



Motivational Assessment of Engineering Students at two centres of the University of Extremadura

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HIGHLIGHTS

- Project-based learning for the acquisition of knowledge in the field of engineering projects.
- Comparison of the motivation of engineering students from two centres of the University of Extremadura.
- Development of classroom intervention plans through the analysis of student motivation.



ABSTRACT

The student's motivational orientation is an indispensable factor for adequate learning during their formative years. The knowledge of motivational orientations allows teachers to enhance the performance of their students. The objective of this work is to compare the motivation of students from two Industrial Engineering centres of the University of Extremadura (Spain). To evaluate these factors, the MAPE-II tool was implemented. The methodology assesses student motivation by focusing on three motivational orientations: learn, results and fear of failure motivation. In addition, the tool allows to know and quantify the motivational orientations of the students through a questionnaire. The Cronbach's Alpha test was used to analyse the internal consistency of the student's responses. Centre 1 presents a higher value in the learning motivation dimension, comparing the results of the dimensions obtained in the two centres analysed. Centre 2 obtained a large increase in the mean value of the second dimension related to motivation for results. Finally, it should be noted that the fear of failure dimension shows much higher values in Centre 2. The analysis of the student's motivational orientation makes it possible to determine negative aspects of learning and to be able to establish the necessary intervention measures to maximize their performance.

Keywords: *Motivation; Industrial Engineering; Teaching; MAPE-II*

1. INTRODUCTION

Students face motivation problems when doing academic activities. They may feel that some of the tasks are irrelevant, uninteresting, boring and difficult [1]. Throughout a student's learning, there are barriers that influence their motivation, such as exposure to uninteresting content [2]. The way these motivational barriers are dealt with leads to very different outcomes, ranging from advanced academic performance to dropping out of school [3].

In the last few years, there has been an increasing amount of research on student motivation during learning and academic performance. Carrillo et al. [4] evaluated the current understanding of motivation and learning and determined their interrelationship. The authors obtained as a result a set of teaching

interventions that improve student learning motivation. Firat et al. [5] analysed the level of intrinsic motivation of distance education students, determining statistically significant differences between different factors such as: gender, academic discipline, type of teaching, etc. Research has also been carried out on the relationship between student motivation and the chosen mode of study at both high school and university level. Wang assessed the motivation of students who choose university education in science, technology, engineering and mathematics (STEM) [6]. Corrales-Serrano [7] analysed the internal and external motivations of baccalaureate students to select different study modes, with the result that external motivational factors have a higher incidence than internal motivational factors.

In addition, there is research that examines the teaching of technical careers such as engineering, improving the student learning process. Carrasco-Amador et al. virtualised graphic expression subjects in different engineering degrees to improve and facilitate students' learning and assess their acceptance criteria [8]. Robison et al. [9] evaluated the expected success, task values and perceived costs in the first two years of university engineering, determining how they evolved over time. Lazzarini et al. [10] identified the characteristics that engineering educators need to have in order to promote the sustainable development objectives to students. González-Domínguez et al. [11] analysed the feasibility of applying circular economy techniques in product design and development through collaborative project-based learning for industrial engineering students.

Student motivation has a substantial impact on their learning and academic performance. Moreover, the importance of analysing student motivation increases in extreme situations such as the pandemic caused by COVID-19 [12]. The aim of this research is to compare the analysis of the motivational orientation of Industrial Engineering students from two centres of the University of Extremadura. In this way, it is possible to determine the motivational differences between students from two different centres, in order to be able to establish future classroom intervention plans.

2. METHODOLOGY

Surveys were carried out in two centres of the University of Extremadura. On the one hand, the survey at the School of Industrial Engineering (Centre 1) has a total of 58 students surveyed, of both genders (50 males and 8 females) enrolled in the final year of the Bachelor's Degree in Engineering at the University of Extremadura

(Spain) during the 2018-2019 academic year. On the other hand, the University Centre of Mérida (Centre 2) carried out the same survey to 38 randomly selected students of both genders (26 males and 12 females) enrolled in the last year of the Degree in Industrial Design and Product Development Engineering. The students in both surveys ranged in age from 21 to 24 years old and were collected anonymously and each student was coded with a number, indicating the order in which the answers were recorded. Los resultados obtenidos de las encuestas del Centro 1 fueron analizados por los autores [13].

The MAPE-II instrument was used to carry out this analysis [14], which assesses student motivation by directing it towards three motivational orientations: learning motivation, achievement motivation and fear of failure. The specific motivations (or scales) that constitute the so-called first-order factors of these motivations are six: (1) high work capacity and performance, (2) intrinsic motivation, (3) laziness, (4) ambition, (5) facilitating anxiety performance, and (6) anxiety inhibiting performance. Scales (1), (2) and (6) make up the first dimension, (3) and (5) the second, and (4), only, constitutes the third dimension.

