IEM@ProjectNetworking revisited: freshmen students closer to professional practice

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Abstract

This paper describes a challenge given to freshman students of the Integrated Master degree of Industrial Engineering and Management (IEM) – University of Minho, Portugal. It was developed in the context of the Integrated Project of Industrial Engineering and Management 1 (IPIEM1). First-year students were challenged to interview an Industrial Engineer, or someone with this function, in a company. That was the second time the challenge was proposed to students of this program, after the first time in 2013. The challenge, called "IEM@ProjectNetworking", has as main idea to allow students, on their own, to establish network with an IEM active professional and to get a full picture of what could be their future career. Students worked in pairs and had a semi-structured interview guide to help them to perform the interview. All interviews were synthetized in a written report and in a summary presented orally. Thirty-three interviews were conducted and assessed by a group of teachers and researchers. Teachers believe that by presenting this challenge, students will be more focused and aware of the contents given in the courses of the following semesters. At the same time, teachers obtain a perspective of what IEM professionals are doing and update their knowledge about industry needs. In fact, many findings were obtained with this challenge, namely: 1) a company database and the connection to IEM professionals for their future contact; 2) the stimulus of students' capacity of initiative; 3) the students learned how to prepare and conduct an interview, to communicate, to extract the most important from an interview; and; 4) the students acquire knowledge where they can work and the variety of functions which they may be engaged. The assessment was based on how the task was organised and accomplished (written report and oral presentation in pitch format). Based on the analysis of results obtained from an online survey applied to students and their feedback during the oral presentation, it is possible to state that the challenge has been mastered perfectly, with a "mission accomplished" feeling.

Keywords: Industrial Engineering and Management Education; Active Learning; Networking, Professional profile, Transversal competencies.

1 Introduction

Normally, first year students (freshman) of Higher Education Institutions do not know much about their future professional career. This is generally the case in Engineering Education programs but it became more visible in Industrial Engineering and Management (IEM) programs, as this engineering has been evolved from different sources (Pimentel et al., 2022). Also, in the future they could perform so many different functions by taking different roles in the companies, from production systems designers to health and safety experts.

The Institute of Industrial and Systems Engineers (IISE) defined Industrial Engineering as: "*… concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems.*" (IISE, 2022).

The IISE is composed of 14 knowledge areas: 1) Work design and measurement; 2) Operations Research & Analysis; 3) Engineering Economic Analysis; 4) Facilities Engineering & Energy Management; 5) Quality & Reliability Engineering; 6) Ergonomics & Human factors; 7) Operations Engineering & Management; 8) Supply Chain Management; 9) Engineering Management; 10) Safety; 11) Information Engineering; 12) Design & Manufacturing Engineering; 13) Product Design & Development and, finally; 14) System Design & Engineering. It is expected that IEM students acquire knowledge and act on these areas in their later future professional in

any type of company or organization, producing goods, services, or both. Furthermore, they must develop competencies that go beyond the knowledge, including the skills and attitudes. This means that skills such as communication, problem solving, critical thinking, teamwork, leadership, capacity of initiative, among others, must be part of their learning.

With so many areas, it is not a surprise that IEM students do not know what will be their role in the companies. Moreover, they need to understand the meaning of learning in such knowledge areas that are included in their curricular plans. Attending to this, a challenge was launched to the IEM first-year, first-semester students called IEM@ProjectNetworking. This activity was developed in the context of Project-Based Learning (PBL) as a milestone to accomplish in the Integrated Project of Industrial Engineering and Management course. The students organized themselves in pairs and had to conduct one interview with an Industrial Engineer or someone that had this role in a company located in the region. The objective of this paper is to present how the challenge was launched, planned and executed and to analyse and evaluate the results obtained by students.

The paper is structured in five sections. After this introduction, the study context and previous work are presented in section two. Section three presents the research methodology. Section four presents the results obtained by students and the main findings of the authors about this challenge. Main conclusions are presented in section five.

2 Study context and previous work

The PBL learning methodology is being used by Industrial Engineering and Management (IEM) program of the School of Engineering of the University of Minho (UMinho) since 2004 (Alves et al., 2020; Lima et al., 2007). From a formal structure without a project course (Alves et al., 2014) to the current one, a long path of 19 editions was carried out (Alves et al., 2021). Along this path, a lot of research and continuous improvement has been done (Alves et al., 2017; Alves & Leão, 2015). This included the challenge of IEM@ProjectNetworking that was developed, for the first time, in the context of the course of Introduction (or Topics) of Industrial Engineering and Management (Alves et al., 2013). The setting for the challenge of this academic year was different and it is explained next.

