

A FIRST OVERVIEW OF GOOD PRACTICES IN OR/MS EDUCATION

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ABSTRACT

This paper aims to describe and analyze the main characteristics of talks on OR/MS education about good practices topic, not only in order to determine the interest of this topic and its evolution over the recent years, but also to improve our understanding on this issue. We built up a database with information about the talks on OR/MS education presented in relevant national and international OR/MS and Education conferences within the period 2006–2011. Beyond the good practices in the education subjects of OR/MS, such as classroom approaches, courses design, and assessment, we also explored the application of OR/MS tools on Education, namely: Data Envelopment Analysis (DEA), Modeling, Scheduling/Timetables, Decision Support Systems (DSS), and Routing for school transportation. Then, we evaluated the developments on OR/MS education in the last half decade, observing what has been done, and describing the related applications and procedures. The result is a review of good practices that have been developed in this field, to gain insight on the recent enhancements of OR/MS education and outline some directions of improvement for the near future.

Keywords: OR/MS education; OR/MS tools; overview; good practices; conferences.

1. INTRODUCTION

In the last few years, there has been increasing interest within the Operations Research/Management Sciences (OR/MS) academic community into how to shape methodologies and approaches for enhancing education; for instance, as described by Teixeira et.al. [2011] for learns at the pre-university levels. Recently, Miranda and Teixeira [2011] also focused the Portuguese efforts involved on the Mathematics Action Program (*Plano de Acção da Matemática*) and considered its achievements and results in face of the Engineering Education needs.

In plus, Miranda [2011] addressed the quality and enhancements of OR/MS education from the point of view of the international cooperation and by sharing good practices. However, little effort has been made to examine the good practices and their attributes that are crucial to successful OR/MS education. The authors consider that further analysis is needed on these attributes and good practices, in order to provide better guidance to OR/MS teaching staff.

The purposes of this paper thus are to outline a first overview of the good practices in OR/MS education, to gain insight on the future directions of this field, and to draw some improvements from the most recent developments. The focus goes essentially to the works presented in OR/MS and Education conferences since 2006, both at national and international level. This is a seminal work on good practices in OR/MS education, which we intend to enlarge in a near future.

By their personal perception, the authors characterized the OR/MS good practices and identified the related key attributes, as follows:

- We selected the practices that were directly related to the education of OR/MS, like classroom practices, design and review of OR/MS courses and learning assessments.

- On the other side, we complemented the analysis by targeting Education issues that required the application of several OR/MS tools, for instance, DEA, Modeling, Scheduling/Timetables, DSS in education, and Routing for school transportation.

Although a significant number of OR/MS education enhancements have been presented in conferences during the last half decade, further developments and applications are still in need.

We have been building a database of the sessions/workshops and talks/posters in OR/MS education presented in relevant OR/MS and Education conferences during the period 2006-2011. The topic, the methodology and techniques analysis, as well as other important aspects of the talks were explored. The aim of this study is to analyze the main features of a series of conferences on the concept of OR/MS education that have been disseminated in some of the most prestigious OR/MS and Education events in the period 2006-2011.

This literature analysis is quite large and it must be delimited, so that the quantity and diversity of data do not prevent us of achieving our purposes. We should point out that we are only interested in those events that can be considered essential references in the OR/MS education field. Therefore, we have selected a set of relevant national and international series of conferences.

Furthermore, it is necessary to analyze works of good quality, so that our conclusions will be based on education, research and innovation developments that are observing good quality criteria. Thus, we have selected a group of conferences of renowned prestige among the national and international academic community, completing the selection with other events that are highly regarded in the area of OR/MS education

The structure of the paper considers: in Section 2, the methodology of the study is presented, targeting good practices and OR/MS education; in Section 3, the key subjects of this overview are described; and in Section 4, the main conclusions are presented.

2. METHODOLOGY OF THE STUDY

The sources of information required for the present research consist of a group of specialized conferences considered likely to include works in the OR/MS education field. We have selected sessions, workshops, talks, and posters, in the understanding that quality works tend to be presented in this type of conferences.

The next step was to select the scientific conferences that would be considered in this study. We opted to select the most prestigious conferences in the area of OR/MS and Education, both at international (global and European) and national (Portuguese and Spanish) level. We chose the topics ‘Good practices’ and ‘Operations Research and Management Science’, which we felt would be two of the most likely to include works on our focus upon OR/MS education.