The KR-20 test, which is a variant of Cronbach's Alpha test, was used to determine the consistency of the responses [15]. This analysis makes it possible to determine the mean value of the reliability of the responses, in order to verify the consistency of the data collected. For this purpose, the IBM SPSS Statistics 25 statistical software was used [16]. Then, the direct scores of the respondents were obtained for each of the three motivational orientations, with the aim of obtaining the results on a common scale, where they could be compared. With the calculation of the direct score of the motivational orientations, the distributions of descriptive statistics were

determined for the students of the two centres studied at the University of Extremadura [13].

Finally, students' motivational orientations were classified into three levels: medium, high, and low. This was done by ranking the direct scores of respondents from both centres. Thus, it was possible to compare the learning motivations, achievement motivations and fear of failure of the two centres.

3. RESULTS

3.1. Internal consistency of the study.

First, the internal consistency of the students' responses was analysed. For this purpose, the reliability of the motivational orientations was determined, reaching a mean reliability value of 0.772.

3.2. Direct scoring.

Fig. 1 shows the distributions of the direct dimension scores for each of the respondents in Centre 1.

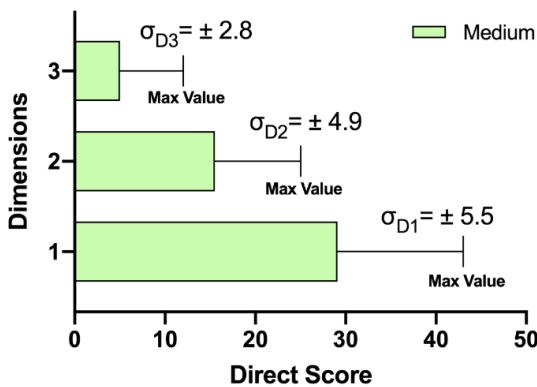


Fig. 1: Distribution of direct scores for Centre 1 dimensions.

With a mean of 29.1 (± 5.5 out of a possible 43), motivation for learning predominates. The dimension of motivation is in second place with a mean value of 15.8 ± 4.9 points with a maximum of 25 points. Finally, fear of failure

scored 5 points on average with a maximum of 12 points and a deviation of 2.8 points.

In the same way, direct scores were obtained for the dimensions corresponding to Centre 2. Fig. 2 shows the distribution of the statistics for the dimensions of Centre 2.

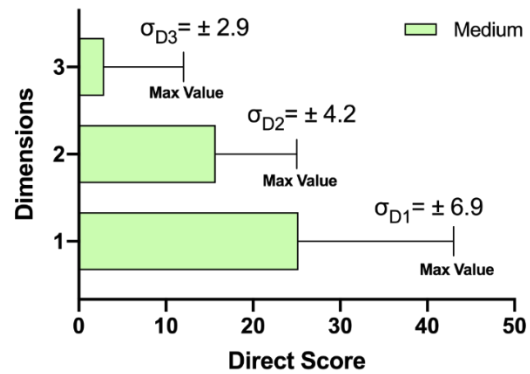


Fig. 2: Distribution of direct scores for Centre 2 dimensions.

It is observed that the predominant dimensions are the dimension of motivation for learning and for the result with a mean of 25.2 (± 6.9 out of a possible 43) and 15.7 (± 4.2 out of a possible 25). Fear of failure is in last place with a mean of 4.8 (deviation of 2.9 points out of a possible 12).

Comparing the results of the dimensions obtained in the two centres analysed, it can be seen that Centre 1 has a higher value in the learning motivation dimension. Centre 2 obtained a large increase in the average value of the second dimension relating to motivation for results. Finally, it should be noted that the fear of failure dimension shows much higher values in Centre 2.

3.3. Percentiles.

The number of students in each dimension was determined according to the levels associated with their percentile. For this purpose, 3 levels were established: low, medium and high. These results are shown in

Table 1.

Table 1: Classification by motivational orientations.

School of Industrial Engineering (Centre 1)						
Dimensions	Levels					
	Low		Medium		High	
	Nº	%	Nº	%	Nº	%
Motivation to learn	2	3.5%	14	24.1%	42	72.4%
Motivation to results	2	3.5%	26	44.8%	30	51.7%
Fear of failure	18	31.0%	28	48.3%	12	20.7%
University Centre Mérida (Centre 2)						
Dimensions	Levels					
	Low		Medium		High	
	Nº	%	Nº	%	Nº	%
Motivation to learn	4	10.5%	20	52.6%	14	36.9%
Motivation to results	2	5.2%	18	47.4%	18	47.4%
Fear of failure	14	36.8%	16	42.1%	8	21.1%

In both centres, the percentage of students with low learning and achievement motivation is very low, with the majority showing a high or medium level of motivation. Centre 1 is notable for the high percentage of students (72.4%) with high learning motivation, while only 36.9% of respondents in Centre 2 have high learning motivation. The response rate for motivation to achieve is similar in both centres. As far as the dimension fear of failure is concerned, Centre 2 has obtained a slightly higher percentage of low level (36.8%) than Centre 1 (31.0%).