Imposed by government, this academic year of 2021_22 implied one more change: from a Master Integrated of five years (300 ECTS) it becomes a Bachelor of three years (180 ECTS). The setting up of this paper is based on the 2021-2022 curricular structure conducted at the UMinho, as represented in Figure 1. From Figure 2 it is possible to see that the six courses that are integrated in the curricular plan are from different schools and departments, having a Science, Technology, Engineering and Mathematics (STEM) structure.

Regime	Curricular Unit
Year 1	
S1	Calculus for Engineering
S1	Computer Programming I
S1	Integrated Project in Industrial Engineering and Management I
S1	Introduction to Economics Engineering
S1	Introduction to Industrial Engineering and Management
S1	Linear Algebra for Engineering

Figure 1. Curricular plan of IEM first-year, first semester, IEM11

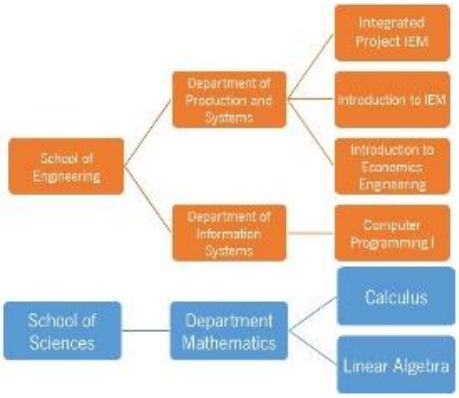

Figure 2. Schools and departments involved in the IEM11

The 67 students of this cohort were organized in eight teams of seven-nine members that need to develop a project in the context of the course Integrated Project in Industrial Engineering and Management I (IPIEM1), applying the contents learned in the five different courses. Each course has their own assessment methodology that includes a project component. Nevertheless, the contents of each course included in the IPIEM1 is assessed

in the presentations, reports, blog, prototypes, that the teams delivered to be assessed. Figure 3 shows the milestones of the IPIEM1 and the weight of each deliverable in the assessment methodology. Individual grade of each student is the result of (a) team grade influenced by a correction factor that result from the peer assessment (Fernandes et al., 2009; Fernandes et al., 2020; Uebe-Mansur & Alves, 2018) (90%) and (b) the grade obtained to the IEM@ProjectNetworking.

Ms	Week	Deliverable	Weight (%)
1	Week 2	1st presentation	not assessed
2	Week 6	2nd presentation	7,5 (team)
3	**Week 8**	**IEM@ProjectNetworking presentation**	**10 (individual)**
4	Week 11	Preliminary report	25 (team)
5	Week 13	Final report + Prototypes + blog	30 + 20 + 5 (team)
6	Week 14	Final presentation & discussion	12,5 (team)

Figure 3. Milestones (Ms) and weight of each in the assessment

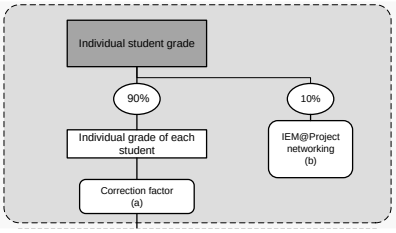

Figure 4. Individual grade of each student

3 Research methodology

The research methodology used by the paper authors to analyse the IEM@ProjectNetworking developed by the students was a content analysis of the interview transcriptions that were described in a report and personal reflections held by students in the oral presentation. Also, two questions related with this challenge were included in the survey that had been used to evaluate the PBL process every year (Alves et al., 2020). The non-parametric test Mann-Whitney (U) for comparison between the ranks of two independent samples, after verification of normality by Shapiro-Wilk test. The statistical software SPSS 28.0 was used for the analysis, and the effect is considered statistically significant for a p-value<α (the significance level).The process of data collection involved 67 students, who mostly worked in pairs, with 33 interviews conducted in a total of 37 companies.

The research involved the four authors of this paper, two of them teachers: one in the course of Introduction (or Topics) of IEM and simultaneously the coordinator of IPIEM1 and the other is coordinator of the course of Computer Programming 1. The other two research members had different roles in the project: one is tutor of a student's team and the other is an educational researcher. The four assessed different criteria defined for this challenge. The criteria considered were: 1) accomplishment of the interview guide topics; 2) reflection about the interview process; 3) auto-reflection; 4) accomplishment of the topic related to the information system; 5) assessment of the interview contents and finally, 6) accomplishment of the delivery conditions (deadline, all documents and audio/video delivered).