As we pointed out earlier, our idea was to analyze those talks about aspects directly related to ‘Good practices’ in OR/MS education, in particular on the: *i)* OR/MS practices in the classroom; *ii)* design, implementation and review of OR/MS courses, and *iii)* students’ performance assessment in OR/MS subjects. We also analyze the application of OR/MS tools on Education, namely, DEA, Modeling, Scheduling/Timetables, DSS in education, and Routing for school transportation. With this in mind, we carried out a conference search using the terms ‘good practices’, ‘education’ and ‘operations research’/‘management sciences’ in the title, abstract or keywords of the talks appearing in the selected conferences during the period of analysis. We also conducted a manual survey of all the abstract books/proceedings because we noticed that some talks on the topics under study were included in streams not associated with these themes.

Our database reports to the following six series of conferences:

- *European Conference on Operational Research-EURO,*
- *Conference of the International Federation of Operational Research Societies-IFORS,*
- *International Conference on Engineering Education-ICEE,*
- *Congresso da Associação Portuguesa de Investigação Operacional-IO,*
- *Congresso Nacional de Estatística e Investigação Operativa-SEIO,*
- *Congreso da Sociedade Galega para a Promoción da Estatística e Investigación de Operacións-SGAPEIO.*

We consider twenty two conferences involving forty sessions/workshops and eighty eight talks/posters devoted to the theme of Education of OR/MS and thirty eight sessions/workshops and seventy six talks/posters devoted to the theme of OR/MS tools applied to Education. In Tables 1 to 7 the results appear in the following form: “data relative to Education of OR/MS” at the slash (/) left side; and in its right side, the “data relative to OR/MS tools applied to Education”.

Table 1: List of conferences

Conferences Series	Number of Conferences	Number of Sessions	Number of Talks
EURO	4	18/25	42/54
IFORS	2	12/4	27/10
ICEE	6	2/0	2/0
IO	4	4/7	12/10
SEIO	4	3/1	4/1
SGAPEIO	2	1/1	1/1
Total	22	40/38	88/76

We note that ICEE conferences are annual, while the others have different cadences. As the posters and workshops appear in a very small number, we decided to include them in talks and sessions, respectively. In particular, IFORS 2008 and EURO 2006 had two workshops each; in SEIO 2010 there were one workshop and one poster. Finally, in IO 2006 and SGAPEIO 2009 there were three posters and one poster, respectively.

On a brief analysis of the aggregated results on Table 1, we consider:

- The high interest of the OR/MS education subjects both in the EURO and IFORS conferences;
- The OR/MS education topic is addressed in ICEE conferences, but the application of OR/MS tools in education seems to be too specific for this conference series; in fact, ICEE considers various subjects of Engineering Education;
- A direct comparison between the Portuguese (IO) and Spanish (SEIO, SGAPEIO) conferences in OR/MS seems to indicate a more significant interest in the OR/MS education subjects in the IO conference series.

3. RESULTS OF THE STUDY

The six series of conferences here considered differ somewhat from each other in terms of main focus and dimension:

- One of them is generally targeting Education subjects (ICEE series), while all the others are specific OR/MS conference series; and
- Some are national conferences (IO, SEIO, and SGAPEIO series) and the others are international (EURO, ICEE, and IFORS series).

For these motives we decided to analyze the themes ‘Education of OR/MS’ and ‘OR/MS tools applied to Education’ separately for each series of conferences.

We observe that OR/MS education has experienced increasing interest in the period of analysis considered, a fact that is mainly reflected in the significant number of talks presented in the analyzed conferences (Tables 2 to 7). Analyzing the talks by research topic, we verify that during the period at hand (2006-2011):

- Four EURO conferences were held. The theme ‘Education of OR/MS’ included eighteen sessions and forty two talks; thirty one of them were about OR/MS practices in the classroom, other nine concerned the design, implementation and review of OR/MS courses, and two mentioned both topics. On ‘OR/MS tools applied to Education’ occurred fifty four talks within twenty six sessions; twenty eight talks were about DEA, six on Modeling, fifteen in Scheduling/Timetables, two in DSS, two in Routing for school transportation and one in Routing for school transportation and Scheduling.

Table 2: EURO conferences

Conferences	Number of Sessions	Number of Talks
EURO 2006	8/1	17/2
EURO 2007	2/7	5/18
EURO 2009	2/8	4/14
EURO 2010	6/10	16/20
Total	18/26	42/54

- Two IFORS conferences were organized with twelve sessions on ‘Education of OR/MS’; nineteen talks aimed OR/MS practices in the classroom, seven focused the design, implementation and review of OR/MS courses, and one mentioned both topics. On ‘OR/MS tools applied to Education’ occurred four sessions with eight talks related to DEA and two in DSS.