3.4. Motivations present in the students.

For each centre, male and female gender and age made no difference to learning motivation. The different levels of the dimensions were

collected for each student surveyed in order to establish their relationship. Thus, the different combinations and trends of the two centres were analysed. The distribution of students by level and according to the motivational orientation of Centre 1 is shown in [13]. Table 2 shows the results of the different levels of the dimensions obtained from the Centre 2 surveys.

Table 2: Distribution of Centre 2 students by level and motivational orientation.

Levels	Dimensions		
	Motivation to learn	Motivation to results	Fear of failure
High	3, 5, 7, 9, 13, 15, 18, 19, 21, 22, 25, 35, 36, 37	3, 7, 9, 10, 15, 16, 18, 22, 23, 25, 26, 27, 30, 34, 35, 36, 37, 38	9, 16, 18, 23, 26, 27, 30, 38
Medium	1, 2, 4, 6, 8, 10, 14, 16, 17, 23, 24, 26, 27, 28, 30, 31, 32, 33, 34, 38	1, 2, 4, 5, 6, 8, 11, 13, 14, 17, 19, 20, 21, 24, 28, 31, 32, 33	4, 6, 7, 8, 10, 11, 17, 20, 22, 24, 25, 28, 31, 32, 34, 35
Low	11, 12, 20, 29,	12, 29	1, 2, 3, 5, 12, 13, 14, 15, 19, 21, 29, 33, 36, 37

The most unfavourable situation is found in the students (nº 12 and 29) who are in the lowest 3 levels of the three dimensions analysed. This is followed by respondents (nº 11 and 20) with a low motivation for learning and a medium level of motivation for results and fear of failure. In addition, students (nº 1, 2, 14 and 33) have the worst level of fear of failure and a medium level in the motivational dimensions. Among the students who were at a high level of motivation through learning, 10 out of 14 were highly motivated by results and the rest were at a medium level. In addition, 8 and 2 of this group had a low and high fear of failure, respectively. It should be noted that among the 18 students who had a high outcome motivation, 10 had a high

motivation for learning and 8 had a medium level. Of these 18 respondents, 8 had a high fear of failure and 4 a low fear. Finally, of the students with a high level of fear of failure (8), 8 were highly motivated by results and 2 by learning.

4. DISCUSSION

The analysis of the learner's motivational orientation makes it possible to identify negative aspects of learning and to establish the necessary intervention measures [17]. By means of interventions it is possible to define how the contents, learning objectives etc. are presented. The aim of this is to prevent the learner from playing a passive role that negatively influences the assimilation of content [18].

Analysing the results obtained, it was observed that the motivational orientation related to the result showed similar values in both centres. This may be due to the similarity of the engineering profile of the students surveyed. Similarly, fear of failure does not show a significant difference between the two centres studied. The greatest disparity obtained at the dimensional level has to do with the student's motivation for learning, being much higher in those surveyed in Centre 1. This motivation is positively related to achievement, so that it will be higher for students in Centre 1. Therefore, the teacher should prioritise the student's learning process over the results, making the necessary interventions in the classroom so that the student focuses on acquiring new skills and knowledge.

Among the limitations of this study are the number of students surveyed and the social-economic influence of the region. This makes it difficult to extrapolate the results to other national and international higher education institutions.

Future studies should aim at comparing the specific motivations (or scales) of students in

both schools, including the correlation between motivational orientations and specific motivations. In addition, it would be interesting to assess students' motivation with virtualisation of subjects and how it affects learning motivation, motivation for results and fear of failure.

5. CONCLUSIONS

The methodology used in this research has been previously validated. However, we proceeded to calculate the internal consistency of the students' responses, validating the results once again.

The motivational orientations of two university centres have been analysed by means of a questionnaire carried out according to the MAPE II methodology. In addition, the results obtained in both centres were compared so that teachers can establish the appropriate classroom intervention strategies for each situation. Thus, it was determined that motivation for results and fear of failure did not show a great difference in both centres. However, 72.4% of the students in Centre 1 are at a high level of motivation for learning, while the students in Centre 2 account for only 36.9% of the total.

This study has shown the interest of properly analysing the motivation of engineering students in order to be able to propose intervention strategies in the classroom to increase knowledge acquisition and student participation.

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