As defined by the criteria, the data considered in the findings focused on the reflections written by students concerning the overall process (before, during and after) of the experience of interviewing an IEM professional in their field, more than just simply describing the content of the interview. The students also discussed the main benefits and difficulties related to this experience. The assessment was based on how the task was organised and accomplished (written report and oral presentation in pitch format).

4 IEM@ProjectNetworking

This section describes the purpose of the IEM@ProjectNetworking challenge, the interview guide used and the results obtained.

4.1 Purpose

In the first stage, the challenge was presented to students with the main goal of explaining the purpose and what was expected from them. The main purpose was presented as:

- To develop proactive attitude;
- To develop awareness of the importance of entrepreneurial attitude.

Nevertheless, objectives also included:

- To bring students closer to their future professional practice;
- To develop a proactive and entrepreneurial attitude, student's initiative and communication competences;
- To develop a proactive attitude towards their own future as industrial engineering professionals;
- To develop awareness among the students on the importance of perseverance and proactive attitude;
- To create a network of contacts of IEM professionals and potential employers;
- To get familiar with IEM professionals point of view as well as with their role in the organizations.

4.2 Interview guide

To collect information from the IEM professionals, the interview was considered an appropriate method to give students a structured tool when approaching the companies. A semi-structured interview guide, adapted from an existing guide, included eight main sections:

1) Introduction, to inform about the interview objectives, highlight the importance of the collaboration, assure the confidentiality and ask for authorization to record the interview;
2) Interviewee profile, in order to know the academic and professional background;
3) Transition to workplace, in order to know the difficulties and expectations related to this issue;
4) Activities/functions held in the company, in order to understand what an industrial engineer is able to do;
5) Importance and recognition of the IEM profession, in order to analyse the employability issues, the advantages and disadvantages related to being an industrial engineer;
6) Personal satisfaction and professional achievement, in order to understand how professionals manage their time between personal and professional life;
7) Production Information system, to know more about the software used by the company, information needs, production management tasks supported by the information system, responsibilities of this task and access privileges;
8) Final observations, to give opportunity to the interviewees to add more information and acknowledge the availability.

The semi-structured interview guide document includes also some recommendations and tips of how to conduct an interview and some relevant literature regarding this topic. With this documentation in their hands, students had to select a company and manage to schedule an interview with an IEM professional with a relevant position in terms of production management. At the scheduled moment, students, in pairs, had to perform the interview, eventually make a small tour in the company and collect as much relevant data/information as possible. Finally, each student pair had to write a report presenting the interview results as well as a personal reflection on their experience of carrying out the interview and present the results in a five-minute oral presentation.

4.3 Results

As expected, this was not an easy task, not for the students neither for the authors that had to collect and assess 33 interviews, including the reports and audio/videos presented. For the authors, this task involved a high consuming-time, not considered in the workload defined for the project, that, normally, implies a high workload (Alves et al., 2009; Alves et al., 2019). Additionally, the content analysis of the report could conduct to different interpretations and unfair assessment between students grade but this is inherent to all other assessments(Fernandes et al., 2012, 2021) . Nevertheless, it is of general opinion that should be repeated every year, since it was assumed as teachers team task (Alves et al., 2021; van Hattum-Janssen et al., 2022). The students organized themselves to conduct the interviews, some online due to pandemic restrictions, others had the opportunity to visit the company and conduct the interview face-to-face. Difficulties reported by the students were, mainly, related with the time management, as they also complain about the time they dedicated to the IPIEM1. The presentation of the Project Networking took place in an online format by zoom (Figure 5).