Table 3: IFORS conferences

Conferences	Number of Sessions	Number of Talks
IFORS 2008	4/3	8/6
IFORS 2011	8/1	19/4
Total	12/4	27/10

- Six ICEE conferences took place, including two sessions and two talks on OR/MS practices in the classroom.

Table 4: ICEE conferences

Conferences	Number of Sessions	Number of Talks
ICEE 2006		
ICEE 2007	1/0	1/0
ICEE 2008	1/0	1/0
ICEE 2009		
ICEE 2010		
ICEE 2011		
Total	2/0	2/0

- Four IO conferences have been organized. This series included four ‘Education of OR/MS’ sessions, eight talks on OR/MS practices in the classroom, one on design, implementation and review of OR/MS courses, and three talks on students’ performance assessment concerning OR/MS subjects. The theme ‘OR/MS tools applied to Education’ involved seven sessions with five talks in DEA, four in Scheduling/Timetables and one in Routing for school transportation.

Table 5: IO conferences

Conferences	Number of Sessions	Number of Talks
IO 2006	1/3	3/6
IO 2008	1/1	3/1
IO 2009	1/2	3/2
IO 2011	1/1	3/1
Total	4/7	12/10

- Four SEIO conferences were also held; including one session on ‘OR/MS tools applied to Education’ with one talk in Routing for school transportation, and three sessions on ‘Education of OR/MS’ with one talk on students’ performance assessment in OR/MS subjects and three talks aiming OR/MS practices in the classroom.

Table 6: SEIO conferences

Conferences	Number of Sessions	Number of Talks
SEIO 2006	0/1	0/1
SEIO 2007		
SEIO 2009	1/0	1/0
SEIO 2010	2/0	3/0
Total	3/1	4/1

- Two SGAPEIO conferences were organized, with one session both on ‘Education of OR/MS’ and on ‘OR/MS tools applied to Education’. Respectively, these sessions included two talks on OR/MS practices in the classroom and one talk on Routing for school transportation.

Table 7: SGAPEIO conferences

Conferences	Number of Sessions	Number of Talks
SGAPEIO 2007	0/1	0/1
SGAPEIO 2009	1/0	2/0
Total	1/1	2/1

Concerning the IFORS series (Table 3), the sessions on 'Education of OR/MS' are three times more than on 'OR/MS tools applied to Education', presenting the number of talks the same proportion. The SGAPEIO series (Table 7) only include one session in both themes, with two talks in 'Education of OR/MS' and one in the other theme. Although the four considered IO conferences (Table 5) present almost twice more sessions on 'OR/MS tools applied to Education' than on 'Education of OR/MS', the number of talks on both themes is similar. The SEIO series (Table 6) only include one session and one talk on 'OR/MS tools applied to Education', while the theme 'Education of OR/MS' has three sessions and four talks. The theme 'OR/MS tools applied to Education' doesn't appear on ICEE conferences (Table 4) held on the last half decade and they only include two sessions and two talks on 'Education of OR/MS'. Finally, the EURO series (Table 2) presents approximately 30% (20%) more sessions (talks) on 'OR/MS tools applied to Education' than on 'Education of OR/MS'.

We observe that EURO is the conference with the highest number of participants, over than two thousand; ICEE usually gathers between five and seven hundred of researchers and the other conferences present a number of participants quite inferior to five hundred, being SGAPEIO the smallest one. This difference in the dimension of the six analyzed conferences can, somehow, explain the difference in the number of sessions/talks that exist on both studied themes. This number is much higher in EURO and IFORS than in the other conferences. Another motif for the lack of 'OR/MS tools applied to Education' sessions in ICEE may be explained, as already mentioned, by the fact that this is a conference on engineering education, a very broader area, being the topics 'Education of OR/MS' and 'OR/MS tools applied to Education' too specific.

4. CONCLUSIONS

We analyzed the research on OR/MS education over the period 2006-2011, through the scientific talks appearing in relevant national and international conferences in the fields of education and OR/MS. It is important to note that throughout the study period, one notes an increase in the number of sessions/talks on both considered topics, which shows the growing interest of researchers in both subjects.

We can also conclude that during the last half decade:

- EURO and IO conferences focused more on the theme 'OR/MS tools applied to Education' than on 'Education of OR/MS', while
- The reverse situation occurred for the remaining conferences; no 'OR/MS tools applied to Education' talks appeared on ICEE series.

We should stress that our intention was to analyze the main characteristics of the research in OR/MS education, an ambitious task interacting with many other fields of research within engineering fields, management sciences, and exact sciences. This work is only the beginning of the authors research on the theme 'OR/MS Education'; they intend to continue the study of this issue, increasing both the time horizon under consideration and the topics to be addressed.

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