne Winston OR/OMBook	E. Johnson OR/OMBook	Lecturer Notes
1		✓	✓	✓		✓	✓
2	✓		✓				✓
3		✓	✓	✓			
4		✓	✓				
5		✓	✓	✓			
6		✓	✓	✓	✓		✓

Different text books are used in relevant universities. Among them; Mehpare Timor OR book 16.6%, Ahmet Öztürk OR book 83.3%, Lieberman OR book 66.7%, Winston and Johnson OR book 16.6% and lecturer notes 50 % are used in courses.

5.6. Assessment Method

In Table VI expressed explicitly; the main assessment method used to assess students' performance in course is exams. In the course of operations research in all Black Sea Region University Business Sections, examinations are frequently used in assessing the performance of students.

Table VI. OR/OM Course Assessment Methods

Institution	Exams	Homework	Projects	Attendance
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1	✓	✓		✓
2	✓		✓	
3	✓		✓	
4	✓			✓
5	✓	✓		
6	✓	✓		✓

In addition, there is a 50 %homework and attendance lesson for students to evaluate their performances. There is also 33.3% project assignment.

5.7. Prerequisite

Table VII exhibits pre-requisites for OR/OM course at different universities' business section offering this course.

Table VII. Prerequisites for OR/OM Course

Institution	Mathematics for Business	Statistics	Quantitative Decision Making	Basic Mathematics	Probability
1	✓	✓			
2		✓		✓	✓
3	✓	✓	✓		
4		✓		✓	✓
5	✓		✓	✓	✓
6		✓		✓	

As shown in Table VII, in terms of pre-requisite of operations research, statistics is 83.3% and business mathematics is 50%. In addition, basic mathematics is 66.7% and probability 50% is a prerequisite. Quantitative decision making with a minimum ratio (33.3%) provides the condition to be a prerequisite.

5.8. Related Lessons

A wide range of courses are offered in the relevant departments of different universities, with the OR/OM course. These are respectively; statistics, quantitative methods, quantitative decision making, decision theory and game theory.

Table VIII. Related Lessons for OR/OM Course

Institution	Statistics	Numerical Methods	Quantitative Decision Making	Decision Theory	Game Theory
1	✓				
2	✓	✓			✓
3	✓			✓	
4	✓		✓		
5	✓	✓	✓		
6	✓		✓		

When Table VIII is examined carefully, statistical lessons are given in the operating departments of all relevant universities. It is also taught in 50% of the relevant departments of the quantitative decision-making course. However, numerical methods are taught as 33.3% and decision theory and game theory as 16.6%.

5.9. Suggestion for Integration OR/OM with Other Discipline

When the results of the interviews conducted by the questionnaires of the relevant universities were evaluated, different approaches and preferences emerged as to how the integration of the OR/OM course with other disciplines should be. Among these approaches, it can be ordered that; case studies, calling speakers from practice, technical visits and theoretical knowledge are sufficient.

Table IX. Suggestions for Integration OR/OM with Other Disciplines

Institution	Case Study	Speakers from Application	Technical Visits	Theoretical Knowledge Suffices
1	✓		✓	✓
2	✓			✓
3	✓		✓	✓
4	✓	✓	✓	
5	✓	✓	✓	
6	✓			

According to Table IX; among the proposed approaches, case studies are most recommended at 100% rate. Also, technical visits are the second most recommended approach with 66.7%. However, the opinion that the theoretical knowledge is sufficient is 50%. The least recommended approach is 33.3%, which is the way the speakers are called from practice.

5.10. Obstacles

According to the questionnaire of the study conducted by the relevant universities of OR/OM lecturers, the teachers encounter some difficulties while giving this lesson. These difficulties can be listed as follows; similar courses have not been taken before, poor mathematical background, no or course package programs, computer availability is low, the difficulty of topics and anxiety about how to tell topics.

Table X. Difficulties Encountered during the Course of OR/OM

Institution	Poor Mathematical Background	Less Interesting for Students	Similar Courses have not Been Taken before	Computer Availability Is Low	No OR/OM Course Package Programs	Difficulty Of Topics	Anxiety About How To Tell Topics
1	✓		✓		✓		✓
2	✓		✓				
3	✓	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	✓	✓
5			✓	✓	✓	✓	✓
6	✓		✓			✓	

As stated in Table X, with the 100% ratio, it can be say that the same lessons have not been taken before as the difficulty most OR lecturers have encountered. Secondly, the most difficult challenge (83.3%) is that the mathematical background of the students is weak. The difficulty encountered at the third level is the lack of OR package programs with 66.7% and the anxiety about how to tell topics

5.11. Expectations

According to the results of the research conducted in the business departments of the relevant universities, it is understood that OR/OM course lecturers have some plans related to this course.

Table XI. From the Perspective of the Future of Operations Research in Related Universities

Institution	Weekly Hours Change	Set Prerequisites	Additional OR/OM Lessons
1		✓	✓
2	✓		✓
3			
4	✓		
5	✓	✓	
6			✓

However, when table XI is examined, it is not possible to draw a definitive conclusion about the future of OR/OM education. Because even the most inclined approach is supported by 50%.

VI. CONCLUSION

This study explored current status of OR/OMeducation at the Black Sea Region University Business Sections. In terms of the position of OR course in the curriculum, the name assigned to this course, its objectives, contents, teaching methods, text-books used, assessment methods, prerequisites, expectations, obstacles and related lessons. Based on the analysis of the collected data, it could be concluded that with respect to number of OR/OMcourses offered, only OR/OMcourse is not enough to provide graduates with the crafts required to tackle current problems using quantitative approach. OR/OM course should be a college basic course in all university business sections due to its significance to all functional areas of business. Instructors teaching OR/OM should place more focus on the use of case studies adopted from the business environment. Also, it provides on the use of projects to close the gap between theory and practice and provide students with the opportunity to apply what they have learned in class to business life problems. When the findings of the study are evaluated in terms of necessity of the OR/OM course, the common program of the business departments should be developed and made obligatory or elective in the whole of Turkey Universities.

If the results of the survey in the study are examined carefully, it is understood that books of Ahmet Öztürk and Hamdy Taha are mainly read in OR/OM courses. However, using of other sources will be beneficial in terms of the development of students. Since OR/OM is a multidisciplinary structure, it must be integrated with other disciplines. The most obvious way to do this is to carry out the current problems and events of different disciplines in lecture and to investigate the solutions for them. Regarding assessment methods used in OR/OM

course, it should be also focused on other methods of assessments such as, duties, presentations and projects. However, the weighted average of all tasks assigned to the students should be taken into consideration to determine their final grade.

According to the research findings on the difficulties encountered during the course of operations research, it was found that the students had not taken similar courses before and their mathematical background were weak. Overcoming these difficulties is possible with the taking prerequisite courses such as business mathematics and statistics before attending OR/OM courses.

This study has several impressive conclusions for researchers. They will be aware of current status of OR/OM education in the Turkey. This in turn might enable them to make better decisions regarding OR/OM courses in terms of objectives, contents, teaching methods, assessment procedure, etc. Current researchers can extract some suggestions from this study. Firstly, this study is a qualitative search, that's why in this topic depth and analytical research can be conducted. Secondly, comparison studies can be carried out with neighborhood countries of Turkey about OR/OM education. Thirdly, condition of OR/OM education studies can be carried out in engineering sections. Eventually, OR/OM education studies should carry out taking into students' views in Turkey.

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