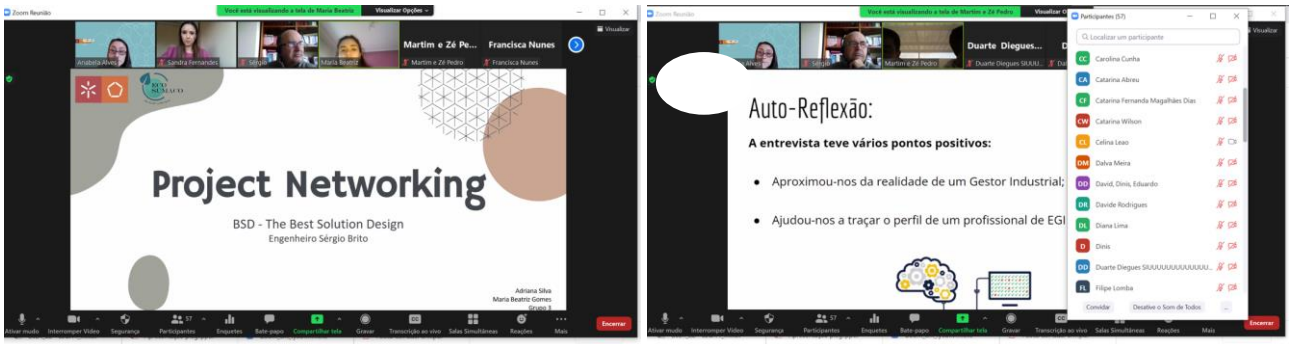

Figure 5. Some snapshots of the zoom session

Main findings from the report and reflections were grouped in four main topics that will be discussed in the following sections: 1) a company database and the connection to IEM professionals for their future contact.; 2) the stimulus of students' capacity of initiative; 3) the students learned how to prepare and do an interview, to communicate, to extract the most important from an interview; 4) the students acquire knowledge where they can work and type of functions they could perform. After the assessment all students obtained a grade higher than 16 (of 20) values.

The two sentences included in the PBL questionnaire that were related with this challenge, and evaluated on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

S1: "The IEM@ProjectNetworking project activity helped me to better understand my professional future."

S2: "I think the weight of the IEM@ProjectNetworking activity (10%) is adequate."

Based on the number of enrolled students, 72% (48 out of 67) voluntarily completed the questionnaire. The main descriptive statistics measures obtained are presented in Table 1, and the students' evaluation distribution for both sentences S1 and S2, by gender, illustrated in Figure 6.

Table 1. Main descriptive statistics obtained for S1 and S2 evaluation (F – female, M – male students).

Descriptive Statistics		**S1**	**S2**
n	F	33	34
	M	14	14
	Total	47	48
mean ± s.d.	F	4.88 ± .33	4.24 ± .82
	M	4.57 ± .65	4.21 ± .80
	Total	4.79 ± .46	4.22 ± ..81
median	F	5	4
	M	5	4
	Total	5	4
min	F	4	2
	M	3	3
	Total	3	2
max	F	5	5
	M	5	5
	Total	5	5

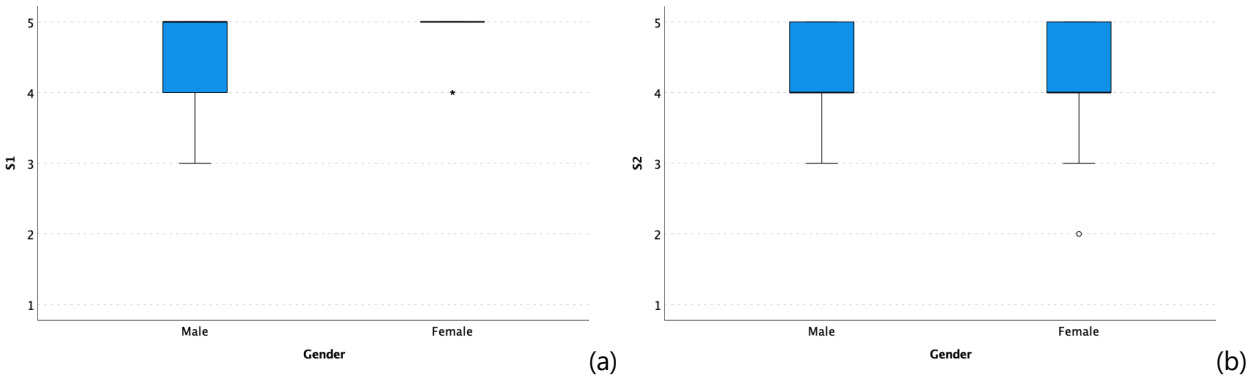

Figure 6. Students' evaluation for sentence (a) S1 and (b) S2, by gender.

Both sentences, S1 and S2, received a positive evaluation, with mean values higher than 4: 4.79 and 4.22, respectively (5 corresponds to strongly agree), with the highest value 5 and the lowest 3. Although slightly differences were observed between the evaluation distribution by gender, namely in sentence S1 with male students with slightly lower values, they are not statistically significance ($U=174.5$, $p>0.05$ for S1, and $U=232.0$, $p>0.05$, for S2). So, students in average considered that the IEM@ProjectNetworking project activity helped to better understand the future professional career.

4.3.1 Database of companies and networking expansion

As referred, 33 interviewes were conducted by students in groups of two, in a total of 37 companies (some students decided to conducted more than one interview and four interviewees were from the same two companies). These companies included international and national companies, small, medium-sized companies (SME) and large companies. Companies were from different sectors: textile, shoes, software development, eletronic components, comercial organizations, cooperatives among others. The interviewees belong to the following list of the companies:

1) PROEF
2) Farfetch
3) BSD - The Best Solution Design
4) Fermir
5) ACCO Brands Portuguesa
6) Bysteel (DST group)
7) Jordão Cooling Systems
8) BytePitch
9) Aldo Shoes
10) Bysteel (DST group)
11) GreenPelts Tannery Lda
12) Leica
13) Marley Spoon
14) BOSCH
15) FORteams LAB
16) Gewiss
17) Grupo M
18) Textil Manuel Gonçalves Sa-Automotive
19) AICEP
20) Custódio Castro Lobo
21) WIM
22) Cooperativa Agrícola de Boticas
23) AMOB
24) Tiajo
25) Leiper
26) Paul Stricker
27) Continental
28) BorgWarner
29) Amkor
30) Off Spin
31) Valerius têxteis SA
32) Caixindu
33) LASA
34) GKN
35) Texteis Penedo

All addresses and emails from the companies and interviewees were collected for future contacts. This interaction was also positive to strengthen the connection between the companies and the academy, as students played the role of academic ambassadors, fostering opportunities for future collaborations in terms of research and development activities. This networking with the companies also allow to the teachers to know a little more about perspectives of employers regarding the Industrial Engineers competencies.

It is worth emphasising that the process of contacting the company was the responsibility of the students. Some through a family member who knew an engineer and suggested contact or through conversations between them (students). Some of the interviewees are former students of the university and of the same IEM degree.

4.3.2 Stimulus of students' capacity of initiative

Related to the stimulus of students' capacity of initiative, all students developed this capacity. They were capable of contacting an engineer through their closer contacts (family, friends, among others) or someone

they knew and heard in university events or explore other possibilities. It is important to highlight that some pairs described the interviews in the team blog. Figure 7 presents some snapshots of two team blogs, where they described the whole process of conducting the interview .

Figure 7. Extract of two teams blogs snapshots of the interviews´ description

Besides a proactive attitude, students developed other transversal competences such as communication competences and organizational behaviour awareness. Although students had an interview guide with questions to support their interview, students also had to deal with unforeseen situations, which led them also to develop the competence of adaptation to new situations, problem solving and resilience in order to proceed successfully with their objectives for this task.

4.3.3 Knowledge to do and interpret an interview

All students followed the semi-structured interview guide and summarized the interviews conducted very well. This was verified by the authors of the paper after hearing and seeing the videos. Also, students were capable of synthesizing the most important contents and recall the interviewees' advices during the oral presentation, for example: "*Do not forget that you work with the people and for the people. It is not forcing processes that will change anything, it is with management by example*".

4.3.4 Awareness of their professional practice

Through their reports, students realized what it means to be an Industrial Engineer, an idea for an IEM profession and how diverse and broad it could be. All knowledge areas discussed in the introduction were exposed by the interviewees. It was a positive discovery for students, who were amazed by all the professional areas in which they can enrol in their future.

This challenge was even more relevant for students to realize how important the information systems are for modern organizations. Industrial Engineers, who frequently assume the leadership of industrial departments, and even top management positions in the case of industrial SMEs, are often called to specify user requirements related to the need for the implementation of new strategic business evolutions in their organizations' information systems. The students' answers provided for the point 7 (Production Information system) of the interview guide were assessed by the teacher of the Computer Programming I course who established a set of user requirements to be fulfilled by the information system and software to implement in the enterprises of their projects of IPIEM1. In comparison to the two previous editions of PBL (2019 and 2020), the task related to Computer Programming I course, in the present year, was accomplished with more pertinent and valuable content, which confirm the positive contribution of the interviews undertaken by the students in the fulfilment of the IEM@ProjectNetworking challenge.

5 Conclusion

This paper presents the main findings of the challenge given to freshman IEM students. According to them, this experience was very rich and useful, allowing them to have a better look at their future professional career.

Based on students' feedback during and after the oral presentation and also on the analysis of results obtained from part of the PBL questionnaire, it was possible to state that, despite some difficulties, as mentioned in section 4.3, it was a worthwhile challenge. Better time management and teamwork of teachers and students continues being the best solution to overcome the difficulties. This is also evidenced by students' good performance, comments and reflections in the IEM@ProjectNetworking report. It was also clear that students enjoyed the activity very much and listened carefully to the advice from the interviewees and, through the experiences lived in the first-person, students easily learned some lessons.

This experience is also relevant for first-year students as they can achieve greater confidence about their professional future, at an early stage of their academic degree. The experience is significant, useful, and impacting for students. Along with the PBL approach, this experience brings forward the meaning of "learning by doing" in the sense that students are actively engaged in the process of their own learning and development.

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